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The Effects of Different Levels of *Yucca schidigera* Added to the Lamb's Diets Containing Urea on Growth Performance, Carcass Characteristics, Some Rumen and Blood Parameters

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Abstract: The aim of this study was to determine the effects of *Yucca schidigera* extract added to lambs concentrate feeds containing urea on growth performance, carcass characteristics, some rumen and blood parameters. Forty-eight Merino male lambs were divided to one control and three treatment groups each consisting of three replicates of four lambs. *Yucca schidigera* extract was added to the concentrate feeds of control and treatment groups at the levels of 0, 200, 300 and 400 ppm, respectively. At the end of the study, rumen urea nitrogen levels of the lambs in treatment group 3 were higher ($p<0.05$) than those of control and treatment group 1. Blood urea nitrogen levels of the lambs in the treatment group 2 and 3 were lower ($p<0.01$) than those of the control and treatment group 1. There were no statistically differences in warm and cold carcass weights, carcass yields and percentages of carcass meat, fat and bone of lambs in the control and treatment groups.

Key words: Blood metabolites, carcass characteristic, lamb, performance, rumen metabolites, *Yucca schidigera* extract

INTRODUCTION

Microbial activity in rumen is necessary for high quality protein synthesis and the utilization of the structural carbohydrates in ruminants. A large portion of dietary protein is hydrolyzed by proteolytic rumen bacteria to polypeptides, peptides and amino acids. The nitrogen that was in amino acid form is converted to ammonia. Non protein nitrogen sources in the diet are also converted to ammonia. Although, the free ammonia and carbon chains are utilized by bacteria to synthesize microbial protein (Ensminger *et al*., 1990), a considerable energy and protein losses (such as methane, ammonia nitrogen) can occur in rumen microbial fermentation.

Some feed additives, as ionophore antibiotics have positive effects on improving the nutrient efficiency because of reducing the total amount of methane or ammonia nitrogen production in rumen. However, use of antibiotics as a feed additive in animal feeds has been forbidden due to the possibility of antibiotic residue in milk and meat and its harmful effects on human health. Because of this reason, alternative feed additives such as plant extracts and probiotics have been investigated intensively for a replacement of antibiotics in animal feeds for improving of performance.

Yucca schidigera extract is prepared by drying and pulverizing of *Yucca schidigera* plant. Recently, the extract has been used in ruminant diets as a feed additive (Cheeke, 1997; Santoso *et al*., 2004). The effect of *Yucca schidigera* extract is based on its steroidal saponin content mainly sarsaponin (Goetsch and Owens, 1985). Reports of sarsaponin effects on nitrogen metabolism in rumen have been vague. Goetsch and Owens (1985) stated that an increase and Ellenberger *et al*. (1985) and Valdez *et al*. (1986) mentioned that a decrease in feed nitrogen degradation in rumen. However, some researchers (Gibson *et al*., 1985; Van Nevel and Demeyer, 1990) noted that little or no effect.

The study was carried out to determine the effect of different levels of *Yucca schidigera* extract added to the lambs diets containing urea on growth performance, carcass characteristics, some rumen and blood parameters.

MATERIALS AND METHODS

Animals, experimental design and feeding: A total of 48, the Middle Anatolian Merino single-born male lambs

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(two-two and half months of age), raised at the Training, Research and Practice Farm of Faculty of Veterinary Medicine of Ankara University, Ankara, Turkey, were used in the study. The animals were randomly divided into 4 groups. Each group contained 12 lambs. The experiment was conducted with one control and three treatment groups each consisting of three replicates of four lambs (sub-groups). The experiment lasted 84 days as 14 days for adaptation and 70 days for experimental period. The one lamb both in treatment 1 and 3 were discarded from the experiment due to palate and chin anomalies. Diets for all groups were prepared to meet nutrients and energy requirements of lambs according to NRC (1985). The concentrate contained 1.5% urea for control and treatment groups. *Yucca schidigera* extract (DK 35-powder) was added to the concentrate for control, treatment group 1, 2 and 3 at the levels of 0, 200, 300 and 400 ppm, respectively. All lambs were allowed to drink water freely and fed as *ad libitum*. The diets had 85% concentrate and 15% alfalfa hay. The concentrate consisted of barley (35.80%), wheat (34%), wheat bran (15%), sunflower meal (10.08%), limestone (1.77%), dicalcium phosphate (0.5%), salt (1%), urea (1.5%), vitamin premix (0.1%) and mineral premix (0.25%). The amount of nutrients in concentrate and alfalfa hay was determined according to the methods described by AOAC (1984), while the level of Metabolizable Energy (ME) in concentrate and alfalfa hay was determined according to the methods described in TSI (1991). The concentrate contained 92.27% dry matter, 16.35% crude protein, 7.69% crude fiber, 1.79% crude fat, 5.82% crude ash and 11.16 MJ ME kg^{-1}. The alfalfa hay contained 91.70% dry matter, 15.60% crude protein, 24.98% crude fiber, 1.23% crude fat, 10.32% crude ash and 8.43 MJ ME kg^{-1}.

Growth performance: At the beginning and during the experimental period, all lambs were weighed individually on two consecutive days before morning feeding and their average live weights were recorded every two weeks. Daily live weight gains were calculated by the differences among weeks. Feed intake and feed conversion ratio were recorded for each replicate (sub-groups) biweekly.

Rumen fluids and blood samples: Rumen fluids and blood samples were taken at 4 h after morning feeding at the initial, middle and end of the experimental period. Ruminal pH was determined immediately in rumen fluids after taking the samples. Ammonia nitrogen and total volatile fatty acids in rumen fluids were determined by using of Markham steam distillation method (Markham, 1942). Urea nitrogen concentrations in rumen fluids were analysed according to Henry (1965). Blood ammonia nitrogen and blood urea nitrogen levels were determined according to Clinical Laboratory (1974) and Henry (1965), respectively.

Slaughtering and carcass characteristics: The lambs were starved for 12 h prior to slaughtering and individual live weights determined and then slaughtered at the end of the study.

After slaughtering, carcasses were weighed immediately to determine warm carcass weights and then the carcasses were chilled at 4°C for 24 h and then weighed. A total of four carcasses in each group were divided to rump, arm, loin, back and others according to described by Akcapinar (1981). Tail, kidney and pelvic fat were recorded for each part of the carcasses.

Meat, bone and fat separations were carried out to determine the carcass quality and composition. Meat, bone and fat were weighed and recorded. This process was carried out using the left parts of the carcasses then these findings were multiplied by 2 in order to determine the meat, bone and fat percentages of the carcasses and their weights.

Statistical analysis: A one-way analysis of variance model was used to determine differences among groups metodu (Snedecor and Cochran, 1980). The significance of differences among means was compared by the Duncan (1955)'s multiple range test.

RESULTS AND DISCUSSION

During the experimental period average live weights of the lambs and average daily live weight gains, average daily feed intakes and feed conversation ratios were presented in Table 1 and 2, respectively. At the end of the study, there were no differences for rumen pH, ruminal ammonia nitrogen and total volatile fatty acids levels among groups in the study.

However, rumen urea nitrogen level in treatment group 3 had higher ($p<0.05$) than that of control and treatment group 1 (Table 3). At the end of the experimental period, blood ammonia nitrogen and blood urea nitrogen levels were shown in Table 4.

Although, blood ammonia nitrogen levels were similar for control and treatment groups, there were differences ($p<0.05$) in blood urea nitrogen levels among groups. At the end of the present study, blood urea nitrogen level of lambs in treatment group 2 and 3 had lower ($p<0.01$) than those of lambs in control and treatment group 1. There were no differences in slaughtering and carcass characteristics among groups (Table 5).

Feeding the diet, containing *Yucca schidigera* extract, to the lambs did not affect the weights of the parts of the

carcasses, the rates of the parts of the carcasses (Table 6) and the meat, fat and bone weights of the parts of carcasses (Table 7) in groups. There is no certain

Table 1: Average live weights of groups during experimental period (kg)

Experimental		Control	Treatment group 1		Treatment group 2		Treatment group 3	
periods	n	$\bar{X}\pm S\bar{X}$	n	$\bar{X}\pm S\bar{X}$	n	$\bar{X}\pm S\bar{X}$	n	$\bar{X}\pm S\bar{X}$
ILW	12	21.24±1.02	12	21.69±0.72	12	20.87±1.03	12	21.15±0.85
14 days	12	25.23±1.06	12	25.90±0.88	12	25.45±1.13	12	25.57±1.17
28 days	12	29.12±1.17	11	30.16±0.93	12	29.32±1.09	11	29.61±0.81
42 days	12	33.27±1.29	11	34.05±0.90	12	33.04±1.20	11	33.65±1.00
56 days	12	36.53±1.32	11	36.97±1.11	12	36.88±0.97	11	37.00±0.93
70 days	12	40.49±1.42	11	39.99±1.17	12	39.79±0.95	11	39.97±1.18

p>0.05, ILW: Initial Live Weight

Table 2: Average daily feed intakes, live weight gains and feed convertion ratio of groups during experimental period

	Control	Treatment groups ($\bar{X}\pm S\bar{X}$)		
Parameters	$\bar{X}\pm S\bar{X}$	1	2	3
Days 0-14				
n	12	12	12	12
ADFI (g day^{-1})	1020±0.01	1010±0.01	1120±0.10	1030±0.01
ADG (g day^{-1})	285.23±6.31	301.18±7.40	326.66±29.56	315.47±6.24
FCR	3.58±0.1	3.35±0.1	3.42±0.1	3.28±0.0
Days 15-28				
n	12	11	12	11
ADFI (g day^{-1})	1170±0.02	1220±0.04	1150±0.03	1230±0.06
ADG (g day^{-1})	277.61±13.18	309.52±36.28	276.66±19.37	294.75±28.35
FCR	4.22±0.15	4.23±0.12	4.20±0.18	4.27±0.16
Days 29-42				
ADFI (g day^{-1})	1300±0.02	1330±0.04	1300±0.03	1380±0.07
ADG (g day^{-1})	265.23±2.03	280.71±17.68	265.95±7.67	293.87±25.92
FCR	4.88±0.04	4.76±0.17	4.89±0.05	4.75±0.17
Days 43-56				
ADFI (g day^{-1})	1560±0.07	1350±0.04	1480±0.05	1430±0.07
ADG (g day^{-1})	240.47±32.60	223.33±7.33	279.75±24.23	224.99±12.54
FCR	6.70±0.86	6.05±0.04	5.35±0.29	6.11±0.29
Days 57-70				
ADFI (g day^{-1})	1630±0.06	1520±0.05	1520±0.04	1500±0.06
ADG (g day^{-1})	238.80±22.94	217.49±17.70	207.85±2.70	214.28±10.78
FCR	6.93±0.43	7.02±0.14	7.32±0.27	7.03±0.08
Total Days 0-70				
ADFI (g day^{-1})	1330±0.03	1280±0.03	1310±0.03	1310±0.05
ADG (g day^{-1})	275.04±7.35	264.04±16.99	270.23±5.76	272.23±16.70
FCR	5.26±0.22	5.08±0.10	5.03±0.05	5.08±0.14

p>0.05, ADFI: Average Daily Feed Intake, ADG: Average Daily Live Weight Gain, FCR: Feed Conversion Ratio

Table 3: Ruminal pH, ammonia nitrogen (mg L^{-1}), urea nitrogen (mg d L^{-1}) and total volatile fatty acid (mmol L^{-1}) values in groups (n = 6)

		Control	Treatment groups ($\bar{X}\pm S\bar{X}$)			
Contents	Days	$\bar{X}\pm S\bar{X}$	1	2	3	p-value
pH	0	5.74±0.05	5.70±0.05	5.85±0.08	5.68±0.08	NS
	35	5.71±0.09	5.56±0.10	5.76±0.13	5.85±0.11	NS
	70	5.72±0.02	5.58±0.05	5.61±0.09	5.51±0.10	NS
NH3-N	0	280.83±19.51	284.16±17.72	271.66±23.75	255.33±25.51	NS
	35	278.33±13.70	260.83±18.50	249.66±18.41	234.00±20.79	NS
	70	256.83±15.48	251.66±18.69	215.83±17.57	242.50±22.12	NS
Urea-N	0	11.40±0.51	10.25±0.35	11.00±0.42	12.08±0.90	NS
	35	15.98±1.31^{b}	16.37±1.17^{b}	22.57±1.78^{a}	24.15±2.66^{a}	**
	70	17.80±1.62^{b}	18.76±1.65^{b}	23.72±2.75^{ab}	25.11±1.74^{a}	*
TVFA	0	79.61±12.45	93.11±8.59	87.28±8.42	81.61±8.69	NS
	35	123.04±6.56	110.62±6.08	112.79±4.64	106.37±6.17	NS
	70	103.58±2.88	107.16±3.80	107.62±2.90	109.87±2.27	NS

There is no significantly differences for same letters in rows (p>0.05), NS, Non Significant, *p<0.05, **p<0.01, NH_3-N: Ammonia Nitrogen, Urea-N: Urea Nitrogen, TVFA: Total Volatile Fatty Acid

information on the effects of natural plant extracts on nitrogen metabolism in rumen (Van Nevel and Demeyer, 1990; Hristov *et al*., 2004). During the experimental period, average live weights of the lambs and average daily live weight gains, average daily feed intakes and feed conversation ratios were similar for control (without *Yucca schidigera* extract) and treatment group 1, 2 and 3 fed diets containing 200, 300 and 400 ppm *Yucca*

Table 4: Blood ammonia nitrogen and blood urea nitrogen levels (mg dL^{-1}) in groups (n = 6)

			Treatment groups ($\bar{X}\pm S\bar{X}$)			
Contents	Days	Control $\bar{X}\pm S\bar{X}$	1	2	3	p-value
BAN	0	1.55±0.15	1.59±0.16	1.61±0.15	1.73±0.16	NS
	35	2.40±0.09	2.24±0.13	2.37±0.10	2.10±0.20	NS
	70	2.36±0.10	2.44±0.08	2.58±0.14	2.16±0.16	NS
BUN	0	49.90±4.52	47.68±4.44	52.36±4.15	50.96±3.90	NS
	35	60.80^{a}±3.78	53.76^{ab}±2.07	55.13^{ab}±2.77	47.34^{b}±2.35	*
	70	58.15^{a}±1.57	56.41^{a}±4.12	45.55^{b}±1.96	44.66^{b}±2.08	**

NS: Non-Significant, *p<0.05,**p<0.01, BAN: Blood Ammonia Nitrogen, BUN: Blood Urea Nitrogen

Table 5: Some slaughtering and carcass characteristics in groups

		Treatment groups ($\bar{X}\pm S\bar{X}$)		
Characteristics	Control $\bar{X}\pm S\bar{X}$	1	2	3
n	12	11	12	11
Slaughtering weight (kg)	40.49±1.42	39.99±1.17	39.79±0.95	39.97±1.18
Warm carcass weight (kg)	20.08±0.83	20.14±0.66	20.00±0.61	20.11±0.67
Warm carcass yield (%)	49.37±0.53	50.16±0.70	50.26±0.66	50.29±0.71
Cold carcass weight (kg)	19.81±0.84	19.78±0.68	19.56±0.59	19.79±0.66
Cold carcass yield (%)	48.36±0.56	49.24±0.74	49.15±0.68	49.43±0.66
Cooling losses (%)	2.56±0.21	2.31±0.23	2.07±0.12	2.06±0.19
n	4	4	4	4
Carcass meat weight (kg)	12.95±0.28	12.85±0.37	12.94±0.23	13.18±0.17
Carcass meat rate (%)	63.15±0.75	63.35±0.71	63.11±0.95	64.16±0.62
Carcass fat weight (kg)	3.26±0.14	3.46±0.09	3.09±0.12	3.05±0.22
Carcass fat rate (%)	17.43±1.06	17.59±0.51	17.55±0.47	16.95±0.70
Carcass bone weight (kg)	3.69±0.11	3.54±0.09	3.73±0.13	3.74±0.05
Carcass bone rate (%)	19.40±0.68	19.04±0.27	19.32±0.53	18.86±0.25

p>0.05

Table 6: The weights of the parts of the carcasses (kg) and the rates of the parts of the carcasses (%) in groups (n = 4)

		Treatment groups ($\bar{X}\pm S\bar{X}$)		
Factors	Control $\bar{X}\pm S\bar{X}$	1	2	3
Rump weight	6.10±0.12	6.01±0.12	6.26±0.04	6.37±0.18
Rump rate	30.99±0.58	30.19±0.31	31.30±0.27	31.33±0.78
Arm weight	3.65±0.11	3.58±0.10	3.85±0.11	3.81±0.09
Arm rate	18.54±0.71	18.00±0.24	19.24±0.48	18.76±0.37
Back weight	2.50±0.19	2.51±0.11	2.42±0.01	2.51±0.04
Back rate	12.65±0.79	12.67±0.69	12.12±0.14	12.37±0.25
Loin weight	1.59±0.15	1.72±0.05	1.63±0.08	1.65±0.10
Loin rate	8.04±0.67	8.67±0.15	8.15±0.37	8.15±0.54
Others weight	5.44±0.05	5.50±0.15	5.44±0.13	5.53±0.09
Others rate	27.65±0.45	27.65±0.57	27.20±0.60	27.98±0.41
Kidney and pelvic fat weight	0.42±0.04	0.56±0.04	0.41±0.03	0.45±0.03
Kidney and pelvic fat rate	2.13±0.25	2.81±0.19	2.08±0.16	2.20±0.14

p>0.05

Table 7: The meat, fat and bone weights of the parts of carcasses (kg) in groups (n = 4)

		Treatment groups ($\bar{X}\pm S\bar{X}$)		
Factors	Control $\bar{X}\pm S\bar{X}$	1	2	3
Rump meat weight	4.17±0.09	4.18±0.13	4.30±0.10	4.40±0.09
Rump fat weight	0.68±0.04	0.70±0.05	0.72±0.05	0.75±0.06

Rump bone weight	1.24±0.05	1.11±0.04	1.23±0.05	1.22±0.08
Loin meat weight	0.97±0.12	1.15±0.03	0.98±0.04	1.11±0.03
Loin fat weight	0.27±0.05	0.24±0.02	0.30±0.06	0.21±0.04
Loin bone weight	0.34±0.05	0.32±0.02	0.34±0.05	0.33±0.03
Back meat weight	1.36±0.10	1.40±0.08	1.33±0.07	1.41±0.03
Back fat weight	0.50±0.09	0.41±0.10	0.42±0.03	0.47±0.03
Back bone weight	0.63±0.08	0.70±0.04	0.66±0.06	0.62±0.06
Arm meat weight	2.52±0.11	2.53±0.08	2.62±0.08	2.70±0.11
Arm fat weight	0.51±0.07	0.45±0.06	0.56±0.07	0.52±0.04
Arm bone weight	0.61±0.06	0.60±0.05	0.66±0.02	0.59±0.03
Others meat weight	3.41±0.06	3.33±0.13	3.38±0.08	3.43±0.05
Others fat weight	1.04±0.07	1.12±0.08	1.08±0.05	1.03±0.02
Others bone weight	0.99±0.06	1.04±0.07	0.96±0.06	1.06±0.05

$p>0.05$

schidigera extract, respectively. The previous studies are controversial. Goodall and Matsushima (1980) and Hussain and Cheeke (1995) did not determine any change in dry matter intake in steers fed concentrate or roughage based diets containing *Yucca* saponin. Wu *et al.* (1994) determined higher feed intake in cows fed diet including *Yucca* saponin.

Wilson *et al.* (1998) reported that *Yucca schidigera* extract (9 g day^{-1} per dairy cattle) did not affect on ruminal pH. However, Wu *et al.* (1994) mentioned that different amount of *Yucca schidigera* extract in gelatine form applied into rumen during the experimental period did not alter ruminal pH value in dairy cattle fed diet containing 1.2% urea. Some *in vivo* studies (Wilson *et al.*, 1998; Wu *et al.*, 1994; Hristov *et al.*, 1999) and an *in vitro* study (Ryan *et al.*, 1997) were showed that *Yucca schidigera* extract had no significant effect on pH in rumen. Furthermore, Hristov *et al.* (2004) reported that plant saponins had no certain effects on ruminal pH. In the present study, the diet made up with high level of concentrate (85% concentrate and 15% alfalfa hay) for control and treatment groups led to low pH in rumen. The result can be based on feeding high level of concentrate. Because feeding high level of concentrate may hide the potential effects of saponin in *Yucca schidigera* extract.

Ryan *et al.* (1997) observed that rumen ammonia nitrogen level increased after 48 h incubation but statistical differences were not detected among groups for this parameter. Increasing of ammonia nitrogen level in group including *Yucca schidigera* extract was lower than control. At the end of the present study, although there were no significantly differences for ruminal ammonia nitrogen level among groups, ammonia nitrogen level of rumen decreased numerically with using of *Yucca schidigera* extract in diets. This result supports Wallace *et al.* (1994) and Hussain and Cheeke (1995), who mentioned that ruminal ammonia may be bounded by the *Yucca* extract. Some researchers (Ellenberger *et al.*, 1985; Gibson *et al.*, 1985; Preston *et al.*, 1987) stated that the goal of using of *Yucca schidigera* extract in diets of ruminants was to unsure of control of ammonia formation in rumen. This effect of *Yucca schidigera* extract was attributed to it had an inhibitor influence on urease activity. At the end of the present study, amount of ruminal urea nitrogen in treatment group 3 was higher ($p<0.05$) than control and treatment group 1. This result supports the opinion (Ellenberger *et al.*, 1985; Gibson *et al.*, 1985; Preston *et al.*, 1987) for sarsaponin, which is found in *Yucca schidigera* extract inhibit to urease enzyme in rumen hence, it reduces urea degradation. However, some researchers (Van Nevel and Demeyer, 1990; Hristov *et al.*, 2004) mentioned that effect of *Yucca schidigera* extract on nitrogen metabolism in rumen was not known certainly. At the end of the study, rumen total volatile fatty acid concentrations in groups were not affected by using of *Yucca schidigera* extract in diet. These findings are in agreement with the results of Wu *et al.* (1994) and Hristov *et al.* (1999, 2004). Amount of ruminal volatile fatty acid was affected by diet composition, absorption degree of products formed by ruminal fermentation, transition periods of feeds in rumen, microorganisms and their activities in rumen (Maynard *et al.*, 1979). At the end of the study, although blood ammonia nitrogen levels were similar for control and treatment groups, there were differences ($p<0.05$) in blood urea nitrogen levels among groups. Rogers (1999) mentioned that blood urea nitrogen and ammonia nitrogen values increased after urea intake. Ryan *et al.* (2001) reported that the administration of 250 mg day^{-1} *Yucca schidigera* extract per sheep increased blood urea nitrogen levels compared to control values for up to 10 days after treatment. However, the urea nitrogen levels at 20 days after treatment were significantly lower than the levels at 10 days after treatment. At the end of the present study, blood urea nitrogen level of lambs in treatment group 2 and 3 had lower ($p<0.01$) than those of lambs in control and treatment group 1. This result may be attributed to subsequent increase in the level of *Yucca schidigera* extract may decelerate urea degradation due to inhibition of urease activity in rumen. However, Wilson *et al.* (1998) reported that giving of 9 g/cattle/day *Yucca schidigera* extract with diet containing high or low soluble protein did not affect plasma and milk urea nitrogen levels.

There were no differences in slaughtering and carcass characteristics among groups (Table 5). Feeding the diet, containing *Yucca schidigera* extract, to the lambs did not affect the weights of the parts of the carcasses, the rates of the parts of the carcasses (Table 6) and the meat, fat and bone weights of the parts of carcasses (Table 7) in groups. These results were similar to the results for Turkish Merino lambs of Tekin and Akcapinar (1993). Tuncer (1982) reported that final live weight before slaughtering, cold carcass weight, warm carcass yield, rates of meat, fat and bone were not different in groups fed with concentrate containing 1 or 2% urea.

CONCLUSION

Results showed that the supplementation of *Yucca schidigera* extract at the level of 200, 300 and 400 ppm to the lamb concentrate feeds containing 1.5% urea did not affect growth performance, rumen pH, total volatile fatty acid levels and carcass characteristics.

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