Applied Clay Science 163 (2018) 291–298

Contents lists available at ScienceDirect

Applied Clay Science

journal homepage: www.elsevier.com/locate/clay

Research paper

Effects of dietary sepiolite usage on performance, carcass characteristics, blood parameters and rumen fluid metabolites in Merino cross breed lambs

Ender Burçak[a,*], Sakine Yalçın[b]

[a] Ministry of Agriculture and Forestry, 06800 Ankara, Turkey
[b] Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Ankara University, 06110 Ankara, Turkey

ARTICLE INFO

Keywords:
Blood parameters
Lamb
Performance
Rumen fluid metabolites
Sepiolite

ABSTRACT

The aim of this experiment was to determine the effects of dietary sepiolite supplementation on performance, carcass characteristics, blood parameters and rumen fluid metabolites in Merino cross breed lambs. For this purpose, a total of 21 weaned lambs, which were 3–3.5 months of age were allocated to one control group and two treatment groups each containing 7 lambs. The experiment lasted for a total of 90 days, of which the adaptation and experimental periods were 22 and 68 days, respectively. Pelleted alfalfa and concentrates were given to lambs individually. Concentrate diets of first and the second treatment groups were supplemented with 1 and 2% sepiolite as top dressed, respectively. There were no significant differences observed in body weights, body weight gains, hot and cold carcass yields, meat pH and meat composition among the groups. Relative weights of internal organs and carcass parts were also not affected by sepiolite supplementation. The addition of 1 and 2% sepiolite to the diets of animals increased the consumption of concentrates and total dry matter intake ($P < .05$). There were no differences among the groups in terms of consumption of dry matter of alfalfa, concentrates and total feed required for one kg body weight gain in lambs. However, body weight gain was increased by 4.22% and total feed conversion ratio was improved by 4.56% with 2% dietary sepiolite supplementation. Haematological and biochemical blood parameters and fecal dry matter were also not affected by the usage of sepiolite. Blood serum IgG levels were increased with sepiolite supplementation ($P < .05$). While the percentage of acetic acid in the total volatile fatty acids (VFA) in rumen fluid was decreased, neither the proportion of other volatile fatty acids nor the quantity of total volatile fatty acids were affected by dietary addition of sepiolite. It was concluded that 2% sepiolite supplementation in diets of Merinos cross bred lambs as top dressed may have economic benefits based on animal's immunity enhancement and some improvement in body weight gain and total feed conversion ratio without any negative effects on performance, carcass characteristics, rumen metabolites and blood parameters.

1. Introduction

Sepiolite is a hydrated magnesium aluminium silicate belonging to phyllosilicates. The presence of micropores and channels in sepiolite together with the fine particle size and fibrous habit explain its high surface area (Galan, 1996). Due to its high absorption and adsorption properties, sepiolite has been used significantly in animal feeds and proved beneficial to the health of animals. Researches involving broilers, laying hens, pigs and rabbits showed that sepiolite concentrations up to 2% had no negative effects in these species (EFSA, 2013; Yalçın et al., 2017). Sardi et al. (2004) showed that inclusion of dietary sepiolite at 1% in the piglets' diet could reduce diarrhea intensity in the post-weaning period. Elitok and Başer (2016) reported that sepiolite addition to daily calf diet at the rate of 2% had a positive effect on their body weight gain and prevention of diarrhea. Deligiannis et al. (2005) indicated that addition of 3% clinoptilolite to the lamb diets decreased their total worm burden and increased the consumption of concentrated feed ($P < .05$) when compared with the control group. In an experiment, supplementation of concentrate diet with 2.5% zeolite (on DM basis) reduced the incidence of clinical ketosis and increased milk yield in dairy cows (Katsoulos et al., 2006). Addition of the zeolite to the diets of suckling calves (Pajovic et al., 1998) and lambs (Stojkovic et al., 2005; Norouzian et al., 2010; Stojkovic et al., 2012) had positively affected the body weight and body weight gain. However, Sherwood et al. (2006) reported that the addition of 1.2% clinoptilolite to the diets did not affect the body weight gain and dry matter intake in cattle.

One of the major concerns arising from the dietary use of bentonite and zeolite is their potential interaction with the dietary compounds,

* Corresponding author at: Ministry of Agriculture and Forestry, Eskisehir St. 10. km, Ankara, Turkey.
E-mail addresses: ender.burcak@tarim.gov.tr, ender.burcak03@gmail.com (E. Burçak).

https://doi.org/10.1016/j.clay.2018.07.001
Received 18 March 2018; Received in revised form 29 June 2018; Accepted 1 July 2018
Available online 30 July 2018

such as minerals, possibly due to their high absorptive and ion exchange capacity (Oliveira et al., 2016). On the contrary, sepiolite has a low cation exchange capacity (0, 0001–0, 0002 eq/g) (Ruiz-Hitzky et al., 2011). Also, in European Union, sepiolite is authorised as binder, anti-caking agent and coagulant, to be used as a feed additive (E562) in the category of technological additives for all animal species (EFSA, 2013). In particular, it is used as a dietary co-adjuvant in feed since it most likely reduces the speed of food passage through the intestinal tract, therefore allowing domestic animals to carry out a more efficient digestion of proteins. This results in an increase in parameters related to animal growth and in an improvement of meat quality (Rodríguez-Beltrán et al., 2013).

Erwanto et al. (2011) stated that the zeolite supplementation to crossbreed Etawa male goats' diets had positive effect on ruminal fermentation which may be due to the high ion exchange capacity of zeolite, thus, releasing the ammonia slowly and reducing excessive ammonia accumulation in the rumen after feeding. However, Mainah and Adriani (2011) showed that using clinoptilolite > 6% in diets decreased the ammonia levels swiftly below the optimum, which consequently reduced the microbial protein synthesis. Elitok and Guvlu (2017) also reported that 2% sepiolite supplementation in cattle diet, due to its selectivity in ion exchange, had resulted in decreased ruminal ammonia concentration which provided more consistent rumen environment by preventing nitrogen loss in the form of ammonia and thus increasing nitrogen utilization in feeds.

Different studies performed on calves and pigs (Stojic et al., 1995; Nik-Khah et al., 2002; Sadeghi and Shawrang, 2008; Stojic et al., 1998) showed that dietary supplementation of zeolite had positively affected the immunity, however, no study was available determining the effects of sepiolite usage on performance and immunity in fattening lambs. Also, there was lack of scientific data about the effects of sepiolite on blood parameters in lambs. Blood haematological and biochemical parameters provide valuable information about animal health status (Opara et al., 2010; Mabruka Saleh, 2014). Therefore, the aim of the present study was to assess the effects of sepiolite on performance, carcass characteristics and blood and rumen fluid metabolites of lambs.

2. Materials and methods

2.1. Animal care and use

All experimental procedures were approved by the Animal Ethics Committee of the Ankara University (2014-22-149).

2.2. Experimental animals and feeding

Twenty one Merino cross breed lambs of 3–3.5 months of age were purchased from a lamb breeder in the district of Beypazarı of Ankara province in Turkey. After adaptation period of 22 days, 21 lambs with uniform body weights and ages were equally distributed into 3 groups each containing 7 lambs. The lambs were housed individually in the pens of 150 cm × 100 cm in length and width, respectively. Two weeks before the experiment started, all lambs were treated for internal and external parasites using ivermectin (Zimec®; active ingredient; 10 mg/ml Ivermectin; dose; 1 ml/50 kg live weight). The trial lasted for a total of 90 days, of which the adaptation and experimental periods were 22 and 68 days, respectively. Diets were formulated based on NRC (2007) guidelines. Concentrate diet and dried alfalfa hay were used in the experiment.

During the adaptation period, the amount of concentrate to be consumed daily by the animals in each group was determined and fed *ad libitum* in a way to increase 10% of the daily consumption of animals during the trial. Lamb fattening concentrate having 16.50% crude protein and 2550 kcal/kg metabolizable energy was prepared in a commercial feed manufacturing factory. Ingredients of the concentrate and chemical composition of the concentrate and dried alfalfa hay used in this trial are presented in Table 1 and Table 2, respectively. Concentrate and dried alfalfa were offered twice daily (08:30 am and 5:00 pm) and fresh water was provided *ad libitum* in plastic buckets. Animals were fed with 1000 g per day concentrate at the beginning while it was gradually increased up to 1400 g per day towards the end of the trial. Similarly, the amounts of dried alfalfa provided at the start and towards the end of experiment were 300 and 500 g per day, respectively. Concentrate was given in granulated form while dried alfalfa was in pellet form. Sepiolite (Exal TH, Tolsa Turkey, Sivrihisar-Eskişehir, Türkiye) was added as top dressed to the concentrate diets of experimental groups at the level of 0% (control), 1% (1st group) and 2% (2nd group). For this purpose, first the concentrate diets for each lamb were weighed in buckets and then required amount of sepiolite was added and properly mixed. The composition of sepiolite used in this study is reported in Table 3.

Table 1
Ingredients of the concentrate.

	g/kg
Barley	150.0
Corn	136.2
Corn DDGS (34% CP)	150.0
Canola meal (34% CP)	57.8
Corn gluten feed (19% CP)	100.0
Wheat bran	300.0
Rice bran (14% CP)	50.0
Condensed molasses solubles (40% CP)	15.0
Limestone	27.0
Salt	8.0
Ammonium chloride	5.0
Vitamin and mineral premix[1]	1.0

[1] Supplied the following per kilogram of diet: 10.000 IU vitamin A, 4.000 IU vitamin D, 50 mg vitamin E, 50 mg Mn, 65 mg Fe, 85 mg Zn, 15 mg Cu, 1 mg I, 200 mg Co and 200 mg Se.

Table 2
Chemical composition (analysed) of the concentrate and dried alfalfa hay (as fed basis).

	Concentrate	Dried Alfalfa hay
Dry matter (g/kg)	909.1	902.1
Crude protein (g/kg)	166.5	169.2
Crude fiber (g/kg)	84.0	215.4
Ether extract (g/kg)	42.3	15.2
Crude ash (g/kg)	76.3	113.9
Acid detergent fiber (g/kg)	97.4	291.6
Neutral detergent fiber (g/kg)	197.8	431.1
Starch (g/kg)	217.6	–
ME (kcal/kg)	2.600	–

2.3. Traits measured

Nutrient composition of the concentrate diet, dried alfalfa hay and

Table 3
The composition of sepiolite used in this study.

Mineral composition		Composition	
Sepiolite, %	65	Moisture, %	8.23
Palygorskite, %	9	SiO_2 (%)	41.8
Dolomite, %	18	Al_2O_3 (%)	1.1
Calcite, %	8	MgO (%)	21.22
Heavy metals		CaO (%)	13.50
As, mg/kg		Fe_2O_3 (%)	0.50
	2.6		
Cd, mg/kg	< 1	Na_2O (%)	0.30
Pb, mg/kg	1.16	K_2O (%)	0.34
Hg, mg/kg	0.02	Mn_2O_3 (%)	0.0 0.01