Egypt. J. Agric. Res., 77 (1), 1999

PHYSIOLOGICAL EFFECTS OF USING UREA AND DEODORASE SUPPLEMENTATION IN RABBIT RATIONS

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(Manuscript received 26 January 1998)

Abstract

Two dietary protein levels (16.5% and 16.5 +2% urea) were fed to New Zealand White weanling rabbits about 35 days of age, each±250 mg Yucca Plant Extract: YE/Kg diet, with 6 rabbits in each of 4 groups.

Body weight and feed intake were recorded weekly. At the end of the experimental period, six animals from each group were sacrificed to measure blood and coecal ammonia and urea nitrogen, coecal pH and, coecal pH volatile fatty acids. There was an increase in body weight in body weight in 16.5% protein groups with or without Deodorase compared to 16.5% plant protein+urea. The same trend was observed for total body gain. Also, there was an improvement in feed/gain ratio in plant protein and inclusion of Deodorase. Volatile fatty acids were incoreased with inclusion of urea or Deodorase. Coecal NH3 and blood urea N were decreased with inclusion of Deodorase especially in 16.5% protein+urea. In general, Deodorase resulted in decrease in blood ammonia, blood urea nitrogen, and decrease in coecal urea nitrogen. Coecaal NH3 was reduced with YE when 2% urea was fed. Thus, Deodorase might improve N utilization in rabbits, particularly when diets containing urea are fed.

Key Words : Rabbits, urea, Yucca.

INTRODUCTION

The importance of feed additives in animal diets increased in the last years with the aim of improving growth performance and the economic situation of the animal projects.

Yucca extract (YE) binds ammonia NH3. The Yucca plant (*Yucca shidegria*) contains glycosylated compounds which bind NH3 (Headon, 1991). Yucca extract (YE) is used commercially as a Deodorase substance, primarily for NH3 control in confinement livestock facilities. It was hypothesized that with high dietary N, YE might bind excess NH3 in the blood and coecum, while, with low N diet, YE migh provide a slow-

release of to facilitate coecal fermentation in the rabbit. Also, there was a hypothesis that using urea is better utilized when supplemented to a low CP diet (Singh *et al.*, 1988, 1990).

The objective of this study was to investigate the previous hypothesis, determine the effect of YE as Deodorase substance in combination with urea in rabbit diets, and to answer the following questions: 1-Does Deodorase affect the utilization of NPN sources such as urea, which is sometimes used in rabbits feed? 2-Is there a difference in effects on N metabolism depending upon dietary protein level ? 3-Via effects on coecal ammonia, does Deodorase affect coecal pH and VFA concentration?

MATERIALS AND METHODS

Twenty-four New-Zealand White rabbits about 5 weeks of age and 650g average body weight were randomly assigned to 4 treatments. The animals were kept in individual wire cages. Treatments consisted of two levels of crude protein, each tested with and without *Deodorase at 250 mg per kg diet, as follows:

1. Plant 16.5% protein with Deodorase and Deodorase-free (16.5% + D and 16.5%, DF and LPUDF, respectively).
2. 16.5% protein + urea, with Deodorase and Deodorase-free (16.5% + U + D and 16.5% + U, respectively).

Ingredients and chemical composition of the diets are shown in Table 1. Feed and water were offered ad *libitum*.

By the end of the experimental period, all were sacrificed to measure blood and coecal ammonia and urea nitrogen, coecal pH and coecal VFA concentration.

Blood and coecal ammonia were determined by diagnostic kits (Sigma, quantitative, enzymatic determination) and measured spectrophotometrically at 340 nm. Blood and coecal urea nitrogen were assayed by quantitative, colorimetric method (Sigma kits) and measured spectrophotmetrically at 525 nm. VFA concentration measured by gas chromatography (HP 5890). Statistical analysis was conducted by analysis of variance using the SAS Package (1990). Means and standard errors of all parameters were estimated and Tukey's test was used to detect significant differences among the means of the experimental groups.

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* Deodorase is a commercial product provided by Altech Company.

Table 1. Ingredients and chemical composition (% kg).

Ingredient	Low CP	Low CP + Urea
Alfalfa meal (20%)	54.00	54.00
Ground corn (8.5 %)	21.00	19.00
Wheat mill run (15.7%)	20.00	20.00
Vegetable oil	1.25	1.25
Molasses (7%)	3.00	3.00
Dicalcium phosphate	0.25	0.25
Vitamins & mineral mixture*	0.50	0.50
Urea	-	2.00
Total	100	100

Analysis of feed samples fed to rabbits (% kg):

Component	Low CP	Low CP + Deodorase	Low CP + Urea	Low CP + Urea + Deodorase
Dry Matter	90.81	90.70	91.17	90.12
Crude Protein	16.63	16.34	22.13	22.33
Avg. Ash.	9.20	8.70	9.01	7.80

* Each Kg vitamin & mineral mixture contained: Vit A. 2000.000 IU, E. 10.000 mg. D3, 180.000 IU, K3 400 mg, B1. 400 mg, B2. 1200 mg, B6. 400 mg, B12. 2 mg, Pantotheinic 400 mg, Niacine 1000 mg, Folic acid 1000 mg, Biotin 40 mg, Choline 240 mg, Mn. 1700 mg, Zn. 1400 mg, Fe. 1500 mg, Cu. 600 mg, Se. 20 mg, I. 40 mg and Mg. 800 mg.

RESULTS AND DISCUSSION

Body Weight, Body Weight Gain and Feed Intake

Means ± SE for final body weight, total body weight gain and total feed intake are presented in Table 2. There were significant differences between the experimental groups. Analysis of variance revealed significant ($P<0.002$ and $P<0.05$) increase in body weight due to level of protein and Deodorase supplementation, but no significant difference due to interaction between protein level and Deodorase was observed. The differences between the 16.5% level of protein with or without Deodorase were significantly different compared to the 16.5% protein + urea with or without Deodorase and that body weight decreased significantly in these groups. Also, there is a significant ($P<0.05$) increase in body weight by 6.79% due to Deod-

orase of the protein level, "where the average body weight with Deodorase was 1072..42 g, vs. 1004.17g for the treatments without Deodorase."

The same trend was observed for total body weight gain, where average body weight gains were high (415.67g) with 16.5% of protein, compared to 16.5% level of protein + urea (299.84 g) regardless of the effect of Deodorase supplementation. The effect of Deodorase on total body weight gain, regardless of protein level, was so clear and increased total body gain by 17.42% compared to treatments without Deodorase. Deodorase was most effective in the 16.5% crude protein group, where total body gain increased from 365.67g in the 16.5% protein group to 465.66g in the 16.5% protein + D group.

Feed intake was increased significantly ($P<0.05$) in Deodorase-supplemented group compared to Deodorase-free group. The interaction between Deodorase and protein level was not significant. The effect of Deodorase on feed intake was great in the 16.5% protein group, where the value increased from 1308.83 g in the 16.5% protein group to 1461.50g in the 16.5% protein + D group. In general, Deodorase improved feed intake regardless of protein level. Average feed intake for the Deodorase groups was 1360.92g compared to 1259.33 g for the Deodorase-free groups. These findings agree with those reported by Miles *et al.*, (1985), Makled (1993), Hattaba *et al.*, (1994) and Badawy (1996) who reported that at least 2% protein in the diet could be saved by adding Arolen as growth promoter. Thus, in accordance with previous results, the use of Deodorase is suggested for a low protein diet to increase total body gain and feed intake. Moreover, Deodorase supplementation improved feed gain ratio.

Regardless of leve of protein, Deodorase improved the feed/gain ratio from 3.62 to 3.25. Thus, Deodorase was not markedly effective when used with urea (as a source of nitrogen), although it did insignificantly increase body weight, total body weight gain, feed intake and slightly improved the feed/gain ratio 4.13 to 4.10.

These results are in agreement with Niedzwiedek *et al.* (1975) and Singh *et al.* (1990), who reported that urea up to a level of 1% in the diet had no adverse effect on performance. Also, they reported , that, incorporation of 1% urea in the diet decreased the cots of feed by about 10%. However, 2% urea in the diet (as in the present study) lowered weight gain and increased feed intake/kg gain. Mathius *et al.* (1988) found very poor reporductive results and very high mortality of preweaning kits when 1% urea was fed to breeding does. Also, Krishna *et al.* (1990)

reported that, urea should not be incorporated into the diet of breeding stock or Angora rabbits (lifespan 4-5 years) as urea even at a level of 0.5% would produce strees on the rabbits on prolonged feeding.

Table 2. Means ± SE for final body weight, total gain, total feed intake and F/G ratio.

Items	16.5% Protein	16.5% Protein + Urea	Average
Final body weight (g)			
Without D	1052.17 ± 17.70	956.17 ± 17.70	1004.17a
With D	1150.83 ± 17.70	994.00 ± 17.70	1072.42b
Average	1101.50 ± 17.70	975.09 ± 17.70b	
Total body gain (g)			
Without D	365.67	292.50	329.09
With D	465.66	307.17	386.42
Average	415.67	299.87	
Total feed intake (g)			
Without D	1308.83 ± 27.29	1209.83 ± 27.29	1259.33a
With D	1416.50 ± 27.29	1260.33 ± 27.29	1360.92b
Average	1385.17 ± 27.29b	1235.08 ± 27.29b	
Feed conversion			
Without D	3.58	4.14	3.83
With D	3.14	4.10	3.52
Average	3.33	4.12	

Coecal parameters

Means ± SE for coecal pH, ammonia and urea nitrogen are given in Table 3. There were no significant differences in coecal pH between groups due to Deodorase, but lower pH was recorded in 16.5 proteint Deodorase group compared to the 16.5 protein Deodorase-free group. The average coecal pH, regardless of protein level, was 6.51 vs. 6.57 for the Deodorase and Deodorase-free groups, respectively. This result is in agreement with Al-bar *et al.* (1992), and Ismail *et al.* (1996 a,b), who reported that Deodorase decreased coecal pH value.

Regarding the protein level, there was no significant difference in coecal pH value due to protein level, but the 16.5% protein + U group recorded the highest value of 6.62, followed by group 16.5% protein (6.45). Results indicated that coecal pH might be affected by dietary ingredients, protein level, source and quality.

The effect of De-Odorase on coecal ammonia was significantly different ($P<0.0001$), and the interaction was significant ($P<0.005$). Regardless of protein level, there was a reduction in coecal ammonia in the Deodorase groups compared to the Deodorase-free groups, where, values were 20.90 and 25.34 (mg/dl), respectively. The effect of protein level and its source was not clear, where, there is no significant differences in coecal ammonia detected with the 16.5% protein and 16.5% protein + U groups. Deodorase with the 16.5% protein + U group showed a marked decrease in coecal ammonia. Values were 27 mg/dl for the 16.5% protein + U group vs. 17.97 mg/dl for the 16.5% protein + U + D group, indicating the marked interaction between protein source and Deodorase. Hence, the effects of Deodorase are modified diet components, the nature and level of protein. In general, there is no contradiction between these and previous results, which have indicated that Deodorase has a binding effect on coecal ammonia (Ismail *et al.* 1996).

Table 3. Means ± SE for coecal and blood ammonia and urea nitrogen concentrations and coecal pH.

Items	16.5% Protein	16.5% Protein + Urea	Average
Cecal NH3 (mg/dl)			
Without D	23.68 ± 3.33	27.00 ± 6.79	25.34a
With D	23.83 ± 0.98	17.97 ± 4.13	20.90b
Average	23.76 ± 2.51	22.44 ± 5.32	
Cecal urea N (mg/dl)			
Without D	14.87 ± 0.12	15.06 ± 0.12	14.97
With D	14.68 ± 0.12	14.55 ± 0.12	14.62
Average	14.77 ± 0.12	14.80 ± 0.12	
Cecal pH			
Without D	6.52 ± 0.05	6.61 ± 0.05	6.57
With D	6.39 ± 0.05	6.63 ± 0.05	6.51
Average	6.45 ± 0.05	6.62 ± 0.05	
Blood NH3 (µg/ml)			
Without D	4.58 ± 0.21	4.62 ± 0.21	4.60
With D	4.20 ± 0.21	4.49 ± 0.21	4.38
Average	4.42 ± 0.21	4.56 ± 0.21	
Blood urea N (mg/dl)			
Without D	15.61 ± 2.37	30.95 ± 4.48	23.28a
With D	14.62 ± 1.31	21.46 ± 6.09	18.04b
Average	15.21 ± 1.84a	26.21 ± 5.29b	

Results for coecal urea nitrogen were similar. Deodorase decreased coecal urea nitrogen in the 16.5% protein and 16.5% protein + urea. However, the effects od Deodorase were not significant and there was no significant interaction. Also, the effect of protein level was not significant, where, coecal urea N increased slightly with inclusion of urea.

Means ± SE for blood ammonia and urea nitrogen are presented in Table 3. There were no significant differences in blood ammonia between the Deodorase-free and Deodorase groups. In this study, protein level had an effect on blood ammonia. Thus, blood ammonia increased with increasing protein level and decreased with decreasing protein level. Urea showed a slight increase in blood ammonia when used as a NPN source. These results are in agreement with Makkar *et al.* (1990), who reported that ammonia levels were statistically similar in rabbits on urea diets.

Deodorase significantly ($P<0.0002$) decreased blood urea nitrogen with different crude protein levels. Its greatest effect was in the 16.5% protin + U + D group, in which blood urea nitrogen was 21.46 mg/dl in comparison to 30.95 mg/dl (the highest value) for the 16.5% protein + U group. In general, regardless of protein level, the Deodorase groups had a lower value for blood urea nitrogen in comparison to the Deodorase free groups 18.04 vs. 23.28 mg/dl, respectively.

Level of protein and its source had significant ($P<0.0001$) effect on blood urea nitrogen. Values were higher in the 16.5% protein + U group (26.21 mg/dl), and much lower in the 16.5% protein group (15.21 mg/dl). Urea as a NPN source dramatically increased blood urea nitrogen. Using Deodorase with urea reduced the side effect of increasing the blood urea nitrogen resulting from adding urea alone.

The was a significant ($P<0.02$) interaction between Deodorase and protein level with regard to blood urea nitrogen, which was increased as protein level increased. The best interaction was recorded in the 16.5% protein + U group, where blood urea nitrogen was low in the Deodorase group as compared to the Deodroase free group. In general, these results are in agreement with Makkar *et al.* (1990), who reported a significant increase in blood urea nitrogen ($P<0.05$) in rabbits on urea diets.

In this study, the effects of Deodorase on coecal VFA proportion and concentration were obscured by interactions with the source and level of protein (Table 4). Despite the lack of significant differences between the Deodorase and Deodorase-free groups, Deodorase resulted in increases in acetate, propionate, butyrate and,

subsequently, total VFA. The effect of Deodorase on VFA concentration was greatest in the 16.5% protein + D group, in which VFA increased by about 25% compared to the 16.5% protein group.

The level and source of protein affectted VFA concentration; with acetate, propionate and butyrate increased slightly with increasing protein level. Values for total VFA were 62.76m mol/dl in the 16.5% protein group and 64.53 m mol/dl in the 16.5% protein + U group, indicating that VFA concentration depends on dietary composition, source and level of protein. Using urea as a source of NPN with the 16.5% protein diet (16.5% protein + U group) seemed to improve VFA concentration, as indicated by the high levels of acetate, propionate and butyrate compared to VFA in the 16.5% protein group. Use of urea with Deodorase had an antagonistic effect, with decreases in all VFA in the 16.5% protein + U + D group as compared to the 16.5% protein + D group. Thus, urea may inhibit or decrease the beneficial effects of Deodorase. Urea and Deodorase showed favourable effects when used alone with a low protein diet, but in combination, their effects on VFA concentration decreased.

Table 4. Means for acetate, propionate, butyrate and total VFA.

Items VFA (m mol/dl)	16.5% Protein	16.5% Protein + Urea	Average
Acetate			
Without D	44.58	46.95	45.77
With D	54.29	53.17	53.73
Average	49.42	50.06	
Propionate			
Without D	2.02	3.68	2.85
With D	4.25	3.79	4.02
Average	3.14	3.74	
Butyrate			
Without D	9.07	11.09	10.08
With D	11.35	10.37	10.86
Average	10.21	10.73	
Total VFA			
Without D	55.67	61.72	58.70
With D	69.85	67.33	68.59
Average	62.76	64.53	

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التأثيرات الفسيولوجية لإضافة اليوريا والديودوراس فى علائق الأرانب

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أستخدام فى هذه الدراسة مستويان من البروتين ١٦,٥٪ ، ١٦,٥٪ + ٢٪ يوريا، وأختبر كل مستوى فى وجود مادة الديودوراس من عدمها عند مستوى ٢٥٠ ملليجرام/ كجم عليقة حيث غذيت عليها أرانب نيوزيلندى أبيض عمرها حوالى ٣٥ يوما بمعدل ٦ أرانب لكل مجموعة. تم تسجيل وزن الجسم والمستهلك من الغذاء اسبوعياً. ومع نهاية التجربة تم ذبح جميع الحيوانات لجمع الدم ومحتويات الأعور لتقدير الأمونيا واليوريا وكذلك تقدير درجة حموضة الأعور ومستوى الأحماض الدهنية الطيارة.

وكانت النتائج كمايلى: كانت هناك زيادة بالنسبة للوزن الحى وتحسنت كفاءة التحويل الغذائى مع مستوى ١٦,٥٪ بروتين فى حالة وجود الديودوراس أو عدم وجوده. بالنسبة للأحماض الدهنية الطيارة زادت مع وجود اليوريا أو الديودوراس. قل مستوى الأمونيا بالأعور ومحتوى الدم من اليوريا النيتروجينى فى وجود الديودوراس خصوصاً مجموعة ١٦,٥ + ٢٪ يوريا. عموماً فإن إضافة الديودوراس نتج عنه إنخفاض الأمونيا واليوريا نيتروجين فى الدم والأعور مع وجود ٢٪ يوريا فى العليقة مما يدعو إلى القول بأن الديودوراس يمكنه أن يحسن من استفادة الأرانب من العلائق المحتوية على نسبة من اليوريا كمصدر للبروتين.