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THE EFFECT OF DIFFERENT DIETARY CRUDE PROTEIN LEVEL ON PERFORMANCE AND SERUM IMMUNO-GLOBULIN G IN MALE KIVIRCIK LAMBS

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Summary

Keser, O., T. Bilal & H. Can Kutay, 2008. The effect of different dietary crude protein level on performance and serum immunoglobulin G in male Kivircik lambs. *Bulg. J. Vet. Med.*, **11**, No 1, 49–54.

The aim of this experiment was to investigate the effect of dietary crude protein (CP) level on serum immunonoglobulin G (IgG) and the performance in male lambs. Twenty Kivircik male lambs were randomly selected for this experiment. Ages ranged between 120–135 days and average body weight was 29.01±3.65 kg. Ten lambs were randomly assigned to each of the two experimental diets containing 10% CP and 18% CP respectively, to determine the effects of dietary CP level on performance and serum IgG. Live body weights and daily body weight gains were greater ($P<0.05$) for lambs fed the 18% CP diet compared to lambs fed 10% CP diet on days 30 and 60. Body weights for lambs fed 10% CP and 18% CP were 33.36 ± 1.53 kg and 38.63 ± 1.74 kg (day 30), and 37.20 ± 1.30 kg and 43.05 ± 1.05 kg (day 60); respectively. Cumulative feed intakes of groups were similar. Serum IgG values of lambs fed 10% CP (2.79 ± 0.31 mg/ml) were higher ($P< 0.05$) than those in the other group (1.98 ± 0.17 mg/ml) on day 0. Differences between serum IgG values on day 30 and 60 were not statistically significant.

Key words: crude protein, immunoglobulin, Kivircik lamb, performance

INTRODUCTION

Nutrition has a profound effect on immunity and health in animals. Nutritional deficiencies impair immune responsiveness and, thereby, increase morbidity and mortality (Boon, 1995). Several micro- and macro-nutrients are needed for normal maintenance of the immune system. These include amino acids, essential fatty acids, and several vitamins and minerals. More recent studies have looked beyond deficiency of nutrients and focused on the level of nutrients needed for optimal immune response (Meydani *et al.*, 1992). Feed restriction causes higher plasma corticosterone levels, which are known to decrease the immune response, possibly through effects on cytokines. Excessive feed, through forced feeding, may also have short-term effects on indicators of humoral immunity (Latshaw, 1991). The biologic consequences of deranged immunologic function during nutrient deprivation include loss of resistance to infectious diseases, although the precise relationship between nutritional status and infection depends on the nature of the dependency of the microbe for a metabolically normal host (Cunningham-Rundles, 1993; McMurray, 1984).

Protein and amino acid nutrition have been studied in relation to immunocompetence. The level of dietary amino acid needed to maximize growth and feed efficiency will also generally maximize measures of immunocompetence (Latshaw, 1991).

The aim of this experiment was to investigate the effect of dietary crude protein (CP) level on immunoglobulin G (IgG) levels and performance in male lambs.

MATERIALS AND METHODS

Animals and housing

The experiment was conducted at the Department of Animal Nutrition and Nutritional Diseases of Istanbul University. A total of 20 Kivircik male lambs were randomly selected for this experiment. Ages ranged between 120–135 days and average body weight was 29.01±3.65 kg. Animals were vaccinated against enterotoxaemia and treated against external parasites before the beginning of the experiment. Ten lambs were randomly assigned to each of the two experimental diets containing 10% CP and 18% CP respectively, to determine the effects of dietary CP level on performance and serum IgG concentrations.

Feeds and feeding procedures

The study consisted of two periods: adaptation period (15 days) and experimental period (60 days). The adaptation period consisted of a 65:35 forage to concentrate ratio for 15 days. This ratio was then gradually decreased until 15:85. During the adaptation period, lambs were fed at maintenance level. In the experimental period, lambs were randomly assigned to two isocaloric diets containing two dietary crude protein levels (10% CP and 18%

Table 1. Ingredient composition and proximate analysis of the two diets used in the experiment

	10% CP diet	18% CP diet
Formula, % as fed		
Pasture grass	15.00	15.00
Barley grain	11.50	47.50
Molassed sugarbeet pulp	60.00	–
Soybean meal	–	21.00
Wheat bran	10.00	13.00
Salt	1.00	1.00
Na-bicarbonate	0.50	0.50
Limestone	1.90	1.90
Vitamin-mineral premix*	0.10	0.10
Analysis, DM basis		
Dry matter, %	89.58	89.05
ME, MJ/kg	10.45	10.53
Crude protein, %	10.10	17.60
Ether extract, %	2.55	2.22

*Composition of premix/kg: vitamin A: 20,000,000 IU; vitamin D_3: 3,000,000 IU; vitamin E: 25,000 mg; cobalt: 200 mg; manganese: 45,000 mg; zinc: 40,000 mg; iodine: 300 mg; iron: 50,000 mg; copper: 10,000 mg; selenium: 300 mg; magnesium: 100 mg.

CP). During the experiment, lambs were fed twice a day at 09:00 and 16:00 h. Water was offered *ad libitum* in buckets and was changed daily. Ingredients and crude protein percentages of diets are shown in Table 1.

Analytical procedures

Amounts of offered and refused feeds were recorded daily and feed consumption was determined at the end of the experiment.

Lambs were fasted overnight and weighed individually on days 0, 30, 60 and data were recorded for statistical performance analysis during the experiment.

Diets for each group were prepared every two weeks and samples of each diet were collected for analysis. Samples of each diet were analyzed according to the standard procedures of the AOAC (1984). The results of chemical analysis of each diet are presented in Table 1.

Blood samples were collected from each lamb at the beginning (day 0) by the 30^{th} and the 60^{th} days of experiment by jugular venipuncture using vacuum tubes before the morning feeding. Serum samples were separated by centrifugation and stored at −20 °C until analyzed. Serum IgG levels were determined by using Ridascreen® R-Biofarm ELISA test kit.

Statistical analyses

All statistical analyses were carried out by using SPSS (1999) package software. One way analysis of variance (ANOVA) was used for each experiment and mean differences were determined by Duncan's multiple range test. Results of performance and serum IgG levels are presented as means with their standard errors.

RESULTS

In this experiment, the lowest dietary CP diet was used as negative control whereas the highest dietary CP diet was used as positive control. There was no significant difference between initial body weights of groups (Table 2). Live body weights were greater ($P<0.05$) for lambs fed the 18% CP diet compared to lambs fed 10% CP diet on day 30 and 60. Body weights for

Table 2. Performance of lambs fed different protein levels. The values are presented as mean ± standard errors (n=10/group)

	10% CP	18% CP
Body weight (kg)		
Initial	28.41 ± 1.19	29.74 ± 1.22
Day 30	33.36 ± 1.53	38.63 ± 1.74[a]
Day 60	37.20 ± 1.30	43.05 ± 1.05[a]
Daily body weight gain (g/d)		
Days 0-30	165.12 ± 11.51	296.15 ± 23.12[a]
Days 31-60	128.73 ± 18.08	147.41 ± 19.22[a]
Days 0-60	146.61 ± 16.14	221.92 ± 21.17[a]
Feed intake (g/d)		
Days 0 to 30	1083	1095
Days 31 to 60	1205	1216

[a] Values for each body weight with superscripts are different ($p<0.05$).

lambs fed 10% CP and 18% CP were 33.36 ± 1.53 kg and 38.63 ± 1.74 kg on day 30, and 37.20 ± 1.30 kg and 43.05 ± 1.05 kg on day 60 respectively. Cumulative feed intakes of groups were similar (Table 2).

At the beginning of the experiment, serum IgG values of lambs fed 10% CP were higher than the 18% CP group, however, they were statistically different ($P<0.05$). These values on day 0 for lambs fed 10% CP and 18% CP were 2.59 ± 0.31 mg/mL and 1.98 ± 0.17 mg/mL respectively (Table 3).

Table 3. Serum IgG levels of lambs fed different protein levels (mg/mL). The values are presented as mean ± standard errors (n=10/group)

	10% CP	18% CP
Day 0	2.59 ± 0.31	1.98 ± 0.17
Day 30	2.63 ± 0.29	1.98 ± 0.17
Day 60	3.10 ± 0.39	2.45 ± 0.43

The differences between serum IgG values of these groups on days 30 and 60 were not statistically significant.

DISCUSSION

In this study, final body weights were 37.20 and 43.05 kg; average daily body weights were 146.61 and 221.92 g/d; for lambs fed diets with 10% and 18 % CP, respectively.

Recently, in the study conducted by Titi *et al.* (2000) in Awassi lambs with 12, 14, 16 and 18 % CP diets, lambs fed 16 % and 18 % CP had the highest daily body weight gain than those of other groups, which is in accordance with our results. Similarly, Haddad *et al.* (2001) reported that lambs fed 16% and 18 % CP diets had higher daily body weight gains than lambs fed 10%, 12% and 14 % CP diets, with no difference between lambs fed 16% and 18 % CP.

In recent years several studies have demonstrated that moderate dietary protein deficiency has a detrimental effect on a variety of immune responses in laboratory and domestic animal species. It was reported that protein deprivation in mice was associated with a decrease in antigen presentation function secondary to down-regulation of MHC Class II expression and/or a modest defect in IL-1 production (McMurray, 1999). Hoffman-Goetz *et al.* (1986) reported that dietary protein deficiency in cattle was associated with reduced serum hemolytic complement levels. Melo *et al.* (1998) carried out an experiment to investigate the influence of low and high protein content diets on antibody production and they reported that mean production of antibodies was consistently higher in those fed on high-protein than in those fed on low-protein diets. Similarly, Praharaj *et al.* (1998) fed chickens with diets contained 19% and 21% crude protein and chickens fed the higher protein diet had better persistence in antibody production to sheep red blood cells than those fed the lower protein diet. Also, Takahashi *et al.* (1992) carried out an experiment using broilers fed on three different level of protein (10, 20 or 40 % CP). They reported that antibody titre to sheep red blood cells in chickens fed on 40% protein was lower than that in chickens fed on either 10 or 20% protein. Rao *et al.* (1999) carried out an experiment with broiler chicks to investigate the effects of different levels of crude protein on immune competence, resistance to *E. coli* and growth and they reported that there were significant differences between the genotypes in antibody production in response to sheep red blood cell inocula-

tion, but no such differences between the chickens fed different levels of dietary protein.

Furthermore, dietary protein level can affect immunity in parasitized animals. Kambara *et al.* (1993) offered two levels of dietary protein (11 and 20%) to lambs vaccinated with *Trichostrongylus colubriformis* to investigate the effect of age and dietary protein on immunity and resistance. While young lambs offered the low protein diet showed a significantly lower resistance to parasites than older animals, the young animals on the high protein diet developed better resistance. Israf *et al.* (1996) quantified the immune response to *Nematodirus battus* infection in lambs offered either a complete basal diet (13.2% CP) or the same diet supplemented with fish meal as a source of rumen bypass protein (18.3% CP) and protein supplementation enhanced serum anti-worm IgG titers.

As a result, body weight gain of lambs were effected by the crude protein level of the diet. The 18% CP diet improved body weight gain positively. However, in this experiment dietary crude protein level had no effect on serum IgG concentration in lambs.

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Na-bicarbonate	0.50	0.50
Limestone	1.90	1.90
Vitamin-mineral premix*	0.10	0.10
Analysis, DM basis		
Dry matter, %	89.58	89.05
ME, MJ/kg	10.45	10.53
Crude protein, %	10.10	17.60
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*Composition of premix/kg: vitamin A: 20,000,000 IU; vitamin D_3: 3,000,000 IU; vitamin E: 25,000 mg; cobalt: 200 mg; manganese: 45,000 mg; zinc: 40,000 mg; iodine: 300 mg; iron: 50,000 mg; copper: 10,000 mg; selenium: 300 mg; magnesium: 100 mg.

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