CHANGE OF BLOOD AMMONIA LEVEL AND EFFICIENCY OF NITROGEN UTILIZATION IN PRIANGAN LAMBS DUE TO KLINOPTILOLIT ADDITION IN RATION

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Abstract

This research was conducted on twenty female Lambs 7- months old, ranging from 13 – 16 kg to explore change of Blood Ammonia Level and Efficiency of Nitrogen Utilization. The research used a Completely Randomized Design with four treatments (doses of Klinoptiloli 2%,4%,6% and 8% of concentrate) and four replication. At the end of trial, blood samples were taken from Jugularis vein of all lambs with six intervals (1, 2, 3, 4, 6, 8 hours) after feeding. The result indicated that addition of Klinoptilolit in ration significantly decreased blood ammonia level (from 0.33 mg/100 ml to 0.09 mg/100 ml) and significantly increased efficiency of nitrogen utilization (from 6.3 % to 14.9 %). The optimum dose of Klinoptilolit was 6 %.

Key words: Blood Ammonia Level, Efficiency of Nitrogen Utilization, Klinoptilolit, Priangan Lambs

INTRODUCTION

In Indonesia, Priangan Lamb which is one source of meat-producing livestock is potential to be developed. Lamb Growth in Indonesia is still slow, the growth rate ranges from 20-40 grams / day and mortality to 20%, this is due to maintenance of Lamb still be traditionil managment and feeding.

In some areas in developing countries, especially tropical areas like Indonesia, the provision of high quality forage is very difficult. Likewise,to meet the needs of nitrogen sources, traditional farmers often add nonprotein nitrogen such as urea in ruminant rations. In Indonesia Urea is easily available and relatively inexpensive. However, the use of urea in ration, when the dose is excessive were given good effects that are not even going to poison animals. One solution to improve nitrogen use efficiency and to avoid poisoning Ammonia in the blood of sheep fed urea in the rations, then the addition of Klinoptilolite in these rations. Klinoptilolite is the most compounds contained in the mineral Zeolite. Natural zeolite was found in the form of sediment from the reaction between volcanic dust containing silicon with salt water, Alumino Silicate is a compound which has a porous structure with liquid in it that easy to release cause Klinoptilolite is as absorbent, molecular filters, cation exchanger and a catalyst. Until now it have been found various types of zeolites such as Analcim, Kabazit, Erionit etc, Klinoptilolite is most species in nature. Klinoptilolite is the chemical formula (Na_4K_4) (Al_8Si_{40}) $O_{96}.24H_2O$. Ion (Na_4K_4) is a cation exchanger and $(Al_8\ Si_{40})$ is a cation and with oxygen to form tetrahedral framework.

Klinoptilolite dose depends on capacity of cation axchange of Klinoptilolit, the weight of animal, levels of NH3 in the rumen, and the amount of carbohydrates ready to use in the rumen. Adding 5% Klinoptilolite in concentrates containing urea to increase the intensity of digestive nitrogen and 40% Synthetic Klinoptilolit addition did not cause side effect (Mumpton, 1984)

MATERIAL AND METHOD

The study was conducted in the area with an altitude of 715 m above sea level with temperatures around 24.5 * C and relative humidity around 74%.

Research used a Completely Randomized Design, using 20 Priangan Lambs ages 7 months, weighing between 13-16 kg (coefficient of variation 7.6%). The Lambs were kept in individual cages the size of 70 x 50 x 60 cm3. Feed is provided in accordance with the usual given by traditional farmers, grass field an ad libitum (about 4 kg / day) with the frequency of two times, at 12:00 and at 18:00. Grass Hay provided in the form that has been chopped.

Concentrates given consist of rice bran, urea (44.58% N), NaCl and Klinoptilolitte. The concentrate was given every morning at 07.00 as much as 150 grams / head / day (As fed.) Drinking water was given ad libitum. Blood sampling was done by the end of research using the method of Lewis (1960) taken from the jugular vein at intervals of 1,2,3,4,6,8 hours after feeding. The variable measured were Blood Ammonia Level and Efficiency of Nitrogen Utilization.

RESULTS AND DISCUSSIONS

Average blood ammonia levels of each treatment were measured at 0 (just before given a concentrate), then after administration of the concentrate 1,2,3,4,6,8 hours. The results was presented in table 2.

Table 2. Average Blood Levels of Ammonia in each treatment

Dosis Klinoptilolit (%)	Blood Amonia Levels (mg/100ml)									
	Hour to								Average	Sign (p<0,05)
	0	1	2	3	4	5	6	8		
0	0,29	0,32	0,36	0,38	0,33	0,34	0,30	0,30	0,33	a
2	0,20	0,24	0,26	0,27	0,24	0,24	0,23	0,23	0,24	b
4	0,12	0,14	0,16	0,18	0,16	0,17	0,17	0,16	0,16	c
6	0,09	0,10	0,11	0,14	0, 10	0, 13	0, 13	0,09	0,11	d
8	0,08	0,09	0,09	0,11	0,09	0,11	0,11	0,09	0,09	d

Table 2 shows, blood N-NH_3 level of K-0 treatment (concentrate, without Klinoptilolitte) on each hours blood sampling its highest, then followed in succession by K-2 (2% Klinoptilolitte), K-4 (4% Klinoptilolitte), K-6 (6%, Klinoptilolitte) and K-8 (8% Klinoptilolitte.) In the hour-0 (just before given a concentrate), blood N-NH_3 levels of control animals (K-0) was high (0.29 mg%) compared with that of normal Lamb blood, which according to Repp, et al. (1955) ranged from .08 to .25 mg%. Similarly, after administration of concentrate, blood N-NH_3 levels livestock-control (K-0) rose very high to be 0.38 mg% (at the 3rd hour), although not yet reached levels of poison as proposed by Ffoulkes (1986), by 0.5 mg%. During the study, conditions of the Lambs also healthy. It is probably due, the level of urea concentrates used in the study still within the recommended range, namely below. 0.5 g / kg body weight (Loosli and McDonald, 1968) or up to '5% of dry matter concentrate (Baumgardt 1964; Arora 1989).

Described by Chalupa (1968) that rumen urease is very active; 30 minutes after consumtion of concentrate containing urea, N-NH_3 level increased very rapidly in the rumen. Subsequently confirmed by Bloomfield, et al. (1960) that the N-NH_3 formed in the rumen would pass (absorbed by blood vessels) before they could be used, because the rate of ureolisis four times faster than the rate of microbial protein synthesis.

Table 2 also showed, the increased dose of Klinoptilolitte in concentrate is always followed by the decreasing levels of blood N-NH_3. Meanwhile ANOVA showed, the addition of Klinoptilolitte in concentrate had a very significant effect on decreasing blood N-NH_3 level ($P < 0.01$). This proved that Klinoptilolitte can function as a controller of N-NH_3 level in the rumen, either through binding of NH_4^+ and NH_3 is formed excessively, so that the absorption of NH_3 by blood vessels was decreased (Mumpton, 1984).

Furthermore, to distinguish between treatment effects in greater detail, was performed of Duncan's Multiple Range Test. As a whole explains. that the use of Klinoptilolitte ranging from 2% (K-2) to 8% (K-8) were significantly decreased blood N-NH_3 level ($P < 0.01$). Meanwhile, between the use of 6% (K-6) and 8% (K-8) did not show significant differences ($P > 0.05$). This approach results Nestorov, et al. (1 979) were cited by Mumpton (1984) that the use of Klinoptilolitte up to 5% in concentrate containing N urea (30% of total N) lower levels of N-NH_3 in the rumen and blood, also increase of the levels of N-acids in the rumen and blood.

There will not significant different between the effect of the use of 6% Klinoptilolitte (K-6) with 8% (K-8) shows that the use of 6% Klinoptilolitte had reached the maximum dose

required. in the binding of N-NH_3 formed in the rumen excessive, so the use of 8% was no longer effective to decrease blood levels of N-NH_3. Increased use of Klinoptilolitte in the concentrate were followed by the increasing ability of Klinoptilolitte in binding N-NH_3 in the rumen. Thus, the use of Klinoptilolitte exceed the amount needed to bind the excess N-NH_3 formed of rumen fluid, tends to disadvantage, because they could bind a number of N-NH_3 that should be allocated to support microbial protein synthesis. Described by Baldwin and Denham (1979) that the maximum microbial protein synthesis.

N-NH_3 concentration requires an optimum, in addition to the levels of N-NH_3-optimum should be available before the enzyme that assimilate N-NH3 reaches a maximum rate. If the condition was not met, then the microbial protein synthesis did not run efficiently. Because of the binding of N-NH_3 excessive by Klinoptilolitte, possibly cause a reduction in N-NH_3 available to microbes.

The peak of blood N-NH_3 concentration at 3rd hour shows that the hydrolysis of urea in the rumen have been completed before three hours. This was in line with the results of research that suggested by the Egan (1986), hydrolysis of urea in the rumen was completed within 1-2 hours. Subsequently confirmed by Lewis (1960), maximum levels of N-NH_3 in blood occurs 0.5 to 1.0 hours after the maximum levels of N-NH3 in the rumen. So, N-NH_3 concentration in the blood will be maximum between 1.5 to 3.0 hours after consumimg consentrate containing urea. The existence of N-NH_3 absorption by blood vessels in the three hours following administration of urea, also proved more than the rate of microbial protein synthesis, when compared with ureolisis rate in the rumen. Furthermore, it was forward by some researchers (Chalupa, 1968; Maynard et al., 1979; Smith, 1979) that microbial protein synthesis required energy and frame C, of whom shall be provided from the source of carbohydrate. N-NH_3 absorbed by blood vessels occur, if the rate of fermentation of carbohydrate was slower than the rate ureolisis; in this case Van Soest (1982) find time for the final fermentation of carbohydrate sources is between 4-6 hours after consumtion. Consequently in 1-2 hours N-NH_3 level in the rumen will immediately decreased, before they could be used by microbes (Egan, 1986). This is due to the speed measure of the take-N-NH_3 material into proteins mikroba is a function of time after feeding (Baldwin and Denham, 1979) that the intensity of the fermentation of carbohydrates should reach its peak (completed) of 2-5 hours, because the need for N-NH_3 by microbes peaked between 2-3 hours after feeding, microbial growth reaches a maximum.

Table 3. Average Efficiency Nitrogen Utilization of Each Treatment

	Treatment				
	K-0	K-2	K-4	K-6	K-8
Consumption of Nitrogen ration (g / head / day)	11,42	11,10	10,91	10,81	10,43
Weight Gain (g / Lamb / day)	71,43	107,14	116,07	160,07	98,14
Efficiency Nitrogen utilization	6,27	9,66	10,67	14,88	9,34

Table 3 shows, Klinoptilolitte in concentrate, from 2% (K-2) up to. 6% (K-6) followed by increased of weight gain and efficiency of Nitrogen utilization. Here also are visible, the highest body weight gain, as well as the most efficient use of N ration obtained in the group of animals that received concentrates containing 6% Klinoptilolitte (K-6), respectively 160.07g and 14.88; then followed successively respectively by K-4 (116.07 g, 10.67), K-2 (107.14 g, 9.66), K-8 (98.14 g, 9.34), and K-0 (71 , 43 g; 6.27).

Meanwhile ANOVA showed that the addition of Klinoptilolitte had a significant effect on weight gain and feed efficiency of N utilization ($P<0.05$), but not the influence on consumption N ration ($P>0.05$). Furthermore, to know the difference between treatments in greater detail, Duncan Multiple Range Test was performed and the results showed that efficiency of Nitrogen utilization efficiency in groups that received 6% Klinoptilolitte (K-6) was significantly higher ($P<0.05$).

Use of Klinoptilolitte in the concentrate did not increase the feed intake ($P>0.05$).

However, increase use of Klinoptilolitte from 2% (K-2) to 6% (K-6) followed by increase of body weight significantly. This showed that the growth rate of livestock is not determined by the number N was consumed, but by the intensity of N digestion in the body. This proved that the use of Klinoptilolitte in concentrate to increase the intensity of N digestion in the body, in line with. report presented by Mumpton (1984) that Klinoptilolitte in rumen function as a buffer. Ammonia (NH4 + or NH3), which formed over the rumen will be bound by Klinoptilolitte, then released gradually in accordance with the ability of microbes in using it for microbial protein synthesis. As a result N-NH3 is absorbed by the blood vessels can be inhibitory, as well as microbial protein synthesis can run continuously, so the use of N-NH3 more efficiently. Eventually this led to increased efficiency of N utilization in the body.

Furthermore, the increased use of Klinoptilolitte from 6% (K-6) into 8% (K-8th) was not followed by increased efficiency of Nitrogen. This was due to the use of more than 6% Klinoptilolitte will bind partially. N-NH3 for microbes to support maximum microbial protein synthesis. This was the evident after the use of Klinoptilolitte in concentrate reached 6%, did not effect anymore on the decreased levels of N-NH3 blood (Table 2) Due to decreasing levels of N-NH3 below the optimum, microbial protein synthesis was reduced, so consequently the contribution of microbial protein for livestock to be reduced as well. While it was described by Conrad and Hibbs (1968), inadequate supply of N-NH3 in the rumen fermentation process would cause a decline in feed. As a result of rumen function become impaired, making feed (primarily forage) to be reduced and eventually become stunted growth in livestock.

CONCLUSIONS

The result indicated that additional Klinoptilolit in ration significantly decreased blood ammonia level (from 0,33 mg/100 ml to 0,094 mg/100 ml) and significantly increased efficiency of nitrogen utilization (from 6,3 % to 14,9 %). The optimum dose of Klinoptilolit was 6 %.

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REFERENCES

[1] Arora, S.P. Microbes Digestibility in Ruminant. Bambang Srigandono, Ed. Gadjah Mada University Press, Yogyakarta. Indomesia. 1989.

[2] AOAC. 1975. Officials Methods of Analysis of the association of the Official Agriculture Chemicst. 9th Ed. Washington D.C.

[3] Baldwin, R.L. and S.C. Denham. Quantitative Aspects of Nitrogen Metabolism in the Rumen: A Modeling Analysis. J.Anim. Sci. 1979. 49(6).

[4] Baumgardt, D.R. Use of Urea in Feeds. Feed Stuff. 1964. 38 :80.

[5] Bloomfield, R.A.; G.B. Garner and M.E. Muhrer. Kinetics of Urea Metabolism in Sheep. J. Anim. Sci. 1960. 19

[6] Chalupa,W. Problem in Feeding Urea to Ruminant. J. Ani. Sci. 1968. 27

[7] _____,. Metabolic Aspects of Nonprotein Nitrogen Utilization in Ruminant Animals. Fed. Proc. 1972. 31

[8] Conrad, H.R. and J.W. Hibbs. Nitrogen Utilization by the Ruminant, Appreciation of Its Value. J. Dairy Sci. 1968. 51(2)

[9] Egan A.R. Principles of Supplementation of Poor Quality Roughages with Nitrogen. In Ruminant Feeding System Utilizing Fibrous Agricultural Residues. Dixon, R.M. ed. International Development Program of Australian Universities and Colleges Ltd, Canberra, 1986. 56.

[10] FAO. 2004. Rumen contents. http://www.Fao.org/ag/AGAP/FRG /AFRIS/DATA/320.html

[11] Ffoulkes, D. Research and Development of Nutrition Strategies for Indonesian Ruminant Livestock. Ind. Agr. Res & Dev. Journal. 1986. 8(344):79

[12] Loosli, J.K. and I.W. McDonald. Nonprotein Nitrogen in the Nutrition of Ruminant. Food ang Agricultures Organization of the United Nation. Rome. 1968. 3-77

[13] Maynard, L.A., J.K. Loosli., H.F. Hintz, and R.G. Warner. Animal Nutrition. 7th Ed. McGraw Hill Book Co, San Fransisco. 1979.

[14] Mumpton, F.A. The Role of Natural Zeolites in Agriculture and Aquaculture. In Zeo Agrculture Use of Natural Zeolites in Agriculture ang Aquaculture. Fond, W.G. and F.A. Mumpton. International Committee on Natural Zeolites. Westview Press, Boulder, Colorado. 1984.

[15] Van Soest P.J. Nutritional Ecology of The Ruminant. Ruminant Metabolism,Nutritional Strategies. The Cellulolitic Fermentation and hemistry of Forages And Plant Fibers. Cornell University Press. London. 1982.