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Effect of Different Protein Levels on Fattening Performance, Digestibility and Rumen Parameters in Finishing Lambs

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Abstract: This investigation was performed to determine the effects of feed with different levels of Crude Protein (CP) on live weight gain, digestibility, rumen pH, ammonia nitrogen (NH_3-N) and Volatile Fatty Acids (VFA) in the finishing period of morkaraman lambs. Twenty four lambs (31.39±0.61 kg) were divided randomly into 3 groups. The groups were fed with the diet 70% concentrate including 10, 13 and 16% CP and 30% hay. Lambs were fed *ad-libitum* twice a day. Experiment was lasted for 50 days. Lambs were weighed in 25 and 50 days, thus their live weight gain, daily weight gain were determined. In the last week of the study; digestibility was determined by total feces collection, rumen pH, NH_3-N and VFA by rumen fluid collection. The daily live weight gain were lower of the 10% CP group than the 13 and 16% CP groups ($p<0.05$). Altough, the the DM digestibility and OM levels were not effected by the protein level, CP digestibility level was the highest in 16% CP level ($p<0.05$). Rumen fluid NH_3-N level was increased, pH level was not effected, acetic acid level was decreased by the increase of dietary CP level ($p<0.05$). As a result, it can be better to feed the Morkaraman lambs in the finishing period with 16% CP for fattening, but 10 and 13% CP including feeds can be used for different breeding aims.

Key words: Lamb, protein, performance, digestibility, rumen parameters

INTRODUCTION

Forage and grasslands are important sources to supply the nutrients requirements of sheep (Ensminger *et al*., 1990). But the consumption of forage in growing and finishing periods restrict the maximum daily weight gain of lambs (Scott, 1988).

There is need to additional protein for maximum performance in the growing and finishing period of lambs (Scott, 1988). In the finishing period, lambs Crude Protein (CP) level need differs from 10-14.5% according to live weight and growing potential (NRC, 1985). Also, it is suggested that lambs between 15-40 kg of live weight need 17% dietary CP (Andrews and Qrskov, 1970). In other studies in which the different CP levels were evaluated (10-18%) it is suggested that lambs live weight gain were increased by the higher dietary CP level, but the feed conversion ratio levels were decreased by this increasing (Purroy *et al*., 1993; Muwalla *et al*., 1998; Haddad *et al*., 2001). Although, Dry Matter (DM) digestibility levels were not different among the different dietary CP levels (10-17%) CP digestibility levels were higher in lambs fed with higher CP levels (Hart and Glimp, 1991; Kaya and Yalçin, 2000; Haddad *et al*., 2001; Dabiri and Thonney, 2004). It is also pointed that rumen ammonia nitrogen (NH_3-N) and Volatile Fatty Acids (VFA) levels increased by the dietary increasing CP level (Haaland *et al*., 1982; Hart and Glimp, 1991; Kaya and Yalçin, 2000).

In this study, it is aimed to investigate the effects of different dietary CP levels in finishing period of Morkaraman lambs performance, rumen parameters and digestibility.

MATERIALS AND METHODS

Experimental procedure and performance trial: This experiment was conducted in October-December, 2007 at Farm of University of Kafkas located in the nortestern of Turkey at 43 E 05, 30 N 36 and an altitude of 1760 m.

Twenty four Morkaraman lambs, 8-9 month age and average 31.39±0.61 kg were used in the experiment. Lambs were divided in three groups with their weight and each group consist of 8 lamb.

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Table 1: Formulation of the concentrate diets fed to lambs

	Crude protein levels (%)		
Item (%)	10	13	16
Barley	90.25	45.00	39.00
Corn	-	21.00	21.00
Sunflower meal	-	15.00	30.25
Wheat bran	-	9.25	-
Molasses	7.00	7.00	7.00
Salt	1.00	1.00	1.00
Limestone	1.50	1.50	1.50
Vitamins and mineral mix**	0.25	0.25	0.25

**Vitamin A 10.000.000 IU, Vitamin D3 2.000.000 IU, Vitamin E 30.000 mg, Mn 50.000 mg, Fe 50.000 mg, Zn 50.000 mg, Cu 10.000 mg, I 800 mg, Co 150 mg, Se 150 mg

In experiment, 10, 13 and 16% CP levels were obtained in concentrate diets (Table 1). The diet with 10% CP was mostly consisted of barley, protein supplements were added to diets to obtain 13 and 16% CP levels.

In the adaptation period the feed consumption amounts of lambs were determined and *ad libitum* feeding was obtained. In the first 25 day period the lambs were fed with 1200 g concentrate and 300 g hay (as feed) in the second 25 day period with 1500 g concentrate and 500 g hay (as feed). Animals were fed twice a day in morning at 08.00, in evening at 16.30. Lambs were fed by groups. Fresh water was always supplied and was not restricted. Animals were medicated against parasites in the adaptation period.

The lambs live weight were detemined in the adaptation period, 0, 25 and 50 days of the study before feeding in the morning. Daily weight gain were calculated from the difference of 2 period.

Determination of rumen parameters: Final day of the experiment, 40 mL samples of ruminal fluid were removed by the rumen tube at 2 h after the morning feeding. The pH of the rumen fluid was determined with pH meter (Accumet, Fischer Scientific, USA) immediately. Then rumen fluid samples were divided into two different 20 mL bottles.

Rumen ammonia N was determined by description of Markham (1942) from the 20 mL rumen fluid samples. The remaining of the 20 mL of ruminal fluid samples was treated with 1 mL of a 25% (w/v) dilution of metaphosphoric acid per 4 mL of ruminal fluid and stored at -20°C (Horney *et al*., 1996). Volatile fatty acid concentrations were also analyzed in gas chromatography (Agilent 6980N, USA) with using 30 m ×0.53 mm (i.d.) capillary colon (Restek Corp. Canada).

For digestibility trial, five lamb in each group were placed individual pens at end of last week of experiment. Total fecal output was determined 5-day. Each animal's feces was weighed daily and a 10% aliquot retained, composited and frozen. Composited samples were subsequently dried in a forced air oven at 60°C at 48 h. Apparent dry matter, organic matter and crude protein digestibility were determined.

Chemical and statistical analyses: Feed and feces samples analysis were determined according to methods described in AOAC (1990).

ANOVA was used to determine the differences between the groups. Differences between the groups were defined by the Duncan test (SPSS 12.0). Data were represented as mean±SEM (Standard Error of Mean).

RESULTS AND DISCUSSION

Dry matter and chemical compositon of the concentrates and grass hay are presented in Table 2. The lambs live weight gain were not effected by the trials. But the daily weight gain were higher in the 16% CP group ($p<0.05$). Although, DM and Organic Matter (OM) digestibility were not different among the groups, CP digestibility increased with dietary CP level increasing and found the highest in group 16%. The differences in rumen metabolites are shown in Table 4.

Fattening performance and digestibility: Because of feeding the lambs totally in groups no statistical evaluation was peformed for feed consumption. Lambs consumed all the concentrate and hay supplied them twice a day. At the end of the study the mean live weight were determined as 40.5, 41.4 and 42.3 kg, sequentally. The live weight increased with the increasing of dietary protein level, but the differences were not statistically significant ($p<0.05$).

The daily weight gain of the groups were determined as 141.5 g, 171.2 ve 183.0 g sequentally. The 16% CP groups mean daily weight gain was 23% higher than the 10% CP group. Dabiri and Thonney (2004) suggested that there was no difference between the groups fed with 13, 15 and 17% CP for 42 days in the cases of live weight, daily live weight gain and feed consumption. Our results are similiar with Dabiri and Thonney (2004) in the case of live weight gain. Also, in another study performed on cattle fed with different levels of CP (9.6, 13.6 and 15.9%) it was determined that there was no difference in the aspects of feed consumption and live weight gain (Legleiter *et al*., 2005).

On the other hand, in another study in which different levels of CP levels were evaluated (10, 14 and 16% CP) it was suggested that live weight and and daily live weight gain were increased with the increased dietary levels (Haddad *et al*., 2001). Lambs fed with low CP (12%) exhibited lower live weight gain than middle (15%) and

Table 2: Chemical composition of concentrate diets and hay in groups

	Crude protein levels (%)			
Item (%)	10	13	16	Hay
Dry matter	87.45	87.52	88.01	92.97
Ash	5.75	6.12	5.99	6.56
Organic matter	81.70	81.4	82.02	86.41
Crude protein	10.20	13.15	16.00	7.65
Crude fiber	4.52	5.40	6.22	27.30
Ether extract	2.46	3.22	4.08	2.33
Nitrogen free extract	64.52	59.63	55.72	49.13
Metabolisable energy (kcal kg^{-1}*)	2813.00	2802.00	2798.00	2050.00

*Calculated

Table 3: Effect of dietary CP level on growth performance and digestibility in lambs

	Crude protein levels (%)		
	10	13	16
Adaptation (kg)	31.31±1.13	31.36±1.09	31.49±1.09
Initial weight (kg)	33.42±1.37	32.79±1.14	33.14±0.99
Final weight (kg)	40.50±1.71	41.35±1.21	42.29±1.20
ADG, g per day	141.5±13.01a	171.2±17.52ab	183.0±6.72b
Feed intake (kg)	1552.46	1553.40	1560.02
Digestibility (%)			
Dry matter	75.15±0.25	74.26±1.35	73.85±1.05
Organic matter	74.14±0.59	73.17±1.17	72.06±0.95
Crude protein	71.23±0.35a	75.38±1.52b	80.93±1.15c

a, b, c: Differences between values having different letters in the same line are statistically significant ($p<0.05$)

high (18%) CP fed lambs in the study of Purroy *et al.* (1993). NRC (1985) determined the moderate and rapid growth potential lambs by 30 and 40-60 kg CP need as 13.6 and 13.1% sequentally. Our studies CP leves are supported by NRC (1985) standarts. The result of the study of Andrews and Qrskov (1970) pointed that there is need for 17% that for the maximum live weight gain of 15-40 kg live weight lambs. This is harmonical with our study in which we obtained the best in 16% CP group.

Altough, there was no difference between the groups in the cases of DM and OM digestibility, CP digestibility level increased with the dietary protein level ($p<0.05$).

Dabiri and Thonney (2004) claimed that lambs fed with different levels of CP showed no difference in the aspects of DM and OM digestibility levels but the CP digestibility was higher in 17% CP group than 13% CP group. By this study DM digestibility was determined between 78.6-81.7%, CP digestibility between 72.4-79%. Our digestibility results are harmonical with this study. On the other hand, in the lambs fed with mostly concantrate containing ratios posessing 10, 14 and 16% CP, DM digestibility had no difference among the groups while it was lower in the 10% CP group, which is in paralel with our findings (Haddad *et al.*, 2001). Yet, the DM digestibility (75%) found by Hart and Glimp (1991) in the lambs fed with 11% CP containing concantrate is also similar to the result of our study on the lambs fed with 10% CP containing concantrate.

Table 4: Rumen pH, NH3-N, VFA levels in groups

	Crude protein levels (%)		
	10	13	16
pH	5.91±0.19	5.67±0.12	5.68±0.13
NH_3-N (mg L^{-1})	147.0±4.43a	282.6±33.88b	478.0±26.34c
Volatile fatty acids (mmol L^{-1})			
Acetic acid	58.25±2.48a	57.55±1.61a	44.41±1.53b
Propionic acid	22.62±1.26	19.73±1.77	20.10±2.23
Butyric acid	14.45±0.19	13.99±1.04	13.67±1.33
Isovaleric acid	2.26±0.33ab	2.94±0.24a	3.68±0.52a
Valeric acid	1.08±0.09	1.05±0.11	1.14±0.07

a,b,c: Differences between values having different letters in the same line are statistically significant ($p<0.05$)

Rumen parameters: At the end of the study, altough there was no statistical difference between the groups in the cases of ruminal fluid pH and VFA levels, NH_3-N level increased with the dietary protein level ($p<0.05$) Table 4.

The pH levels determined in our study are harmonical with Hart and Glimp (1991) study in which different levels of dietary CP levels were evaluated (11.3 and 10.8%) but our study is not harmonical with the sudy of Haaland *et al.* (1982) in which increase of pH was determined by the dietary CP level increase of cattle (11.3, 14.2 and 17.5%). Kaya and Yalcin (2000) determined the pH, NH_3-N and VFA levels 5.28, 284 mg L^{-1} and 126 mmol L^{-1} sequentally of the lambs fed with 16.5 CP level which are not harmonical with our 16% CP group. Faria and Huber (1984) found the acetic acid, propionic acid butyric acid levels as 63.9-68.6, 17.8-23.8, 8.4-10.2 mol/100 mol sequentally in the cattle fed with 8.3, 11.3 and 13.3% and 5.4 CP. But in our study increase of dietary CP caused to decrease of acetic acid.

CONCLUSION

Morkaraman lambs (30-40 kg) finishing period best live weight, daily live weight gain and digestibility of nutrients are obtained in the group of fed with 16% CP including concentrate diet. This diet was added of 30.25% of protein supplement. The diets without protein supplementation (10%) and supplemented protein (13%) can be used succesfully in the finishing period of lamb fattening.

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