Animal Feed Science and Technology 163 (2011) 93–98

Contents lists available at ScienceDirect

Animal Feed Science and Technology

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

Effects of dietary forage-to-concentrate ratios on performance and carcass characteristics of growing fat-tailed lambs

N. Papi [a], A. Mostafa-Tehrani [a,*], H. Amanlou [b], M. Memarian [b]

[a] Institute of Animal Science Research, Shahid Beheshti St., P.O. Box 31585, Karaj, Iran
[b] Department of Animal Science, Zanjan University, P.O. Box 45371, Zanjan, Iran

ARTICLE INFO

Article history:
Received 18 October 2009
Received in revised form 17 October 2010
Accepted 19 October 2010

Keywords:
Forage-to-concentrate ratios
Growth performance
Carcass characteristics
Chall lambs

ABSTRACT

This study was conducted to evaluate the effects of using different dietary forage-to-concentrate ratios on growth performance and carcass characteristics of eighty Chall male fat-tailed lambs, averaging 165 ± 15 (SD) days of age and body weight of 38.4 ± 4.8 (SD) kg, randomly assigned to four diets containing alfalfa hay-to-concentrate ratios (DM basis) of 70:30 (C30), 50:50 (C50), 30:70 (C70), 10:90 (C90). Metabolizable energy (ME) contents were, 9.12. 9.96, 10.67, and 11.34 MJ/kg dry matter (DM) and crude protein (CP) contents were 143, 152, 161, and 174 g/kg for the C30, C50, C70, and C90 diets, respectively. Sixteen lambs (4 lambs/treatment) were slaughtered at the end of feeding period (84 days). Dry matter intake and feed conversion ratio (FCR) (i.e., kg DM/kg gain) decreased linearly ($P<0.001$) as concentrate level increased in the diet. However, a linear increase ($P<0.001$) for ME intake and a quadratic increase for average daily gain (ADG, $P<0.001$) and final body weight ($P<0.01$) were observed with increasing dietary concentrate. Slaughter weight, eye muscle area, and weights of lean, bone, neck, shoulder, rack–loin, leg, skin, head, lung, and spleen were not affected by the experimental diets. However, as dietary concentrate increased, a linear increase for dressing percentage, feet weight ($P<0.001$), and backfat thickness ($P<0.02$), a quadratic increase for empty body weight (EBW, $P<0.02$), weights of hot and cold carcass ($P<0.001$), subcutaneous fat ($P<0.02$), total fat ($P<0.01$), brisket–flank ($P<0.04$), and tail fat ($P<0.001$), a linear decrease for weights of liver ($P<0.01$), and heart ($P<0.05$), and a quadratic decrease for lean-to-fat ratio ($P<0.02$) were observed. This study indicates that in Chall fat-tailed lambs the increase of dietary concentrate (up to 700 g/kg) improves growth rate, FCR and dressing percentage with negative effect on carcass lean-to-fat ratio.

1. Introduction

Lambs fattened for slaughter are one of the major sources of red meat required for increasing consumer demands in Iran. Lamb rearing mainly depends on grazing alone is not sufficient for optimizing live weight gain. Optimum growth can be obtained with appropriate combination of concentrate and forage in the lamb's diet. Finishing lambs on pasture- or forage-based diets may offer leaner carcasses but may lead to decreased growth rate and carcass weight. In contrast, fattening lambs on concentrate-based diets resulted in faster, more efficient growth and heavier carcasses (Murphy et al., 1994).

Abbreviations: ADF, acid detergent fiber; ADG, average daily gain; aNDF, neutral detergent fiber; C30, C50, C70, and C90, diets with alfalfa hay-to-concentrate ratios of 70:30, 50:50, 30:70, and 10:90, respectively; CP, crude protein; DM, dry matter; FCR, feed conversion ratio; FBW, final body weight; ME, metabolizable energy.

* Corresponding author. Tel.: +98 261 443 0010; fax: +98 261 446 4230.
E-mail address: atehrani7m@gmail.com (A. Mostafa-Tehrani).

0377-8401/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.anifeedsci.2010.10.010

Table 1
Ingredient and chemical composition of the experimental diets (DM basis).

Item	Experimental diets[a]			
	C30	C50	C70	C90
Ingredient (%)				
Alfalfa hay, 15% CP	70	50	30	10
Barley grain	7.5	15	22.5	29
Maize	9	15	20	25
Soybean meal, 43% CP	5	10	15	20
Molasses, sugarcane	5	5	5	5
Fish meal, 59% CP	0.2	0.2	0.2	2
Wheat bran	1.3	2.66	4	4.77
Dicalcium phosphate	0.77	0.74	0.57	0.29
Mineral mix[b]	0.25	0.25	0.25	0.25
Vitamin mix[c]	0.25	0.25	0.25	0.25
Limestone	0.03	0.2	0.85	1.35
Salt	0.5	0.5	0.5	0.5
Bicarbonate sodium	0.2	0.2	0.88	1.59
Chemical composition (g/kg)				
Crude protein	143	152	161	174
Metabolizable energy (MJ/kg)	9.12	9.96	10.67	11.34
ADF[d]	208	168	112	72
aNDF[d]	368	336	248	226
Calcium	11.6	10.8	9.4	9.0
Phosphorus	3.7	4.2	4.3	4.4

[a] C30, C50, C70, and C90 refer to diets with alfalfa hay-to-concentrate ratios of 70:30, 50:50, 30:70, and 10:90, respectively.
[b] Supplies per kg of diet: 99.2 mg Mn, 50 mg Fe, 84.7 mg Zn, 10 mg Cu, 1 mg I, and 0.2 mg Se.
[c] Supplies per kg of diet: 9000 IU vitamin A, 2000 IU vitamin D, and 18 IU vitamin E.
[d] ADF: acid detergent fiber; aNDF: neutral detergent fiber.

The literature shows that increasing concentrate portion of forage-based diets for growing ruminants can improve production efficiency via reducing visceral heat production and energy cost of excreting fecal dry matter (DM) and urinary nitrogen (Moody et al., 2007). In addition, the efficiency of utilization of absorbed nutrients for synthesis of animal tissues or products is usually increased when grain is incorporated into a forage diet (Dixon and Stockdale, 1999).

Although it is a usual practice to use high-concentrate diets in the intensive lamb fattening systems in Iran, it is not well determined the best level of concentrate for finishing lambs of fat-tailed breeds. Moreover, the responses of lambs to high-concentrate diets depend on the type and level of used energy and protein supplements. In most of the previous fattening studies, high-concentrate diets have been provided by increasing only the energy levels of diet, but there is a rare research to use high-concentrate diet with increasing both energy and protein levels. Objective of this experiment was to determine the effects of increasing ratios of forage-to-concentrate by adding energy and protein levels in complete pelleted diets on performance and carcass characteristics of Chall growing fat-tailed lambs.

2. Materials and methods

Eighty weaned uncastrated male lambs of the fat-tailed Chall breed with an average of 165 ± 15 (SD) days of age and initial body weight of 38.4 ± 4.8 (SD) kg were blocked into 4 groups of 20 animals each (homogenous in age and weight). Lambs were randomly assigned to 4 dietary treatments, 4 replicates of 5 animals per treatment (group fed). During the first three weeks of trial, lambs were adapted to their diets, treated for external (Azantole, Bayer, Germany) and internal (Triclabendazole + levamisole, Darou-Pakhsh Co., Iran) parasites and vaccinated against enterotoxemia and foot and mouth disease. Lambs were housed in concreted floor pens (1.5 m × 8 m, 5 lambs/pen) in an open shed building and were allowed *ad libitum* access to feed, salt lick and water throughout the trial.

The experimental diets were formulated according to the requirements recommended by National Research Council (1985) and consisted of four alfalfa hay-to-concentrate ratios of 70:30 (C30), 50:50 (C50), 30:70 (C70), and 10:90 (C90). Alfalfa hay was chopped into short lengths (2–3 cm), mixed with concentrates and then prepared in pelleted complete rations The pellets were made in cylindrical shape with diameter of 1.5 cm and length of 2.5 cm. Metabolizable energy (ME) contents were 9.12, 9.96, 10.67, and 11.34 MJ/kg dry matter (DM) and crude protein (CP) contents were 143, 152, 161, and 174 g/kg for the C30, C50, C70, and C90 diets, respectively (Table 1). Lambs were fed three times a day at 8:00, 14:00 and 20:00 h for 84 days. Individual feed intake was recorded by subtracting weight of the daily offered feed from refused quantities for each 5-animal group and then dividing it by 5. All lambs were individually weighed on days 0, 21, 42, 63, 84 at 8:00 h after 16 h feed deprivation. Average daily gain (ADG) for individual lambs was calculated using sum of average daily gains of every 3 week record divided by 4 (times of BW recording). Feed conversion ratio (FCR) for each lamb was calculated as a ratio of daily DM intake to ADG.