Jurnal Sain Peternakan Indonesia
Available at https://ejournal.unib.ac.id/index.php/jspi/index
DOI: https://doi.org/10.31186/jspi.id.17.4.211-215
P-ISSN 1978-3000
E-ISSN 2528-7109
Volume 17 Issue 4 October-December 2022

Digestibility Quality of Elephant Grass (*Pennisetum purpureum*) and Concentrate with The Addition of Urea Molasses *In Vitro*

A. Fariani, A. N. T. Pratama, G. Muslim and L. Warly

Jurusan Teknologi dan Industri Peternakan Fakultas Pertanian, University Sriwijaya,
Jalan Palembang – Prabumulih, KM 32 Inderalaya Kab. Ogan Ilir, Palembang, Indonesia

ABSTRACT

This study aimed to study the digestibility quality of Elephant Grass (*Pennisetum purpureum*) and concentrate with the addition of urea molasses in vitro. The study was conducted *in vitro* using an experimental method. The design used was a completely randomized design (CRD) with four treatments and five repetitions: T0 (Elephant Grass 100%), T1 (Elephant Grass 60% + 40% Concentrate), T2 (Elephant Grass 60%) % + Umos 40%) T3 (Elephant Grass 60% + Concentrate 20% + Umos 20%). The results showed no effect (P>0.05) of the combination treatment on dry matter digestibility. Meanwhile, T2 and T3 treatments affected the fermentation quality, including VFA, NH3, total gas production, and methane gas concentration.

Keywords: *In vitro*, digestibility, methane production

INTRODUCTION

Feeding, breeding, and management affect the success of the livestock business. Livestock productivity is largely determined by the quality and quantity of feed consumed. Feed is the most important livestock business, especially ruminant farming. Feed is important to support health, growth, and energy supply so that metabolic processes can run well and grow and develop properly. The increase in livestock productivity cannot be fulfilled optimally due to limiting factors, namely, feed and feed consumption degradability.

The main feed of ruminants is forage which is about 60-70%. However, the feed given (forage) depends on land availability, so it is necessary to find alternative feed sources of other fiber as a substitute for forage. The fulfillment of balanced protein and energy needs in fattened cows cannot be met only from forage feed, but the role of concentrate feed is very important. Concentrated feed is a source of protein and energy, while forage is a fibrous feed.

Elephant grass (*Pennisetum purpureum*) is a forage with a high-energy source that can be utilized by livestock to meet their nutritional needs. Forage and concentrate feeding is good for livestock because it can meet nutritional needs and provide forage available throughout the season for ruminants. In addition, it is also very much needed for the productivity of ruminants because the provision of single grass has not been able to optimize livestock productivity (Maxwell *et al.,* 2015). Furthermore, this is becoming increasingly complex because the addition of concentrate feed that has been carried out so far tends to be uneconomical. Concentrates or reinforcing feed ingredients are high-concentration feeds that contain crude protein and sufficient energy with relatively low crude fiber content and are easily digestible and needed to accelerate productivity. Balance forage and concentrate consumption significantly affect cows' growth, development, and digestibility.

A common source of protein is reinforcing feed (concentrate), but to obtain concentrates with a high protein content are difficult to obtain. In addition, the factor of a fairly expensive cost is often a limiter for the use of concentrates, for which additional materials are needed sources of protein and energy. One way to overcome this problem is by adding protein and energy sources, including urea and molasses. Besides being easy to get, Urea and molasses are relatively cheap and affordable for breeders. Molasses, a byproduct of the sugar industry, has been used as a ready-to-use carbohydrate and can increase palatability so that consumption levels increase, especially in forage feed, whose result will affect livestock performance (Ciriaco et al., 2016). Molasses as a feed supplementation in livestock is highly recommended because it can reduce variability in feed consumption (Gordon and DeVries, 2016).

The use of urea as a source of protein and molasses as an energy source in the rations of large ruminants has been widely reported with good results, of course, with an administration that does not exceed the limit. Information about giving urea and molasses in liquid form is minimal, even though the combination of urea and molasses in liquid form has advantages, including being easily absorbed by the body, having high palatability, preventing the formation of urea clots that can poison livestock, so it is necessary to carry out research on the addition of urea and molasses in liquid form to the digestibility of elephant grass (*Pennisetum purpureum*) and concentrates.

MATERIALS AND METHODS

Sample preparation

The study was conducted in vitro using experimental methods and the design used was a Complete Randomized Design (RAL) with four treatments and five tests: T0 (Elephant Grass 100 %) T1 (Elephant Grass 60% + Concentrate 40%), T2 (Elephant Grass 60% + Umos 40%) T3 (Elephant Grass 60% + Concentrate 20% + Umos 20%). The elephant grass (*Pennisetum purpureum*), which was used as a powder sample, was harvested from animal feed forage land in the experimental pen of the livestock study program. Elephant grass (*Pennisetum purpureum*) was chopped so that the size becomes about 3-5 cm. Together with the concentrate sample, it was dried in the oven at a temperature of 105ºC to remove the moisture content. After that, the dried sample was ground using a grinding machine then sifted to take the fine part in the form of powder. The powder-shaped samples were then put into ziplock plastic and taken to the laboratory for analysis. The sample used in this study was powdered to make it easier for homogeneous samples when mixed with rumen liquid. After the sample expansion is completed, it will be continued with a digestibility test with the *in vitro* method.

Urea Molases (UMOS)

UMOS liquid feed is a reinforcing liquid feed resulting from formulations in the process of submitting IPR. The constituent ingredients of UMOS liquid feed are a mixture of Non-Protein Nitrogen (NPN), molasses, premise, and water.

Data analysis

The data obtained were analyzed according to the design used, and if there were differences between the treatments, the Duncan Multi Range Test (DNMRT) was carried out (Steel and Torrie, 1999).

RESULTS AND DISCUSSION

Digestibility of dry matter

The digestibility of dry matter is one factor that affects the quality of a feed ingredient because it is closely related to the level of absorption of nutrient content from feed to become an important nutrient for the livestock body. As seen in Pada Tabel 1, analysis results showed the overall absence of influence ($P>0.05$) of each combination of treatments on the digestibility of dry matter. The decrease in dry matter digestibility can be caused by many factors, including the non-development of microbes in the rumen, causing the degradation of feed in the rumen to be not optimal. Keskin *et al.* (2005) reported that urea and molasses supplementation in sorghum silage did not yield significant results against dry matter's digestibility in *vitro*. The same results were shown in *Leucaena* silage supplemented with urea and molasses at different concentration levels (Phesatcha and Wanapat, 2016).

VFA and NH_3 values

The digestibility value of feed in the rumen is influenced by the chemical composition of the feed, especially the fiber and protein content. Those that affect fermentation conditions include pH, N-NH_3, and VFA, which support the digestibility of feed during the fermentation process. This is as seen in table 1, which shows that UMOS has a significant effect ($P<0.05$) on the VFA and N-NH_3 values.

Table 1. Dry matter digestibility (DMD), VFA, and N-ammonia (NH_3) of elephant grass (*Pennisetum purpureum*) concentrated with the addition of urea molasses

Parameters	Treatment			
	T0	T1	T2	T3
Dry matters digestibility (%)	44.60 ± 6.85	45.83 ± 5.40	50.18 ± 4.60	43.00 ± 4.84
Volatile Fatty Acid (mM)	63.75 ± 2.62^{a}	86.16 ± 4.47^{b}	115.25 ± 15.76^{c}	127.70 ± 17.93^{c}
N-NH_3 (mM)	2.55 ± 0.83^{a}	3.37 ± 0.56^{ab}	4.09 ± 1.11^{b}	3.91 ± 0.00^{ab}

T0 (Elephant Grass 100 %) T1 (Elephant Grass 60% + Concentrate 40%) T2 (Elephant Grass 60% + Umos 40%) T3 (Elephant Grass 60% + Concentrate 20% + Umos 20%); Column means with different superscript(s) differ significantly at $P<0.05$

The high value of VFA in the T2 and T3 treatments is thought to be caused by the high energy or carbohydrate content in the composition of the treatment feed ingredients due to the addition of molasses, a high source of carbohydrates easily dissolved. Molasses is a feed often given to livestock and a source of energy intake in ruminants. Its structure quickly degraded inside the rumen to provide energy for livestock and microorganisms. In addition, molasses is widely used because it can increase the palatability of feed, as evidenced by the increasing consumption of dry matter (Cleef *et al.,* 2018). The same results were shown in many studies urea-molasses supplementation with various feed ingredients can increase the total value of VFA in vitro (Phesatcha *et al.,* 2016; Silva *et al.,* 2017; Chakra *et al.,* 2018).

Meanwhile, the high value of N-NH_3 in the T2 treatment is thought to be due to the important role of urea in the treatment feed. Urea is a source of non-protein nitrogen, fermentable and quickly degraded in the rumen, so the availability of nitrogen for forming microbial bodies during the fermentation process can be fulfilled. The use of urea in feed by supplementation can increase the crude protein content in the chemical composition of the feed and increase digestibility and N-NH_3 during the fermentation process in *vitro* (Phesatcha *et al.,* 2016; Silva *et al.,* 2017; Changqing Li *et al.,* 2018). Furthermore, Chakra *et al.* (2018) reported that urea administration/supplementation in feed does not always result in a high N-NH 3 content during the fermentation process due to the N-NH 3 content being used for the formation of microbial proteins.

Gas production and methane concentration

Based on the results of measurements, it shows that the addition of UMOS to the combination of treatments has a significant effect ($P<0.05$) on compulsive gas production during the incubation process (table 2). The results were positively correlated with the digestibility values of dry matter, VFA, and N-NH_3 in the T2 treatment (Elephant Grass 60% + Umos 40%). The increase in gas production in the treatment is suspected to be due to the addition of UMOS where UMOS containing nitrogen and energy is available quickly due to its easily degraded nature during the fermentation process resulting in the growth of rumen microbes increasing so that the feed degradation process will also increase which will then be followed by an increase in gas production as a byproduct of the degradation and fermentation process in the rumen. Norrapoke *et al.* (2017) reported urea-molasses and microbial supplementation accompanied by yeast in cassava pulp showed higher gas production when compared to treatment without urea-molasses supplementation. The high digestibility of feed ingredients can cause increased gas production during the fermentation process caused by urea-molasses supplementation treatment in the feed (Kang *et al.,* 2018). However, in the results of this study, the digestibility did not show significant results, so the digestibility value was considered not to have a great influence on gas production. This result was the same in other studies (Pilajun and Wanapat, 2016).

Most of the rumen's total gas production from fermentation consists of CO_2, ammonia, methane, and hydrogen gases. Methane gas is one of the parameters often measured in many studies because of its nature that utilizes feed energy in its formation. Based on the results of measuring methane gas concentration, it was found that the combination of treatment with the addition of UMOS affected ($P<0.05$) the methane gas concentration where the lowest values in the T2 and T3 treatments (Table 3). The decrease in the concentration value of methane gas in the treatment is suspected to be because the UMOS used is a mixture of urea and molasses. Molases is a type of animal feed that is often used as an energy source for livestock during the fermentation process in molasses rumen tends to form fermented energy in the form of propionate.

Table 2. The mean (± SD) cumulative gas production at the time of incubation to 24 hours

Treatment	(mL)
T0 (Napier grass)	7.05 ± 0.37^{a}
T1 (Napier grass 60% + concentrate 40%)	10.60 ± 0.74^{b}
T2 (Napier grass 60% + UMOS 40%)	9.05 ± 0.44^{b}
T3 (Napier grass 60% + consentrate 20 % + UMOS 20%)	7.20 ± 4.04^{A}

Column means with different superscript(s) differ significantly at *P*<0.05

Table 3. The mean (± SD) methane concentration (ppm) of elephant grass (*Pennisetum purpureum*) concentrated with the addition of urea molasses

Treatment	Methane concentration (ppm)
T0 (Napier grass)	77.39 ± 16.60[b]
T1 (Napier grass 60% + Concentrate 40%)	68.76 ± 18.18[b]
T2 (Napier grass 60% + UMOS 40%)	52.80 ± 98.78[a]
T3 (Napier grass 60% + Concentrate 20% + UMOS 20%)	38.03 ± 32.38[a]

Column means with different superscript(s) differ significantly at P<0.05.

Propionate in its formation, will utilize hydrogen atoms during the fermentation process so that there will be competition for hydrogen atoms while in the rumen and decrease the concentration of methane gas in the rumen. A decrease in methane gas concentration in the total gas production of fermented feed in the rumen can occur by increasing the production of propionate acid or decreasing the ratio of acetate: to propionate during the fermentation process in the rumen (Vongsamphanh *et al.,* 2017). However, the results in other studies also found that ure-molasses supplementation, which causes an increase in proionate and a decrease in the ratio of acetate:propionate does not always affect reducing methane gas in in vitro experiments (Phesatcha et al., 2016). Furthermore, Bhatt *et al.* (2019) reported that the decrease in methane gas based on mean values was followed by a decrease in propionate and acetate:propionate ratio in vitro digestibility tests.

CONCLUSION

Study results show no significant influence (P>0.05) on the combined treatment of dry matter digestibility. However, T2 and T3 treatments substantially impact fermentation quality, including VFA, NH3, total gas production, and methane gas concentration.

REFERENCES

Bhatt, R. S., L. Soni, and A. Sahoo. 2019. Methane production and microbial protein synthesis in adult sheep fed total mixed ration as mash and as complete feed block. Carbon Management 10(3): 241-253.

Cakra, I.G.L.O., A.A.A.S. Trisnadewi, I. M. Mudi and A.A.P.P. Wibawa. 2018. Using Molasses in a Rice Straw Urea Lime Molasses Mixture to Improve Digestibility and In vitro Metabolite Fermentation. Pakistan Journal of Nutrition 17 (12): 677-682.

Changqing Li, Alatengdalai, Shuyuan Xue, A. Asano, A. Tajima, and N. Ishikawa. 2018. Dynamic Changes of Main Rumen Microflora and Ruminal Fermentation in Sheep Supplemented with Molasses-Urea. Journal of Rangeland Science 8(1): 1-10.

Ciriaco, F. M., D. D. Henry, V. R. G. Mercadante, T. M. Schulmeister, M. Ruiz-Moreno, G. C. Lamb, and N. DiLorenzo. 2016. Effects of molasses and crude glycerol combined in a liquid supplement on ruminal fermentation in beef steers consuming Bermuda grass hay, Journal of Animal Science 94 (9): 3851–3863.

Evan, C, M. Almeida, J. Paschoaloto, E. Castro Filho, R. Barducci, G. Soragni, E. Zampieri Neto, A. Pedro, J. Ezequiel. 2018. PSXV-17 Effects of increasing concentrations of soybean molasses on feed intake, growth performance, carcass and meat traits of feedlot lambs. Journal of Animal Science. 96(3): 471.

Gordon, L. J. T. J. DeVries. 2016. Technical note: Impact of a molasses-based liquid feed supplement on the feed sorting behavior and growth of grain-fed veal calves. Journal of Animal Science 94(8): 3519–3526.

Kang, S., M. Wanapat, and A. Nunoi. 2018. Effect of urea and molasses supplementation on quality of cassava top silage. Journal of Animal and Feed Sciences 27: 74–80.

Keskin, B., I. H. Yilmaz, M. A. Karsli, and H. Nursoy. 2005. Effects of Urea or Urea plus Molasses Supplementation to Silages with Different Sorghum Varieties Harvested at the Milk Stage on the Quality and In Vitro Dry Matter Digestibility of Silages. Turk J Vet Anim Sci. 29: 1143-1147.

Maxwell, C. L. B. C. Bernhard, C. F. O'Neill, B. K. Wilson, C. G. Hixon, C. L. Haviland, A. N. Grimes, M. S. Calvo-Lorenzo, D. L. VanOverbeke, G. G. Mafi, C. J. Richards, D. L. Step, B. P. Holland, and C. R. Krehbiel. 2015. The effects of technology use in feedlot production systems on feedlot performance and carcass characteristics, Journal of Animal Science 93(3): 1340–1349.

Maxwell, C. L. B. C. Bernhard, C. F. O'Neill, B. K. Wilson, C. G. Hixon, C. L. Haviland, A. N. Grimes, M. S. Calvo-Lorenzo, D. L. VanOverbeke, G. G. Mafi, C. J. Richards, D. L. Step, B. P. Holland, and C. R. Krehbiel. 2015. The effects of technology use in feedlot production systems on feedlot performance and carcass characteristics, Journal of Animal Science 93(3): 1340–1349.

Norrapoke, T., M. Wanapat, A. Cherdthong, S. Kang, K. Phesatcha and T. Pongjongmit. 2017. Improvement of nutritive value of cassava pulp and in vitro fermentation and microbial population by urea and molasses supplementation. Journal of Applied Animal Research 46(1): 242-247.

Phesatcha, K. and M. Wanapat. 2016. Improvement of Nutritive Value and In vitro Ruminal Fermentation of Leucaena Silage by Molasses and Urea Supplementation. Asian-Australas J Anim Sci. 29(8): 1136–1144.

Ruangyote, P. and M. Wanapat. 2018. Chemical composition and in vitro gas production of fermented cassava pulp with different types of supplements, Journal of Applied Animal Research, 46(1): 81-86.

Silva, L. G., P. D. B. Benedeti, E. M. Paula, F. Malekjahani, P. M. Amaral, L. D. S. Mariz, T. Shenkoru, and A. P. Faciola. 2017. Effects of carbohydrate and nitrogen supplementation on fermentation of cheatgrass (*Bromus tectorum*) in a dual-flow continuous culture system, Journal of Animal Science 95(3): 1335–1344.

Steel, R. G. D. and J. H. Torrie. 1995. Principles and Procedures of Statistics. Rather Sumantri Language, B. Statistics Principles and Procedures. Issue 4 P. T. Publishers Gramedia Pustaka Utama, Jakarta.

Tilley, J.M.A. and R.A. Terry. 1963. A Two-Stage Technique For In Vitro Digestion Of Forage Crop. J. British Grassland Society. 18: 104-111. F.L.

Vongsamphanh, P., T. R. Preston, and R. A. Leng. 2017. Glycerol supplementation increased growth rates, decreased the acetate: propionate ratio in rumen VFA, and reduced enteric methane emissions, in cattle fattened on cassava pulp-urea, brewers' grains and rice straw. Livestock Research for Rural Development. 29 (2).