EFFECT OF FEEDING DIETS CONTAINING YUCCA EXTRACT OR PROBIOTIC ON GROWTH, DIGESTIBILITY, NITROGEN BALANCE AND CAECAL MICROBIAL ACTIVITY OF GROWING NEW ZEALAND WHITE RABBITS

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ABSTRACT

Eighty-one growing New Zealand white rabbits 35 days-old were used to study the effect of feeding diets containing yucca extract or probiotic on growth performance, nitrogen utilization, digestibility, blood parameters, caecal microbial activity and relative revenue. Rabbits were randomly distributed into 3 groups fed three diets without supplementation (control), with 250 mg/kg yucca schidigera extract or with 0.5 gm/kg Lact-A-Bac (Probiotic) from 5 to 13 weeks of age. At the end of growth experiment, six male rabbits per treatment were used to determine the digestibility and nitrogen balance. Blood and caecal samples were taken from 6 slaughtered rabbits (13 weeks old) per diet to estimate some blood parameters and caecal microbial activity. The results showed that the yucca extract or probiotic supplementation to diets significantly ($P<0.05$) affected growth performance. Average daily gain increased ($P<0.05$) by 12.1 or 9.6% for rabbits feed diets with yucca extract or probiotic respectively, as compared to control diet. Feed conversion ratio was improved ($P<0.01$) by using treatment diets with means of 3.62 for treated and 3.87 for control rabbits. Nitrogen utilization improved ($P<0.01$) by 24.3 or 16.2% for rabbits received diets supplemented with yucca extract or probiotic, respectively, as compared with control diet. Addition of yucca extract significant increase the digestibility values of DM, CP, EE and GE by 5.4, 10.5, 6.4 and 5.0%, respectively, while efficiency of fiber utilization improved ($P<0.05$) by 13% with using probiotic. Blood and caecal urea and ammonia concentrations were reduced ($P<0.05$; $P<0.01$) by using these additives. The effect of yucca extract addition in the reducing urea and ammonia levels seems to be more effective than effect of probiotic (as average 11 and 20.1% *vs.* 7 and 11.7%, respectively). Additives containing probiotic recorded the highest ($P<0.01$; $P<0.01$) values were 93.2 , 10.3 and 42.9 x 10^5 for total count, Lactobacilli and Celluloytic bacteria, respectively, except for ureolytic bacteria, which recorded the lowest value (0.96 x 10^5). The results showed that the supplementation of yucca extract or probiotic to diets could had a positive effect on the relative revenue. It could be concluded that the dietary yucca extract or probiotic decrease urea and ammonia levels in the blood and caecal and thus may be beneficial for improving the health, by reducing ammonia emission in rabbit buildings, for both rabbits and humans working in the rabbitry.

Key word: Rabbit, yucca extract, probiotic, growth, digestibility, urea, ammonia.

INTRODUCTION

Ammonia is one of the microbial products that is known to have negative health effects in both humans and animals (COLINA *et al.*, 2001). Under intensive production, rabbits produce the greater amount of wastes. In addition any excess of dietary protein will contribute to urea formation, which may be hydrolyzed to ammonia by urease present in manure (AARNINK *et al.,* 1998). Also, ammonia concentration in the rabbitry may be high because of reduced ventilation rates in an attempt to conserve the heat in the winter. Ammonia produced from amino acids degradation in the body is converted to urea in the mammalian liver. A significant amount of the urea (20-25%) is hydrolyzed into ammonia by microbial urease in the gastrointestinal of chicks (YEO and KIM, 1997). This ammonia may be used for microbial protein synthesis or may enter the blood stream. The effects of yucca extract may be associated with the glyco-components which bind ammonia and decreasing emissions from the manure pit (COLINA *et al*., 2001). Another effect of yucca extract has been attributed to the inhibition of urease activity (DUFFY and BROOKS, 1998). Several experiments have investigated the addition of special dietary ingredients for reducing the aerial ammonia concentration. Ammonia emission has been reduced by adding yucca extract to the diet (HUSSAIN *et al.,* 1996; COLE *et al.*, 1998; CROMWELL *et al.*, 1999; SLIWINSKI *et al.*, 2002). Dietary probiotic has been found to decrease urease activity and subsequently reduce ammonia production in small intestinal contents of chicks (YEO and KIM, 1997) and of rats (KIM and KIM, 1992). The present study was conducted to evaluate the effects of dietary Yucca extract or probiotic on growth performance, digestibility, caecal microbial activity and some physiological traits of growing New Zealand White rabbits.

MATERIALS AND METHODS

The present study was carried out in the Rabbitry farm of Poultry Production Department, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, during winter 2003. A control barley-based diet was formulated to meet or exceed the nutrient requirements of growing rabbits according to de DE BLAS (1986). Ingredients and chemical composition are shown in Table 1. Two dietary treatments (yucca or probiotic) were made by adding 250 mg/kg yucca schidigera extract or 0.5 mg/kg Lact-A-Bac (dried *Lactobacillus acidophilus* 0.8 billion CFU/g) to control diet.

Eighty-one New Zealand white rabbits of 35 day old were individually housed and assigned at random to 3 groups of 27 rabbits each. Feed and water were offered *ad libitum* throughout the experimental period. Each group was fed one of experimental diets from 5 to 13 weeks of age. Live body weight and feed intake were recorded. Performance index (PI) was calculated as: live body weight (kg) x 100 / feed conversion ratio. Digestibility and nitrogen balance were carried out, at the end of the growth experiment, using 6 males per treatment to determine the nutrient digestibility coefficients of dietary treatments. Rabbits were housed individually in metabolic cages allowed separation of faeces and urine. The faeces and urine were collected individually during 5 consecutive days according to European reference method for rabbit digestion

trials (Perez *et al.*, 1995). Chemical analysis was carried out for diets, faeces and urine according to methods of AOAC (1995) for ash, CP, CF, DM and EE. Gross energy was determined using an adiabatic bomb calorimeter.

Table 1: Ingredients and chemical composition of the experimental diet.

Ingredients	%	Chemical analysis	(% as DM)
Barley	30	Ash	10.5
Berseem hay	29	Crude protein (CP)	18.5
Soybean meal	23	Crude fiber (CF)	12.5
Wheat bran	14.5	Ether extract (EE)	2.46
Limestone	1.8	N-free extract (NFE)	56.04
Bone meal	1.0	Digestible energy, Kcal/g (DE)	2.63
Salt	0.2	Calcium [2]	1.10
Premix [1]	0.3	Phosphorus [2]	0.59
DL – methionine	0.2	Lysine [2]	0.97
Total	100	Methionine [2]	0.57

1- Each 3 Kg vitamin and mineral mixture provides : Vitamin A 12000000 IU, Vit.D3 2200000 IU, Vit. E 10000 mg, Vit.K,2000 mg, Vit.$B_1$1000mg, Vit.$B_2$4000mg, Vit.$B_6$1500mg, Vit.B_{12}10mg, Pantothenic Acid 10000mg, Niacin 20000mg, Biotin 50 mg, Folic Acid 1000mg, Choline chloride 500gm, Selenium 100mg, Manganese 55000mg, Zinc 50000mg, Iodine 1000 mg and carrier CaCo3, to 3000 gm.
2- Calculated

Blood samples were taken from 6 male rabbits of each diet to determine urea and ammonia by using commercial kits and colorimetrically methods, following the same steps as described by manufactures. The microbial content of the caecum of same slaughtered rabbits (6 rabbits/diet) was estimated in their selective media, as described by BRYANT and ROBINSON (1961) for total microbial count, HUNGATE (1957) for cellulolytic bacteria, DIFCO (1971) for rueolytic bacteria and DE MAN and SHARPE (1960) for lactobacilli. Technique of colony forming unit (CFU) was adopted. Incubation took place at 30° C - for 2-7 days. Data of growth experiment, digestibility, nitrogen balance, caecal microbial count and blood were statistically analyzed for the effect of dietary treatments using the general linear Model Program of SAS (1990). Duncan's multiple range test was performed (DUNCAN, 1955) to detect significant differences among means.

RESULTS AND DISCUSSION

Growth performance

Final body weight, average daily gain and performance index were significantly ($p<0.05$) increased by 7.99, 12.1 and 15.8%, respectively, in the Yucca extract diet, while in the probiotic diet increased ($P<0.05$) by 6.67, 9.57 and 14.1%, respectively, as compared to control diet (Table 2). There was no significant difference in feed intake among rabbits fed the three diets. While, feed conversion ratio was significantly ($P<0.01$) improved by adding the yucca extract or probiotic in the diets with means of 3.615 for treated and 3.865 for control rabbits. The growth performance values were slightly higher for rabbits

received diet containing yucca extract than those fed diet with probiotic, but these differences were not significant. The benefits have generally been attributed to improvements in health status of the rabbits. Suppressing urease activity and ammonia production can be beneficial for improving animal health and enhancing growth performance, as shown in the Table 2, because ammonia produced by ureolysis in the intestinal mucosa can excrete a significant damage to the surface cells and urease has been known to play an essential role in pathogenesis of gastritis induced by Helicobacter Pylori (YEO and KIM, 1997).

Table 2: Effect of dietary yucca extract or probiotic on growth performance of growing NZW rabbits.

	Control	Yucca extract	Probiotic	SEM	Sig.
Initial body weight (g)	623	609	619	34.5	NS
Final body weight (g)	2202[b]	2378[a]	2349[a]	57.9	*
Average daily gain (g/d)	28.2[b]	31.6[a]	30.9[a]	0.86	*
Feed intake (g/d)	109	114	112	12.6	NS
Feed / Gain (g/g)	3.87[b]	3.61[a]	3.62[a]	0.092	**
Performance index (%)	56.9[b]	65.9[a]	64.9[a]	3.22	*
Number of dead rabbits	1	1	1		

[a, b] Values within a raw with different superscript are significantly (P<0.05) different .
*= P<0.05, **= P<0.01, NS= not significant, SEM = standard error of means, Sig. = significant .

Mortality was low in the three diets. One rabbit died from each diet and diarrhoea disease was the cause. These results are in agreement with those observed by many authors (JOHNSTON *et al.*, 1982; HUSSAIN *et al.*, 1996; YEO and KIM 1997; DUFFY and BROOKS, 1998 and COLE *et al.*, 1998) who reported positive effects on growth performance when yucca extract or probiotic were added to chick, rabbit and pig diets. In contrast, MOREL (1997), VAN DEN BERGHEL *et al.* (2000) and COLINA *et al.*, (2001) found that yucca extract addition to diets did not affect growth performance of nursery pigs.

Nitrogen utilization

Although all groups were positive in the nitrogen balance, the rabbits fed control diet retained less nitrogen (P<0.01) than those received other dietary treatments (Table 3).

Nitrogen balance as % of N-intake improved (P<0.01) by 24.3 and 16.2% for rabbits kept on diets containing yucca extract and probiotic, respectively, as compared to control diet. The improvement of nitrogen utilization may be due not only to decrease ammonia concentrations in faeces and urine, as a result to bind ammonia by yucca saponin (SLIWINSKI *et al.*, 2002), but also to reduce urease activity in the gastrointestinal tract by dietary probiotics (YEO and KIM, 1997; DUFFY and BROOKS, 1998).

Table 3: Effect of dietary yucca extract or probiotic on nitrogen utilization of growing NZW rabbits.

	Control	Yucca extract	Probiotic	SEM	Sig.
No. of rabbits	6	6	6		
N- intake (g/d)	2.423[c]	2.682[a]	2.597[b]	0.039	**
Fecal – N (g/d)	0.867[a]	0.809[b]	0.823[a]	0.045	*
Urinary – N (g/d)	0.538[a]	0.472[c]	0.506[b]	0.027	**
N – absorbed (g/d)	1.556[c]	1.873[a]	1.774[b]	0.036	**
N – balance (NB; g/d)	1.018[c]	1.401[a]	1.268[b]	0.023	**
NB as % of N-intake	42.01[c]	52.24[a]	48.83[b]	2.95	**

a , b , c Values within a raw with different superscript are significantly (p<0.05) different.
* = p<0.05, ** = p<0.01, SEM = standard error of means, sig. = significant.

Digestibility coefficients

Yucca saponins cannot be absorbed across the epithelial membrane of the digestive tract (MOREL, 1997) therefore they must be influencing digestion within the lumen of the digestive tract by their surfactant properties. Data in Table 4 indicated that yucca extract or probiotic addition significantly improved all the digestibility coefficients and nutritive values. The digestibility of DM, CP, EE and GE were increased (P<0.01) by 5.4, 16.6 and 5%, respectively, while CF digestibility decreased (P<0.01) by 4.12% for rabbits fed diet supplemented with yucca extract as compared with control diet. The increase in nutrients digestibility may be due to reducing the surface tension of cell membranes which could aid in better absorption of nutrients across the cell membranes (JOHNSTON *et al.*, 1982), but the decrease in the CF digestibility may be due to inhibit growth of cellulolytic caecal bacteria (WANG *et al.*, 2000).

Table 4: Effect of dietary treatments on digestibility coefficients and nutritive values .

Nutrient	Control	Yucca extract	Probiotic	SEM	Sig.
Digestibility (%):					
DM	66.6 [c]	70.2 [a]	68.3 [ab]	0.84	*
CP	65.5 [b]	76.4 [a]	72.7 [a]	0.62	**
CF	26.7 [b]	25.6 [b]	30.4 [a]	1.12	*
EE	76.6 [c]	81.5 [a]	79.8 [b]	0.96	**
GE	62.3 [c]	65.4 [a]	63.6 [b]	0.39	**
Nutritive value (%):					
DCP	12.11 [c]	13.39 [a]	12.89 [b]	0.06	**
DE (Kcal/g DM)	2.63 [bc]	2.76 [a]	2.68 [b]	0.04	**
TDN	55.9 [b]	57.8 [a]	56.2 [b]	0.75	*

a , b , c values within a row with different superscript are significantly (p<0.05) different.

Apparent digestibility of CF was improved (p<0.05) by 13% for rabbits received diet containing probiotic as compared with control diet, due to increase the number of

cellulolytic bacteria as a result to enhancing lactate utilization and moderating pH of the media (DAWSON, 1987).

Blood and caecal Parameters and caecal bacteria count

The supplementation of yucca extract or probiotic had significant effect on the urea and ammonia concentrations in the blood and caecal contents (Table 5). Plasma urea and ammonia concentrations were reduced (P<0.05) by 11.25 and 25.16%, respectively, for rabbits fed diet with yucca extract. While, decreased (P<0.05) by 6.95 and 14.54%, respectively, for those received diet contained probiotic as compared with control diet. The same trend was found for caecal urea and ammonia, but caecal pH showed insignificant differences among the dietary treatments. Caecal urea and ammonia concentrations were decreased (P<0.01 *vs.* P<0.05) by 10.7 and 14.9%, respectively, for rabbits fed with yucca extract. While, reduced (P<0.01 *vs.* P<0.05) by 6.9 and 8.8%, respectively, for those kept on diet contained probiotic as compared with control diet.

Table 5: Effect of dietary yucca extract or probiotic on blood and caecal parameters of growing NZW rabbits.

	Control	Yucca extract	Probiotic	SEM	Sig.
Blood parameters:					
Urea – N (mg /dl)	30.2^{a}	28.8^{c}	28.1^{b}	1.15	*
Ammonia-N (mmol/l)	6.12^{a}	4.58^{bc}	5.23^{b}	0.49	*
Caecal parameters :					
Urea – N (mg/dl)	15.9^{a}	14.2^{c}	14.8^{b}	0.11	**
Ammonia – N (mmol/l)	18.1^{a}	15.4^{c}	16.5^{b}	0.62	*
PH	6.22	6.19	6.84	0.99	NS
Caecal bacteria count(x 10^{5} $CFUml^{-1}$):					
Total microbial count	9.95^{b}	10.38^{b}	93.19^{a}	4.67	***
Ureolytic bacteria	2.12^{a}	2.19^{a}	0.96^{b}	0.29	**
Celluloytic bacteria	3.01^{b}	1.82^{c}	10.32^{a}	0.96	*
Lactobacilli	2.83^{b}	3.11^{b}	42.94^{a}	1.12	**

a, b, c Values within a row with different superscript are significantly (p<0.05)different.

The effect of yucca extract addition in reducing urea and ammonia levels in the blood and caecal contents, via binding ammonia by glyco-components (COLINA *et al.*, 2001), seems to be more effective than the effect of probiotic, which reduces or inhibits the urease activity (KIM and KIM, 1992). Reduction of plasma and caecal urea and ammonia concentrations due to supplemental dietary yucca extract has been reported in rats (DUFFY and BROOKS, 1998), poultry (BALOG *et al.*, 1994), rabbits (HUSSAIN *et al.*, 1996; AL-BAR and AL-AGHBARI, 1996) and steers (HUSSAIN and CHEEKE, 1995). However, LOWE and KERSHAW (1997) observed that blood urea significantly increased in the cats fed diets with yucca extract. They suggested that this may be possibly due to the saponins of yucca extract affecting gut wall permeability.

AS shown in Table 5, total microbial count, *Lactobacilli* and cellulolytic bacteria were significantly increased by adding dietary probiotic, but yucca extract supplementation did not effect except for cellulolytic bacteria, which decreased (P<0.05) by 39.5% due to inhibit the growth of bacteria (WANG *et al.*, 2000). These results are in agreement with observed by KAISTHA *et al.*, (1996) who found that total microbial count and the ratio of Gram-Positive to Gram-Negative microbes were significantly increased for the broilers fed on diets mixed with *Lactobacillus acidophilus* or *Streptococcus*. Ureolytic bacteria was decreased (P<0.01) by 54.7% for rabbits fed diet with probiotic. This may be due to suppress the growth of bacteria as a result to moderate pH of the media (DAWSON, 1987 and YEO and KIM, 1997).

Relative revenue

Data in Table 6 show that the total feeding cost increased by 11.6 and 7.5% with adding yucca extract and probiotic to diets, respectively, as compared with control diet. However, selling price of total meat yield increased by 11.9 and 9.5% in the yucca extract and probiotic diets respectively. The results showed that the feed additives had a positive effect on the relative revenue.

Table 6: Effect of experimental diets on relative revenue of growing NZW rabbits at 13 weeks of age

	Control	Yucca extract	Probiotic
Price / kg diet (L.E.)	0.92	0.98	0.96
Feed intake (kg/ rabbit)	6.104	6.384	6.272
Total feed intake (kg)	158.7	165.98	163.07
Total feed cost (L.E.)	146	163	157
Selling price * (L.E.)	370	414	405
Net revenue ** (L.E.)	224	251	248
Relative revenue	100	112.1	110.7

* Selling price of 1 kg = 9 L.E.

** Net revenue = selling of total meat yield – total feed cost.

CONCLUSIONS

Conclusively, it could be concluded that yucca extract and probiotic supplementation to diets improved the nitrogen utilization, digestibility and enhanced the growth. In addation, reducing blood and caecal urea and ammonia, which could led to improve rabbit health via decreasing aerial ammonia concentrations in the rabbitry. From economic point, feed additives can be used profitable in growing rabbit diets without affecting growth performance or net revenue.

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