THE EFFECT OF INCUBATION TIME AND LEVEL OF UREA ON DRY MATTER, ORGANIC MATTER AND CRUDE PROTEIN DIGESTIBILITY OF PASSION FRUIT (*Passiflora edulis var. flavicarpa*) HULLS

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ABSTRACT

This research was aimed to evaluate the effect of incubation time and level of urea on dry matter, organic matter and crude protein digestibility of Passion fruit hulls. The research was conducted by two phases. The first, the research was conducted to analyze of Passion fruit hulls before and after ammoniation, and then conducting digestibility of Passion fruit hulls using rumen fluid. Factorial Randomized Block design 2x3, with factor A was incubation time of ammoniated Passion fruit hulls (2 weeks, 3 weeks) and factor B was the level of urea used (4%, 6% and 8%) was used in this study. The results showed that there was no significantly effects among treatments on dry matter and organic matter digestibilities, but significant effect ($P<0.05$) on crude protein digestibility by level of urea treatment, even those there was no interaction between each treatment. The research showed that increasing level of urea could increase *in-vitro* digestibility of crude protein nutrients. In conclusion, the best treatment was 8% level of urea with 2 weeks of incubation length.

Keywords: Passion fruit hulls , ammoniation, digestibility

INTRODUCTION

Passion fruit hulls is one of horticultural waste and there are many people utilize them as alternative sources of feedstuff. Passion fruit (*Passiflora edulis var. flavicarpa*) is the typical product of West Sumatra in Solok Regency. In 2005, Passion fruit production in West Sumatra reached about 115,498.5 tons (Dinas Pertanian Kabupaten Solok, 2006). The national production of Passion fruit was 138, 027, 120, 796 and 131,988 tons for 2008-2010, respectively (Badan Pusat Statistik, 2011). Passion fruit is not seasonal, so it can be obtained at any time.

Passion fruit hulls has a crude protein content of 7.32% which is similar to the grass so it is a potential passion fruit hulls to substitute forage in using for animal feeding. Unfortunately, passion fruit hulls have anti-nutritional content of tannin (1.85%) and high lignin content of 31.79% (Astuti, 2008). The low nutritive value of passion fruit hulls must be increased and it can be done by technology of treatment to be utilized as animal ration. Urea ammoniation increase crude protein content and reduced of lignin and tannin contents as a prohibitive factor in the consumption and digestibility of nutrients. Parida *et al.* (2000) stated that the reducing digestibility of dry matter, crude proteins and consumption level of livestock consuming feed with containing tannins were caused by the nature of the tannins. It could form a proteins-tannin complexes that were insoluble in water causing turbidity, sedimentation and inhibits the activity of enzymes.

Van Soest (2006) reported that ammoniated rice straw could increase the organic matter digestibility of sheep about 13-18% and dry matter consumption of cattle until 45% than that of without ammoniating. Urea ammoniation treatment on fibrous feeding could loosen the lignocellulosic bonds, easier digested by rumen bacteria, and could increase the crude protein content as the nitrogen requirement for growth rumen bacteria (Nguyen *et al.*, 1998; Granzin and Dryden, 2003).

Ammoniation treatment stretches the lignocelluloses bonds become more tenuous and it makes easier for rumen microorganisms to

ferment the passion fruit hulls. The digestibility of dry matter, organic matter and crude protein can be increased by ammoniation using urea. Simanihuruk (2005) stated that the flour passion fruit hulls could be used as a mixture of goat feed until of 45%, and at the same time as an alternative feed ingredient to replace some components of the concentrate, but the utilization of passion fruit hulls was effective only 15% in the ration.

This research was aimed to evaluate the effect of incubation time and level of urea on dry matter, organic matter and crude protein digestibility of Passion fruit hulls.

MATERIALS AND METHODS

The main materials used in this study were the passion fruit originating from Lembah Gumanti of Solok Regency, West Sumatra. Chemicals composition and the potency of the fruit for feedstuffs using was determined by proximate analysis of *in-vitro* analysis (Tilley and Terry, 1963), ruminal fluid and urea. The study was conducted experimentally by using Factorial Randomized block Design of 2x3 (Steel and Terrie, 1991). Factor A was incubation length: A1= 14 days (2 weeks), A2= 21 days (3 weeks). Factor B was level of urea: B1 = 4%, B2 = 6% and B3 = 8%.

The parameters were digestibility of dry matter, organic matter and crude protein in in-vitro methods. Digestibility was calculated by the formula:

Digestibility of nutrient =

$$\frac{(nutrient\ \ feed)-(nutrient\ residual)\ x\ 100}{nutrient\ \ feed}$$

RESULTS AND DISCUSSION

The nutrient content and digestibility of with and without ammoniated Passion fruit hulls are presented in Table 1 and Table 2. While, the influence of incubation time and level of urea on the digestibility of dry matter, organic matter and crude protein passion fruit hulls are presented in Table 3.

The results showed that there was no interaction (P>0.05) of incubation time and level of urea treatment on dry matter digestibility. Analysis variance also showed that there was no effect (P>0.05) of incubation time and level of urea on dry matter digestibility of Passion fruit hulls, however the digestibility of dry matter Passion fruit hulls was increased by the ammoniation treatment and range at 22.07%-35.12% when compared to controls (Table 3). The digestibility of dry matter was increased with increasing level of urea. The incubation time of ammoniation passion fruit hulls treatment also improved digestibility at range of 36.7%-36.9% when compared with controls. This was consistent with opinion of Lang (1991), in which treatment with urea amoniation on fibrous feeding was able to loose the lignocelluloses bonds to be easily digested and was able to supply nitrogen for the growth of rumen microbes. Gohl (1981) stated that the addition of urea in feed ammoniation would increase the crude protein content up to 12.7%.

The increasing of dry matter digestibility on each additional level of urea along with decreasing content of lignin in Passion fruit hulls, so the nutrients were soluble rapidly digested by rumen microbes. The digestibility of dry matter was better with urea amoniation treatment when compared with control was suspected has something to do with the decline a decrease in tannin content compared between controls with

Table 1. Nutrient Content and Anti Nutrition of Passion Fruit Hulls

Unsure	%
Dry matter	82.89
Organic matter	75.96
Crude Protein	7.32
Lignin	31.79
Tannin	1.85

Table 2. Digestibility of Nutrient Before Ammoniation

Digestibility Coefficient of Nutrients	%
Dry Matter	31.26
Organic matter	35.96
Crude Protein	29.65
Crude fiber	19.20
ADF	11.89
NDF	27.49
Cellulose	21.71
Hemicelluloses	43.88

passion fruit hulls ammoniated was quite dramatically. If the mammals consumed feed with relatively high tannin content, it would decrease the level of dry matter and crude protein digestibility (Hagerman and Robbins, 1993). Fahey dan Jung (1989) stated that the ability of tannins to form complexes proteins, roughage and digestibility enzymes could interfere digestibility of feed. The ammoniation treatment could decrease tannin content until 88.65% from controls (Table 4). When the decrease in tannin content of passion fruit hulls ammoniated, it can cause increased protein content, so increasing the digestibility of crude protein. Herrera *et al.* (1983) stated that if the crude protein content was higher, then it made degradation to be increased.

Content of tannins decreased with decreasing of passion fruit hulls ammoniated, in which it was expected to increase the digestibility of nutrients passion fruit hulls ammoniated, too. According the results of Hanafi research (1999), the palm leaves were ammoniated and silage treatment turns out that the best of dry matter digestibility was on ammoniation treatment. This is in agreement to opinion of Jackson (1977) that urea could dissolve some components of crude fiber and it caused to increase of nutrients availability to be digested. This was because of urea loosen the bonds of lignocelluloses, thus facilitating penetration product of rumen microbial enzymes was more perfect. Consequently, it would increase the digestibility of dry matter, organic matter, cell wall, total digestible nutrients and digestible energy. This study were not much different with the results of Nurhaita research (2008) that ammoniated could improve the digestibility of dry matter up to 26.29% compared by controls.

Digestibility of organic matter of this research is presented in Table 2. Based on the results of analysis variance, there was no interaction (P>0.05) between the incubation

Table 3. Effect of Incubation Time and Level of Urea on Digestibility Dry matter (DM), Organic Matter (OM) and Crude Protein (CP) on Passion Fruit Hulls (%)

Nutrient	Incubation Time (weeks)	Level of Urea			Average	SE
		4	6	8		
DM	2	36.25	41.38	42.25	42.80	
	3	40.06	36.04	42.24	42.73	2.78
	Average	38.16	38.72	42.24		
OM	2	44.05	43.08	42.86	43.33	
	3	44.83	41.54	45.01	43.79	2.36
	Average	44.44	42.31	43.94		
CP	2	44.24	55.67	60.89	53.60	
	3	27.84	41.24	40.22	36.43	2.62
	Average	36.04^{A}	48.45^{B}	50.56^{B}		

Different superscript (A,B) in the same column indicates significantly different (P<0.05)

Table 4. Effect of Incubation Time and Level of Urea on Lignin and Tannin Content of Passion Fruit Hulls (%)

Anti Nutrition Content	Incubation Time (weeks)	Level Urea (%)			Average
		4	6	8	
Lignin	2	21.98	18.08	14.749	18.27
	3	17.62	18.79	21.71	19.37
	Average	19.80	18.43	18.23	
Tannin	2	0.2096	0.2095	0.2091	0.2094
	3	0.2098	0.2104	0.2097	0.2099
	Average	0.2097	0.2099	0.2094	

length and level of urea on organic matter Passion fruit hulls ammoniated, as well as the effect of incubation length and level of urea treatment showed no significant (P>0.05) effect

There was no effect of treatment on the digestibility of organic matter due to the passion fruit hulls ammoniated. The increasing of digestibility of organic matter showed the same percentage ranging from 41.54% to 45.01%. The effect of incubation time also showed the similar digestibility of organic matter, that was 43.33% on the incubation time of 2 weeks and 43.79% on the incubation time of 3 weeks. This means that incubation time of 2 weeks were optimal in solving the organic matter in Passion fruit hulls in the rumen.

The digestibility of Passion fruit hulls showed significant (P<0.05) improvement when compared to digestibility of organic matter of Passion fruit hulls without ammoniated. The increasing digestibility of organic matter was also cause increasing of digestibility of dry matter. The organic matter was part of the dry matter components which would result in increasing digestibility of crude protein and crude fiber.

Increasing the digestibility of organic matter was also caused by a decreasing in lignin content of fruit Passion hulls ammoniated (Table 1) so it was more easier for microbes to digest feed nutrients. This was consistent with the opinion of Maynard and Loosely (1979) that lignin was a limiting factor of degradation feed nutrient.

The interactions between the incubation time and level of urea showed no effect on crude protein digestibility (P>0.05), but the each treatment the incubation time and level of urea showed a significantly different effect (P<0.05) on crude protein digestibility of Passion fruit hulls ammoniated.

The results showed that the digestibility of crude protein with 8% of urea (50.56%) were significantly higher (P<0.05) than the level of 4% urea (36.04%), whereas at the levels of urea 6% (48.45%) showed not significantly different with 8% urea. The incubation time of 2 weeks provided the digestibility value of crude protein was higher than 3 weeks (53.60% vs 36.43%). Unexpectedly, the incubation time of 2 weeks gave the optimum time to increased the digestibility of crude protein.

The incubation time of 2 weeks and 3 weeks could improve the digestibility of crude protein up to 80.78%, from 29.65% to 53.60% for 2 weeks and 22.87% from 29.65% to 36.43% for 3 weeks, compared to controls. The increasing digestibility of crude protein on this experiment presumably because of increasing of crude protein content in ammoniated Passion fruit hulls due to increasing level of urea. It caused that increased crude protein content (Table 1), from the Nitrogen of urea and cause decreased to tannins because of urea. The urea can break tannin-protein bond in the Passion fruit hulls ammoniated. According Ortiz *et al.*(1993) to reduce the content of tannin animal feed was through using of alkali such as NaOH, K_2O_3, CaO and ammonia. At the time of breaking complex tannins will release proteins, and caused to increase its digestibility.

The most effects of tannins, was to decrease in vivo feed utilization especially protein, decrease growth, palatability and feed intake (Makkar, 2003). In this research with urea has gave good effect on the nutrients digestibility. Amoniation with urea provide to increase the digestibility of feed. Ammoniation also reduced levels of lignin and tannin so it increased the digestibility of feed (Passion fruit hulls).

CONCLUSION

The urea level of 8% with incubation time of 2 weeks were the best treatment on digestibility of crude protein compared to the others treatments, even though no significantly different (P<0.05) found among the treatment for the all parameters.

REFERENCES

Astuti,T. 2008. Evaluasi Nilai Nutrisi Kulit Buah Markisa yang Difermentasi dengan *Aspergillus niger* dan *Trichoderma harzianum* sebagai Pakan Ternak secara *in-vitro*. Tesis. Program Pascasarjana. Universitas Andalas, Padang.

Badan Pusat Statistik. 2011. Produksi Hortikultura dan Buah-buahan. BPS, Jakarta.

Gohl, B. 1981. Tropical Feeds. FAO Animal Production and Health Series No. 12. FAO, Rome, pp.529

Granzin, B.C. and G. Dryden. 2003. Effect of alkali, oxidants and urea treatment on the nutritive value Rhodes grass (*Chloris gayana*). Anim. Feed. Sci. Tech. 103:113-122.

Hagerman, A.E. and C.T. Robbins. 1993. Spedficity of tannin-binding salivary proteins relative to diet selection by

mammals. Canadian J. Zoology. 71:628-633

Halliwell, B. and J.M.C. Gutteridge.1999. Free Radicals in Biology and Medicine. 3rd. Edition. Oxford University Press, Oxford

Hanafi, N. D. 1999. Perlakuan Biologi dan Kimiawi untuk Meningkatkan Mutu Daun Kelapa Sawit sebagai Bahan Baku Pakan Domba. Tesis. Institut Pertanian Bogor, Bogor.

Herrera,S. R., D.C. Church and R.O. Kellems. 1983. Effect of ammoniation treatment of wheat straw an *in-vitro* and *in-vivo* digestibility. J. Anim. Sci. 56:938-942

Jackson, F.S., T.N Barry., C. Lascano and B. Palmer. 1996. The extradite and bound condensed tannin content of leaves from tropical tree, shrub and forage legumes. J. Sci. Food Agric. 70:235-245

Leng, R.A. 1991. Principles and Practices of Feeding Tropical Crops and By-Products to Ruminant. Armidale: Department of Biochemistry and Nutrition, University of New England

Makkar, H.P.S. 2003. Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds. Small Ruminant Research. 49:241–256

Maynard, L. A. and J. K. Loosly. 1979. Animal Nutrition. 7th Ed, Logman. Grope Ltd, London.

Nguyen, X.T., C.X. Dan, L.V. Ly and F. Sundstol. 1998. Effect of urea concentration, moisture content and duration of treatment on chemical composition of alkali treated rice straw. Livest. Res. Rural. Dev. 10(1). http://www.lrrd.org/lrrd10/1/trac101.htm

Nurhaita. 2008. Evaluasi dan Pemanfaatan Daun Kelapa Sawit dalam Ransum Ternak Ruminansia. Disertasi. Universitas Andalas, Padang

Ortiz, L. T., C. Centeno and J. Trevino. 1993. Tannins in faba bean seeds: effects on the digestion of protein and amino acids in growing chicks. Anim. Feed Sci. Technol. 41:27l-278.

Parida, W. R., Pratiwi and G. Semiadi. 2000. Tanin dan Pengaruhnya Pada Ternak. Jurnal Peternakan dan Lingkungan. 06(3): 66-711

Simanihuruk, K. 2005. Pemanfaatan Kulit Buah Markisa (*Passiflora edulis.sim f.edulis Deg)* sebagai Campuran Pakan Pellet Komplit pada Kambing Kacang . Tesis. Institut Pertanian Bogor, Bogor.

Dinas Pertanian Kabupaten Solok. 2006. Profil Dinas Pertanian dan Perikanan Solok, Sumatera Barat.

Steel, R.G.D. and J.H. Terrie. 1991. Principles and Procedures of Statistics. McGraw-Hill Book Co. Inc. New York.

Tilley, J.M.A. and R.A. Terry. 1963. A two stage technique for in-vitro digestion of forage crops. J. British Grassland Soc. 18:104-111

Van Soest, P.J. 2006. Rice straw the role of silica and treatment to improve quality. J. Anim. Feed. Sci. Technol. 130:137-171.