The Study on the Application of Hydroquinone in Production of Lambs as Urease Inhibitor

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Abstract: The study was composed of two parts. A one-factor design was adopted to investigate DMD, CPM, NDFD and ADFD of diet by total feces collection method in trial one. Twelve lambs were allotted randomly to 4 groups of 3 animals (replicates), which were fed with basal diet, basic diet plus 40 mg/kg urease inhibitor, urea diet, urea diet plus 40 mg/kg urease inhibitor. Experimental period consisted of a 10-day adjustment period and a 5-day collection period. The experimental results have shown that urease inhibitor did not affected nitrogen balance. But the digestibility of fiber was increased by 20 mg/kg. In trial two twenty weanling crossbreed lambs（Texel×local breed） were allotted to five group of 4 animal （replicates） with an average body weight in all the groups. Each group was fed urea-containing diet （1%, 1.5%, 2% urea of complete ration）+UI, basic diet +UI and basic diet without UI. From the growing trial with administration of 40mg/kg, urease inhibitor, it can be concluded that the urea can replace all soybean meal in the diet in the presence of urease inhibitor. In addition, no significant change occurred to feed intake, average daily gain and feed conversion rate. It is obvious that the economic benefits will be obtained from inclusion of urease inhibitor in urea-containing diet. [Nature and Science, 2004,2(2):20-24]

Key words: urease inhibitor; lambs; metabolic rate; performance

1 Introduction

The main factor limited the utilization of urea for ruminant is that the rate of urea hydrolyzed by urease exceeds the ability ansforming ammonia to protein for mcroorganism in rumen. The activity of the urease can be curbed by urease inhibitor in diet, leading to ammonia releasing speed match the need of microbe, then the non protein nitrogen, urea, can be used more for the lambs to reduce the feed cost. The urease inhibitor was gained wide acceptance for its low price, easy usage, and can be add to concentrate directly. The purpose of the study is to test the effects of urease inhibitor, hydroquinone, in lamb production.

2 Material and Method

2.1 Animals selected and trial design

The trial was conducted in northeast agriculture university. Twelve East-north Fine-wool rams were used with average weight 35 kg, four months age, allotted randomly to 4 groups of 3 (replicates), which were fed with four different diets (the composition of diet in Table 1) in trial one. All lambs cultivated normally with good appetite and no illness. Twenty weanling rams in trial two are first hybrid generation of Texel and East-north Fine-wool and the average age of them was three month old. They were allotted to five groups including testing groups (from one to three) with gradually increasing urease inhibitor levels (1%, 1.5%, 2%), and the animals of group four were fed basic diet plus urease inhibitor and the lambs of group five basic diet. The composition of diet listed in Table 2. Four lambs in each group keep same original condition.

2.2 Ration and management

The ratio between concentrate and forage was 1∶1, the forage was Leymus chinensis with good quality and cut about 1cm mixed with

concentrate, and the formular is followed. Every lambs was fed about 1.2 kg seperated two times in the morning and at night. Water was available ad libitum. The rest feeds were weighted and recorded accurately, and each the animal' behaveour of intaking and rumination was observed every day.

Table 1 Composition and nutriet level of each group diet in trial one

Ingredient (%)	Control	Control + UI	Urea diet	Urea +UI
Leymus chinensis	50.0	50.0	50.0	50.0
Corn	32.0	32.0	39.0	39.0
Soybean meal	15.5	15.5	7.5	7.5
Urea	0.0	0.0	1.0	1.0
Na_2SO_4	0.1	0.1	0.1	0.1
Salt	0.5	0.5	0.5	0.5
Limestone	0.5	0.5	0.5	0.5
$CaHPO_4$	0.9	0.9	0.9	0.9
Vitamin premix	0.3	0.3	0.3	0.3
Mineral premix	0.2	0.2	0.2	0.2
Urease inhibitor	—	40 mg/kg	—	40 mg/kg
Nutrient level				
Cal/kg	2.66	2.66	2.64	3.64
Crude protein (%)	13.02	13.02	13.00	13.00
Calcium (%)	0.64	0.64	0.62	0.62
Phosphorus (%)	0.43	0.43	0.41	0.41

In trial two the forage was pelleted composed of alfalfa and maize stover in order to strict ratio intake for the animals, while the concentrate was fed separately for no activities urease inhibitor had been lost in the procedure of feed pelleted. The forage was available ad libitum in 24 hours, and the concentrate was administered according to intake of forage at 1:1 ratio.

One-factor design was adopted in trial one and two. The pre-experience lasted ten days in the first trial, then all lambs were taken into metabolic cage in the next five days when the feed intake and rest in trough were recorded accurately every day. Feces and urine were collected and weighted during the five period, and the lambs were trained to be familiar to the procedure in order to avoid the sample contaminated.

In trail two fourteen days to test in advance worms removed by medicine, and the formal experimentation is forty days. During the pre-experimentation the average feed intake of animal was estimated to keep the feed available in every trough, and water ad libitum during the whole trial period.

2.3 Test method

We observed the feed intake, rumination, health and shape of feces every day and took note. Dry matter (DM), crude Protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and total nitrogen content of urine were test in trial one, and the calculating formula followed:

CPM（%）= (a-b-c)/a×100%

NDFD（%）= (a-b)/a×100%

ADFD（%）= (a-b)/a×100%

CPM: crude protein metabolic rate of the ration

NDFD: DNF digestive rate of the ration

ADFD: ADF digestive rate of the ration

a: the total nutrient ingredient intake from feed

b: the total nutrient ingredient excluded in feces

c: the total nutrient ingredient in urine

NDF and ADF test adopted Van Soest (1963)

Method, and nitrogen was determined by the Kjeldahl procedure (A.O.A.C., 1960)

The data analysis use the general linear model (GLM) in SAS （1986~1989） software.

3 Results

The result of trial one showed in Table 3. It can be found from the Table 3 that the dry matter apparent digestive rate (DMD) in every treatment existed not any differences, which demonstrated whether urea or urease inhibitor added to diet did not affect the dry matter intake of the animals (P>0.05).

There was no difference between the control and the treatment fed basic diet plus urease inhibitor in CPM, but the NDFD in basic plus UI group are 51.56%, significantly high compared with the control 44.83 (P<0.05). The NDFD of the urea diet group administrated UI was 49.36%, no varying to those fed urea diet 48.04%. The ADFD of the basic plus UI was 38.89% higher than the control 29.94% significantly (P <0.01). There was no obvious difference between the group fed urea and the group fed urea diet plus UI (P>0.05), but both above the control (P<0.05).

Table 2 The composition and nutrient level of diets in trial two

Ingredient (%)	Group 1	Group 2	Group 3	Group 4	Control
Alfalfa meal	13.89	13.89	13.89	13.89	13.89
Maize stover	36.11	36.11	36.11	36.11	36.11
Corn	39.35	42.35	46.35	32.35	32.35
Soybean meal	8.00	4.50	0.00	16.00	16.00
Urea	1.00	1.50	2.00	0.00	0.00
$CaHPO_4$	0.50	0.50	0.50	0.50	0.50
Limestone	0.50	0.50	0.50	0.50	0.50
Salt	0.35	0.35	0.35	0.35	0.35
Premix	0.2	0.2	0.2	0.2	0.2
Na_2SO_4	0.1	0.1	0.1	0.1	0.1
UI	+	+	+	+	-
Total	100	100	100	100	100
Nutrient Levels					
DM (Cal/kg)	2.69	2.67	2.66	2.72	2.72
CP (%)	12.39	12.53	12.33	12.45	12.45
Ca (%)	0.64	0.62	0.61	0.66	0.66
P (%)	0.62	0.61	0.59	0.65	0.65

Table 3 Effect of urease inhibitor on DMD, CPM, NDFD, ADFD

Treatment	DMD	CPM	NDFD	ADFD
Control	60.34^{Aa}±3.69	61.49^{Aa}±1.99	44.83^{Ab}±2.33	29.94^{Bc}±1.73
Basic +UI	62.97^{Aa}±0.81	60.36^{Aa}±2.07	51.56^{Aa}±1.50	38.89^{Aa}±2.06
Urea diet	62.96^{Aa}±3.58	55.69^{Aa}±4.67	48.04^{Aab}±0.40	35.98^{ABab}±0.54
Urea +UI	60.89^{Aa}±3.39	56.50^{Aa}±7.48	49.36^{Aab}±3.72	34.22^{ABb}±0.55

Note: Values in the same row with different superscripts are significant.

During the whole trial two, the twenty lambs grew normally, with good health, normal regurgitation and appetite, and the feces shape was natural. Only at the beginning of the feeding, it took a short term (3~5 days) to be adapted to diet and management. The result of test was showed in Table 4.

Table 4 Feed intake，gain weight，feed/gain weight of lambs

Performance	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Control
Feed intake (kg)	1.63^{a}±0.21	1.57±0.19	1.61^{a}±0.26	1.61^{a}±0.54	1.53^{a}±0.27
Gain weight (g)	174.67^{a}±28.37	189.00^{a}±12.81	194.67^{a}±23.18	222.67^{a}±92.12	174.6^{a}±38.02
Feed/Gain (g/g)	9.34^{a}±0.84	8.32^{ab}±1.29	8.26^{ab}±0.62	7.23^{b}±0.84	8.77^{ab}±0.89
Feed price (￥/kg)	0.71	0.67	0.63	0.78	0.78

Note: Values in the same row with different superscripts are significant.

We found no differences among the treatments and the control in feed intake and gain weight from the Table 4. In the field of feed/gain the treatment 4 was lower than treatment 1 ($p<0.05$), while other treatments and control were not ($P>0.05$).

4 Discussion

From the result of the trial one, it's no doubt that the urease inhibitor can curb the urease activity effectively in rumen to decrease the urea hydrolyzing speed, then avoided ammonia release abruptly, which benefit for synthetic action of microbe protein, further, the urea as the cheapest non protein nitrogen can be use more in diet for growing lambs. But whether nitrogen retention in the body of ruminant increased is few reported. In our trial the nitrogen retention receiving UI was not greater than the control, which was not accord to Streeter (1969) who had report 5.2% greater improved received AHA (acetohydroxamic acid, another urease inhibitor). Also, Zhou Jianmin (1999) has believed that the nitrogen balance is changed by urease inhibitor (AHA). Perhaps a different kind of UI seldom used in animal before in ours was the key factor.

The result that digestive rate of NDF and ADF promoted agreed to Zhou Jianmin's theory that it is necessary for microorganism's best digesting forage in rumen to keep certain ammonia concentration, about 20 mg/100mL. but Sreeter (1969) reported that urease inhibitor can not improve the digestibility of DM, NDF ($P>0.10$), and More (1968) provided the similar report that under the circumstances of urea diet urease inhibitor did not improve the digestive rate of NDF and ADF, which was accord to ours.

By the trial one we found the digestive rate of NDF and ADF improved, which demonstrated limited administration of the cheap urea can act as RDP, then bringing active effect for forage degraded. Allen (1968) and Belasco (1954) draw a conclusion that in vitro ammonia hydrolyzed from urea activated the forage degradation. In their substrate composed of fiber and starch, the hydrolysis of fiber and starch increased when the soybean meal was stead of urea as nitrogen resource. EL-shazly (1961) studied the antag- onism between fiber digestion and starch, which slacked if the substrate was added urea. He explained the digestion of fiber was inhibited by starch just because the microorganisms digesting starch compete nitrogen with the microbe degrading fiber. The nitrogen balance and DM digestion appears to be relatively independent of feeding urea. This idea is supported by the results of Caffrey (1967).

During the period of trial two, all lambs were in gear including feeding, rumination and defecation without any ammonia toxicosis when using soybean meal instead of urea gradually, even completely substitute urea for soybean meal. The production

performance of the lambs was not affected receiving urea in diet as the urease activity was curbed by UI and the ammonia release smoothly. As we know the feed intake is confine to the physiological traits of the animal and feed characteristics, while main to the feed traits for low quality kind, urea（Montgonery, 1965）. In our study, the ram got adapted to the specific feed in a short term, and dry matter intake did not decreased, though urea level of the ration was very high. The gain per day is independent of feeding urea, receiving UI in diet. This idea is opposed to the Zhou Jianmin's theory (1999) that UI can change the recycle of nitrogen in ruminant, then microbe protein improved by UI.

The cost of treatment 1, treatment 2, and treatment 3 was 0.71, 0.67, 0.63 ￥/kg respectively, lower than control 8.91%, 14.10%, 19.23%. So, it is convenient way to decrease the feed cost by using urease inhibitor to utilize the urea, and the urease inhibitor we use is hydroquinone, which is only one to tenth in price comparing with AHA.

In general, the degradation of fiber for ruminants increases using urease inhibitor, but the nitrogen balance is not affected. The utilization of urea can be enlarged by UI, but it do not benefit for animals receiving in normal diet without urea.

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