PHYSIOLOGICAL EFFECTS OF USING DE-ODORASE WITH DIFFERENT LEVELS OF CRUDE PROTEIN IN RABBIT RATIONS

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Abstract

Twenty-Four New-Zealand White rabits rabbits about 35 days of age were assigned to four groups. Treatment consisted of two levels of crude protein: high and medium. Each treatment was tested with and without Deodorase (Yucca Plant Extract: YE) at 250 mg/kg diet.

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 cecal ammonia and urea nitrogen, cecal pH and cecal volatile fatty acids. There was an increase in body weight due to protein level and Deodorase. The same trend was observed for total body gain. There was an improvement in the feed/gain ratio due to the high levels of protein and inclusion of Deodorase. There was a decrease in cecal pH due to Deodorase, but this was not significant. Cecal pH was affected by protein level. Volatile fatty acids were increased with high levels protein groups. The Deodorase groups showed decreases, although non-significant, in blood ammonia and urea nitrogen. The high protein groups showed a significant ($P<0.0001$) and non-significant increase in blood urea nitrogen and blood ammonia, respectively, compared with medium protein groups. It can be concluded that, dietary YE with high levels of protein or concentrates reduced the susceptibility to diarrhoea or enteritis problems and gave a good performance.

Key Words : Rabbits, Yucca, Nitrogen.

INTRODUCTION

Rabbits are susceptible to enteritis, especially when fed concentrates (Cheeke, 1987). Prevention of enteritis and disease control are most important factors for rabbit producers. Morrisse *et al.* (1985) have shown that, diarrhoea in rabbits is associated with a drop in the level of volatile fatty acids (VFA) in the cecum, and a subsequent increase of NH3 level, leading to a high pH and proliferation of colstridia and colibacillus bacteria. The rabbit industry needs new technology to enhance feed conversion and to protect rabbits from pathogens and enteric organisms

that compete for nutrients.

Antibiotics have provided these two benefits, however, the use of antibiotics has many disadvantages and causes some precaution and fearing among producers and customers because of poor efficiency, risk of antibioresistance and residues in the meat. This fearing is a signal that we need to seek other alternatives (to antibiotics) to promote feed efficiency.

Recently, many commercial companies are engaged in preparing and producing several forms of direct fed microbial (DFM's) or some plant extracts as feed additives. De-Odorase is an extract of Yucca plant. The concept of using De-Odorase (glucoproteins) to reduce ammonia and other noxious gases in animal housing has been well studied (Pauzenga, 1991 and Al-Bar *et al.*, (1992). Current research by Ismail *et al.* (1996 a,b) indicates that, De-Odorase has ammonia binding properties in cecum, and thereby, reduces cecal pH, stimulates growth, improves feed efficiency, increases cecal VFA and modifies blood and cecal ammonia and urea nitrogen concentrations in rabbits. According to previous results, it is possible to use concentrates in rabbit feeding without any diarrhoea or enteritis problems.

Since the prices of yellow corn and soybean meals are less expensive in the U.S.A. than diets based on alfalfa meal, it will be advantageous for rabbit growers to utilize these feed sources (Luick *et al.*, 1992).

The objective of this work was to study the effects of using two levels of protein (high, 22% CP) and medium (19% CP) in rabbit diets each with and without De-Odorase as feed additives on growth performance and some physiological changes in blood constituents and cecal content.

MATERIALS AND METHODS

Twenty-four New-Zealand White rabbits about 5 weeks of age and 650g average body weight were randomly assigned to four 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. High dietary crude protein with Deodorase and Deodorae-free (HPD and HPDF, respectively).
2. Medium dietary crude protein with Deodorase and Deodorase-free (MPD and MPDF, respectivley).

The experimental diets were prepared at Oregon State University (OSU), Laboratory Animal Research. Ingredient and chemical composition of the diets are shown in Table 1. Feed and water were offered ad *libitum*. Body weight and feed intake were recorded weekly. By the end of the experimental period, all six animals belonging to each group were sacrificed to measure blood and cecal ammonia and urea nitrogen, cecal pH and cecal VFA. Blood and cecal ammonia were determined by diagnostic kits (Sigma; quantitative, enzymatic determination) and measured spectrophotometrically at 340 nm. Blood and cecal urea nitrogen were assayed by quantitative, colorimetric method (Sigma kits) and measured spectrophotometrically at 340 nm. Blood and cecal urea nitrogen were assayed by quantitative, colorimetric method (Sigma kits) and measured spectrophotometrically at 525 nm. VFA were 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.

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

Ingredient	High CP	Medium CP
Alfalfa meal	54	54
Soybean meal	21	10
Ground corn	-	11
Wheat mill run	20	20
Vegetable oil	1.25	1.25
Molasses	3.00	3.00
* TM salt	0.25	0.25
Dicalcium phosphate	0.25	0.25
** Vitamin	0.25	0.25

Analysis of feed samples fed to rabbits (% kg)

	High Protein	High Protein + De - Odorase	Medium Protein	Medium Protein + De - Odorase
Dry matter	90.16	90.35	90.28	90.15
Crude protein	23.41	22.41	18.78	19.09
Average	8.73	9.02	8.56	8.37

* Each Kg minerals contained: Choline chloride 240 mg, Mn, 1700 mg, Zn 1400 mg, Fe 1500 mg, Cu 600 mg, Se mg, I 40 mg and Mg 800 mg.

** Each Kg vitamin contained: Vit. A 2,000,000 IU, E 10,000 mg, D3 180,000 IU, K3 400 mg, B1 400, B2 1200 mg, B6 400 mg, B12 2 mg, Pantothenic acid 400 mg, Niacin 1000 mg, Folic acid 1000 mg, Biotin 40 mg.

RESULTS AND DISCUSSION

Growth performance

Live body weight (LBW) and body weight gain (BWG) of rabbits fed the experimental diets are summarized in Table 2. Results indicated no significant difference in LBW or BWG between the two groups of rabbits which received diets con

Table 2. Means ± SE for final body weight, total feed intake, total gain and feed conversion.

Final body weight (g)	High	Medium	Average
Without De-Odorase	1112.00±10.90	1118.83±16.50	1115.42
With De-Odorase	1259.83±17.70	1139.17±13.70	1199.50
Average	1185.92	1129.00	
%	13.20	1.90	
Total body weight gain			
Without De-Odorase	436.67±	450.00±	443.34 ±
With De-Odorase	573.00±	491.00±	532.00 ±
Average	504.84±	470.50±	
%	19.9	9.10	
Total feed intake			
Without De-Odorase	1445.00±27.29	1546.83±18.39	1495.92
With De-Odorase	1484.29±27.20	1561.62±21.29	1523.09
Average	1464.75	1554.25	
Feed conversion (Feed/gain ratio)			
Without De-Odorase	3.31		3.37
With De-Odorase	2.59	3.44	2.86
Average	2.90	3.18	
%	14.20	3.31	10.70

taining high or medium level of protein. Rabbits fed diets supplemented with De-Odorase showed a numerically increase in LBW and BWG; the differences were insignificant. The groups of rabbits received diets containing high or medium level of protein and supplemented with De-Odorase increased in BWG by 19.9% and 9.0%, respectively. Feed intake was increased in all De-Odorases - supplemented groups compared to De-Odorase-free groups, but, these increases were not significant. The interactions between De-Odorase and protein levels were not significant. In general,

De-Odorase improved feed intake regardless of protein level. Average feed intake for the De-Odorase groups were 1523.1 vs. 1495.9 for De-Odorase free groups. This indicates, that, De-Odorase supplementation may have the greatest potential in the diet, irrespective of protein level. Similarly, the same trend was observed in the feed conversion, where, the protein level and De-Odorase clearly increased body gain, feed intake and improved feed gain ratio. The greatest improvement in feed/gain ratio due to De-Odorase was with the high level of protein, where, the value improved from 3.31 in HPDF group to 2.59 in HPD group followed by the MPD 3.18 vs. 3.33 in MPDF group. Regardless of protein levels, De-Odorase improved the feed/gain ratio from 3.37 to 2.86. The results of the current study generally support the findings of Hollister *et al.*, (1989); Hollister *et al.*, (1990); Al-Bar *et al.*, (1992) and El-Maghawary *et al.*, (1993) who found that, using probiotic in the feed during 5-12 weeks of age improved the final body weight by about 9.6% and weight gain by about 15.4%.

Cecal parameters

Results presented in Table 3 revealed that, De-Odorase supplementation to diet containing high protein level resulted in reduceing acetate and butrate and in

Table 3. Means ± SE for acetate, propionate, butyrate and total VFA.

VFA (mU/Kg)	High protein	Medium protein	Average
Acetate			
Without D	80.17±8.12	60.17±8.12	70.17±8.00
With D	64.73±7.10	61.20±9.23	62.97±8.76
Average	72.45±6.65	60.69±7.77	
Propionate			
Without D	4.44±0.65	3.26±0.88	3.85±0.56
With D	5.22±0.77	3.43±0.34	4.33±0.34
Average	4.83±0.87	3.35±0.21	
Butyrate			
Without D	14.16±1.05	12.00±1.23	13.08±1.90
With D	12.85±2.14	13.05±1.50	12.95±1.68
Average	13.51±0.99	12.35±1.89	
Total VFA			
Without D	98.77±8.21	75.43±7.21	87.10±7.99
With D	82.80±9.33	77.68±6.44	80.24±8.13
Average	90.79±7.13	76.56±6.55	

D = De-Odorase

some increase in propionate, with subsequent decreased total volatile fatty acids (VFA's). On the other hand, the De-Odorase supplementation to diet containing medium protein level resulted in increasing acetate, propionate, butrate and subsequently, total VFA's. Values for total VFA's were 90.79 and 76.56 for the high and medium protein groups, respectively. It seems that, the protein level, source and dietary composition were more effective in VFA production compared to De-Odorase.

Means ± SE for cecal pH, ammonia and urea nitrogen are shown in Table 4. Results indicated that, lower pH was observed with groups that received diets supplemented with De-Odorase compared to the De-Odorase free groups. There was no significant difference between groups that received diets containing high or medium protein level. This result is in agreement with Ismail *et al.* (1996) who reported that De-Odorase decreased cecal pH. Also, the high level of protein seemed to be more effective in decreasing cecal pH (5.94) more than De-Odorase (6.06), and this may be due to the increasing level of total VFA, subsequent pH decrease, where, the total VFA for high protein level groups were 90.79 vs. 76.56 for medium protein groups.

The effects of De-Odorase and protein level on cecal ammonia were insignificant. Regardless of level of protein, there was an increase in cecal ammonia in De-Odorase groups compared to the De-Odorase-free groups, where, values were 30.80 and 29.75, respectively. According to previous works, De-Odorase combines with ammonia in the cecum. This effect was more pronounced with group that received HPD compared to the HPDF groups, where, values were 32.9 vs. 30.95. The protein level seemed to be effective in increasing cecal ammonia, where HP recorded 31.93 vs. 28.63 for MP.

The effect of De-Odorase with HP and MP on cecal urea-N were contradicting, where, De-Odorase increased cecal urea-N in the HPD groups as compared to the HPDF group (16.22 vs. 15.53), while, it decreased cecal urea-N with MPDF group compared to the MPD group (15.04 vs. 15.61); the differences were insignificant.

Blood parameters

Blood ammonia and urea-N data are presented in Table 4. There were no significant differences in blood ammonia between the De-Odorase-free and De-Odorase groups. Groups of rabbits that received medium protein diet and supplemented with De-Odorase decreased blood ammonia from 6.09 to 5.12, while, with HP the blood ammonia increased to 6.76 in HPD group compared to 6.14 in the HPDF group.

Concerning blood urea-N, results showed that, values were high in HP and low with MP (28.56 vs. 21.42) irrespective of the De-Odorase supplementation; the differences were significant. De-Odorase decreased blood urea-N with high and medium protein levels; the differences were insignificant and more pronounced with MP compared to HP. The level and source of protein seem to have a great effect on blood urea nitrogen.

With high and medium protein diets, dietary YE had little effect on blood and cecal NH3 and urea N values. Cecal and blood NH3 and urea N increased with increasing dietary protein level. There were no consistent trends in VFA with Yucca Plant Extract (YE). Total VFA production increased with increasing dietary prtein level. Overall, the results of the experiment suggest that, YE may improve nitrogen utilization in rabbits, particularly when high protein diets are fed.

Table 4. Means ± SE for blood and cecal urea nitrogen and ammonia and cecal pH.

Item	High protein	Medium protein	Average
Cecal urea-N			
Without D	15.53±0.12	15.61±0.12	15.57±0.12
With D	16.22±0.12	15.04±0.12	15.63±0.12
Average	15.87±0.12	15.32±0.12	
Cecal NH3			
Without D	30.95±4.04	28.55±7.84	29.75±0.05
With D	32.90±1.42	28.70±3.27	30.80±0.05
Average	31.93±3.01	28.63±5.76	
Cecal pH			
Without D	5.96±0.05	6.22±0.05	6.09±0.05
With D	5.91±0.05	6.20±0.05	6.06±0.05
Average	5.94±0.05	6.21±0.05	
Blood NH3			
Without D	6.14±21	6.09±0.21	6.12±0.21
With D	6.76±021	5.12±0.21	5.91±0.21
Average	6.45±021	5.61±0.21	
Blood urea N			
Without D	29.12±5.41	22.2±4.25	25.68±4.05
With D	28.03±1.67	20.60±3.24	24.32±3.33
Average	28.56±3.34a	21.42±3.97b	

a differs from b ($P<0.002$)
D = De-Odorase

REFERENCES

1. Al-Bar, A., P.R. Cheeke and H.S. Nakaue. 1992. Effect of Yucca extract De-Odorase on environmental levels and growth performance of rabbits. Proc., 5th World Rabbit Congress.
2. Cheeke, P.R. 1987. Rabbit Feeding and Nutrition. Academic Press, Orlando.
3. El-Maghawry, A.M., M.I. Tawfeek and A.A. Habeeb. 1993. Growth, liver and kidney functions and carcass traits of rabbits as affected by supplementation with Bospro under conditions of Egypt. Egypt. J. Rab. Sci., 3 (1): 1-11.
4. Hollister, A.G., P.R. Cheeke, K.L. Robinson and N.M. Patton. 1989. Effects of water-administrated and acidifiers on growth, feed conversion and enteritis metability of weanling rabbits. J. Appl. Rab. Res., 12: 143-147.
5. Hollister, A.G., P.R. Cheeke, K.L. Robinson and N.M. Patton. 1990. Effects of dietary probiotics and acidifiers on performance of weanling rabbits. J. Appl. Res., 13: 6-9.
6. Ismail, A.M., K.M.Mansour, and P.R. Cheeke. 1996. Evaluation of some probiotic growth promoters on rabbit performance. Ann. Agric. Sci., Sp. Issue, 71-79.
7. Ismail, A.M., K.M. Mansour, S.M. Siam, A.G. Abdallah and S.Abou El-Wafa. 1996. Effect of De-Odorase and Lacto-Sac administration on rabbit performance and some blood constitutuents. Ann. Agric. Sci., Sp. Issue: 81-89.
8. Luick, B.R., G.A. El-Sayaad and P.R. Cheeke. 1992. Effect of fructooligosaccharides and yeast culture on growth performance of rabbits. J. Appl. Rab. Res., 15: 1129-1136.
9. Morrisse, J.P., E. Boilletote and R. Maurice. 1985. Alimentation et modification du milieu intestinal de lapin (AGV, NH3, pH, Flore). Rec. Med. Vet., 161 (5).
10. Pauzenga, U. 1991. Animal production in the 90's. In harmony with nature. A case study in the Netherlands. In: Biotechnology in the Feed Industry. Proc. Alltech's 7th Annual Symposium. Alltech Technical publications. Nicholasville, KY. pp. 121-132.
11. SAS Institute, In. 1990. SAS/STAT Guide for Personal Computers. Versi.

التأثيرات الفسيولوجية لإستخدام الديودوراس مع مستويات مختلفة من البروتين فى علائق الأرانب

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أجريت هذه الدراسة على ٢٤ من الأرانب النيوزيلندى الأبيض والبالغة من العمر ٣٥ يوما. وتكونت المعاملات من مستويين من البروتين ٢٢٪ و ١٩٪. وأختبر كل مستوى فى وجود مادة الديودوراس من عدمها عند مستوى ٢٥٠ ملليجرام/كجم عليقة. تم تسجيل وزن الجسم والمستهلك من الغذاء أسبوعيا. مع نهاية التجربة تم ذبح جميع الحيوانات لجمع الدم ومحتويات الأعور لتقدير الأمونيا واليوريا. وكانت النتائج المتحصل عليها كمايلى:

بالنسبة للوزن الحى وكفاءة التحويل الغذائى زاد بزيادة مستوى البروتين ووجود الديودوراس فى العليقة. ولوحظ إنخفاض فى درجة الحموضة بالأعور مع وجود الديودوراس والذى تأثر أيضا بمستوى بروتين العليقة. كما زادت نسبة الأحماض الدهنية الطيارة مع المستوى العالى من البروتين. بينما كانت هناك زيادة معنوية فى محتوى الدم من النيتروجين وزيادة غير معنوية بالنسبة للأمونيا وذلك مع المستويات العالية من البروتين. ومن هنا يمكن القول بأن إستخدام الديودوراس مع المستويات العالية من البروتين قلل من يوريا الدم ودرجة حموضة الأعور وزادت درجة إرتباطه بالأمونيا فى الأعور ولم تكن هناك مشاكل معوية أو إسهالات مع المستويات العالية من البروتين أو المركزات فى علائق الأرانب.