Animal Feed Science and Technology 184 (2013) 49–57

Contents lists available at SciVerse ScienceDirect

Animal Feed Science and Technology

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

Effect of *Echium amoenum* extract on the growth rate and fermentation parameters of Mehraban lambs

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ARTICLE INFO

Article history:
Received 30 October 2012
Received in revised form 30 May 2013
Accepted 3 June 2013

Keywords:
Echium amoenum
Ruminal parameters
Growth rate
Lamb

ABSTRACT

This study aimed to evaluate the effect of *Echium amoenum* extract (EAE) supplementation at four levels 0 (control), 0.3 (E2), 1.5 (E3) or 3 (E4) ml/kg DM on the growth rate, and rumen ecosystem of Mehraban lambs. Forty-eight, six month old male growing lambs (initial average live weight of 32.1 ± 3.9 kg) were randomly assigned according to a completely randomized design to receive different levels of EAE. Growth rate, rumen fermentation parameters, protozoa, cellulolytic bacteria, apparent diet digestibility and nitrogen retention were evaluated. Inclusion of EAE decreased ammonia-N concentration in rumen liquor (quadratic (*Q*), P=0.047) at two days of sampling (day of sampling 35, DS35, and day of sampling 70, DS70). However, total volatile fatty acids (TVFA) (DS35, linear (*L*), P=0.027; DS70, control *vs*. EAE, P=0.018) and propionate (C3) (DS35, *L*, P=0.023; DS70, *Q*, P=0.011) concentrations were increased and acetate (C2) (DS35, control *vs*. EAE, P=0.026; DS70, *L*, P=0.001) and C2:C3 decreased by the addition of EAE at both sampling times. EAE showed a defaunating activity, since the total protozoal population and *Entodininnae* subfamily decreased considerably (*L*, P<0.0001). Nitrogen retention was increased by EAE supplementation (*Q*, P=0.008). It is concluded that EAE improved ruminal fermentation through increasing MP and decreasing ammonia-N concentration, C2:C3 ratio and protozoal population. However, it failed to improve apparent diet digestibility and growth rate of Mehraban lambs.

1. Introduction

Inefficient use of protein and energy in ruminant nutrition is a major concern, which affects animal productivity. It has been reported that 700–850 g N/kg N ingested is excreted in the urine and feces which make the efficiency of N retention low in ruminants (Aarts et al., 1992). Plant extracts have been widely used to improve the efficiency of protein metabolism in the rumen by reducing amino acid deamination (Talebzadeh et al., 2012) and the reduction of the acetate to propionate ratio in the rumen (Eckard et al., 2010). Pen et al. (2007) found that adding *Yucca schidigera* and *Quillaja saponaria* extracts to the diet of sheep decreased the size of protozoal population and improved N metabolism, propionate concentration and acetate to propionate ratio. Moreover, Salem et al. (2011) reported that using natural extracts of *Salix babylonica* and *Leucaena leucocephala* in the diet of growing male lambs increased the organic matter (OM) digestibility and improved growth performance.

Abbreviations: ADF, acid detergent fiber; ADG, average daily gain; C2:C3, acetate/propionate; control, 0 ml of EAE; CP, crude protein; DMI, dry matter intake; E_2, 0.3 ml of EAE; E_3, 1.5 ml of EAE; E_4, 3 ml of EAE; EAE, *Echium amoenum* extract; EE, ether extract; FCR, feed conversion ratio; NDF, neutral detergent fiber; OM, organic matter; VFA, volatile fatty acids.

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http://dx.doi.org/10.1016/j.anifeedsci.2013.06.002

Table 1
Ingredients and nutrients composition (g/kg DM) and metabolizable energy (ME) for the experimental diets given to sheep.

	g/Kg DM
Ingredients	
Alfalfa hay	400
Barley grain	355
Soybean meal	170
Wheat barn	60
Sodium bicarbonate	5
Commercial vitamin and mineral premix	5
Salt	5
Nutrients composition	
Dry matter	928.5
Organic matter	861
Ether extract	29.9
Crude protein	145
Neutral detergent fiber	397
Acid detergent fiber	187
ME (MJ/KgDM)[a]	10.46

[a] ME was calculated using equations of Menke and Steingass (1988) as: ME (MJ/kg DM) = 2.20 + 0.136 × Gp + 0.057 × CP + 0.0029 × XL^2 where CP is crude protein in g/100 g DM,Gp is the net gas production (ml) and XL^2 is crude lipids from 200 mg DM after 24 h of incubation.

Echium amoenum belongs to Boraginaceae family, and has many uses in Iranian ethnic medicine and its antimicrobial properties have been reported by Mehrabani et al. (2005). Studies have shown that the antimicrobial effect can be attributed to either the presence of saponin (Shafaghi et al., 2002) or rosmarinic acid (a phenolic compound) (Ghassemi et al., 2003). To the best of our knowledge, no information is available on the response of ruminants to *Echium amoenum* extract (EAE).

The aim of the current study was to assess the effect of EAE on the growth rate, rumen fermentation parameters, and apparent diet digestibility in growing Mehraban lambs.

2. Materials and methods

2.1. Plant extract

EAE was obtained using the method described by Goel et al. (2008). In brief, the shade-dried samples of *E. amoenum* were finely ground and stored at room temperature until extraction. For EAE preparation, 20 g of dried ground sample were suspended in 400 ml of 500 ml/L aqueous ethanol solvents, stirred overnight and centrifuged (3000 × *g* for 10 min). The supernatant was collected and the ethanol was evaporated in a rotary vacuum evaporator at 45 °C. The remaining aqueous solution was stored at 4 °C until used. The total saponins content of EAE was estimated by using the method described by Hiai et al. (1976).

2.2. Animals and diets

Forty-eight Mehraban growing male lambs, 6 month old, (32.1 ± 3.9 kg; mean initial BW ± S.D.) were penned individually and allowed 2 weeks to adapt to the experimental conditions. At the start of the adaptation period, all the animals were treated for external (1 ml of Azantole 10% per 7 l of water, as spraying method; Bayer, Germany) and internal (Triclabendazole + levamisole, 12 ml per each lamb; Darou-Pakhsh Co., Iran) parasites and vaccinated against enterotoxaemia (3 ml per each lamb; Razi Vaccine and Serum Research Institute, Iran). They were randomly divided into four groups (each with twelve sheep), then allocated to the basal diet (Table 1) including different level of EAE (*i.e.*, 0 (control), 0.3 (E2), 1.5 (E3) or 3 (E4) ml of EAE/kg diet DM). The animals were fed to meet requirements of growth rate of 300 g/day according to NRC (2007). EAE was added to the diet at 08:30 h by pipette. The animals were fed thrice daily (08:30, 14:30 and 20:30 h). Every morning and before feeding the animals, excess feed from the previous day was collected and the orts (refusals) were weighed. The forage to concentrate ratio was 40:60. Fresh water was freely available at all times.

2.3. Growth performance

Animals were weighed at 14-d intervals throughout the total trial, which lasted for 97 d. Average daily gain (ADG) was calculated for each sheep from regression analysis of live weight *vs.* time from day 1 to day 97 of each treatment. Feed conversion ratio (FCR) was calculated as the ratio between DMI and ADG.