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Productive performance and carcass characteristics of lori-bakhtiari finishing lambs supplemented with sodium bicarbonate or magnesium oxide

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Effect of sodium bicarbonate (SB) and magnesium oxide (MgO) in high concentrate fed Lori-Bakhtiari lambs was studied on productive performance and carcass characteristics. Eighteen weaned (90 days old) Lori-Bakhtiari male lambs divided into three equal groups were fed basal diet. Each group received a basal diet for 75 days with one of the following three treatments: (1) no additives (NA); (2) 0.05% magnesium oxide and (3) 0.2% sodium bicarbonate. Lambs were individually confined to 1.5 m^2 metabolic cages. Cold and hot carcass weight (kg) and hot dressing (%) were higher in group receiving MgO than the SB group (p<0.05). There were no significant different (p>0.05) in visceral fat contents (kidney, rumen mesenteric) in lambs of control and treated groups. Body weight (kg) and average daily gain (ADG) was higher in group receiving MgO than the SB group (p<0.05). No effect of MgO or SB in the diet was observed on weight of liver, lungs, blood and lie. Heart weight was greater (p<0.05) for lambs consumed diets supplemented with MgO. The results showed that the use of 0.05% magnesium oxide in the diet can increase dry matter intake, weight gain and improvement is weight and percent carcass than the control group and sodium bicarbonate.

Key words: Hot dressing, skin, lungs, lamb, carcass.

INTRODUCTION

The concentrate feeds are important components of the diet of ruminant animals. The lambs maintained on high-concentrate feed for maximizing gain usually exhibit rumen acidosis and lower fiber digestibility (Snyder et al., 1983; Krehbiel et al., 1995; Santra et al., 2003) due to changing rumen environment including pH and rumen microbial population. The cost per unit of energy of feedlot diet is lower with high-grain diets than with forage-based diets (Huntington, 1997). However, high-grain diets fed to lambs can cause digestive disturbances related to ruminal acidosis. Rumen acidosis has been defined as biochemical and physiological stresses

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Table 1. Ingredients (dry matter basis) and chemical composition of the basal diet.

Ingredient	Percentage
Wheat	14
Barley	33.8
Corn	3
Soybean meal	3.1
Cotton seed meal	3.8
Wheat bran	33
Rice bran	4
Anzymite	1.6
Mineral and vitamin per mix[1]	2
NaCl	0.3
[3]Ca	0.80
[3]P	0.6
Chemical composition (%)	
Crude protein	14.16
Neutral detergent fiber	36.4
Acid detergent fiber	20.6
Ash	6.3
Metabolizable Energy[2] (Mcal/kg)	2.6

[1]Supplies per kg of feed: 4.9 mg of Zn, 4.05 mg of Mn,0.45 mg of Cu, 0.075 mg of I, 0.1 mg of Se, 2.500 IU Vitamin A, 400 mg of Vitamin D, 2.5 IU Vitamin E. [2]Calculated metabolized energy. [3]Di calcium phosphate (DCP).

caused by a rapid production and absorption of organic acids in the rumen, which may cause severe damage to rumen papillae, in some cases severe ulceration of rumen wall (Britton and Stock, 1987). Acidosis can cause keratinization of rumen epithelium and various secondary disorders observed in feedlots animals, such as laminitis, polioencephalomalacia, rumenitis and liver abscesses (Huber, 1976; Owens et al., 1998). To prevent acidosis in feedlot cattle and lambs, feeding of fibrous material, in enough quantities and in a particle size that would stimulate rumination, is recommended to stimulate saliva production, counteracting a drastic reduction of ruminal pH. Additives or products that buffer rumen environment may prevent acidosis and improve the productive performance of feedlot animals that consume high-grain diets (NRC, 2001; Wallace and Newbold, 1993). Sodium bicarbonate and magnesium oxide are the additives most commonly used against acidosis. These additives can be included (0.5-2.5%) in diets (Coskun, 1998). The growth of animal as influenced by dietary buffer is studied by various workers (James and Whohlt, 1985; Nishino, 1994; Wondra et al., 1995), but little information is available on carcass quality (Mandebvu and Galbraith, 1999). Therefore, the objective of the present study was to observe the effect of magnesium oxide or sodium bicarbonate supplementation, in high concentrate fed lambs, on carcass characteristics and productive performance of Lori-Bakhtiari finishing lambs.

MATERIALS AND METHODS

Experimental location, animals, diets and sampling procedures

The experiment was conducted at Lori-Bakhtiari sheep breeding and culture center, shahrekord, iran. Eighteen Lori-Bakhtiariweaned (90 days old) lambs were divided into three equal groups, 1) Control group (No Additive), 2) Control group + 0.05% magnesium oxide (MgO) and 3) Control group + 0.2% sodium bicarbonate (SB). The lambs of control group were maintained on a complete diet containing 40:60, forage: concentrate ratio for 75 days. Sodium bicarbonate and magnesium oxide were added in the feed offer preparation in the required proportion. Ingredients and chemical composition of basal diet is presented in Table 1. All the lambs were individually fed throughout the study. Lambs were confined to individual metabolic cages (1.5 m^2) equipped with water and feed troughs. Diets were formulated to be isonitrogenous and contain 14.6% crude protein. Diets were offered three times daily at 8:00, 13:00 and 17:00 h. Feed offered was based on the intake of the previous day plus an additional 10% in order to reduce selection of feed components. This trial lasted for 75 days; including a 15-days adaptation period and 60-days data collection period. After adapting to the metabolic cages and experimental diets, lambs was weighed on provide baseline weights. At the end of the experiment, the lambs were transported to a slaughter house, where they were weighed before sacrifice. Hot carcass weight and dressing percentage (carcass weight as a percent of live weight) were recorded. Weights of skin, kidney, lungs, blood, heart, lie, legs and head were recorded.

Statistical analysis

Data were analyzed with an analysis of variance of a completely randomized design. Treatment effects on DM intake, weight body (0-30, 30-60 and 0-60 days), weight gain, feed efficiencies, slaughter weight, hot and cold carcass weight, hot and cold dressing percentages, weight of visceral organs, were analyzed using the GLM procedure of a completely randomized design (SAS, 2009). Initial live weight was used as a variable and covariance analysis was conducted on live weight gain. The significant treatment means were compared by Duncan's multiple range test (Duncan, 1995).

RESULTS

Feed efficiency, DM intake, Body weight (0-30, 30-60 and 0-60 days), live weight gain

Feed efficiency (Table 2) of lambs was influenced by SB ($p<0.05$). More feed was required per unit of gain when MgO was added to the ration ($p<0.05$). Feed efficiency expressed as kg feed/kg daily weight gain averaged 7.03 for lambs fed ration with 0.2% sodium bicarbonate. It appears that since the lambs were not at maturity, most of the feed energy may have been used primarily for muscular synthesis, and very little for fat deposition, throughout the 60- days study. Treatments means of DM intake (kg), body weight (0-30, 30-60 and 0-60 days) and body weight gain (kg/day) of lambs are presented in Table 2. Initial body weight (kg) of lambs did not differ ($p>0.05$) among treatments (Table 1). Effect of period (0-30 versus 30-60 and 0-60 days) on body weight was not

Table 2. Feed intake, body weight, weight gain and feed efficiency of lambs fed finishing diets with Magnesium Oxide (MgO) Sodium Bicarbonate (SB) during the 60-days trial

Item	NA	MgO	SB
Initial body weight(kg)	39.31 ± 0.74[a]	40.03 ± 1.37[a]	40.38 ± 0.86[a]
Body weight (kg)			
0-30 days	46.14 ± 4.63[a]	46.06 ± 5.62[a]	41.96 ± 3.24[a]
30-60 days	49.56 ± 4.11[a]	51.18 ± 9.27[a]	48.25 ± 3.66[a]
0-60 days	53.76 ± 0.65[b]	56.48 ± 2.43[a]	54.45 ± 1.75[ab]
Average daily gain (g/day)	199 ± 0.01[b]	247 ± 0.14[a]	206 ± 0.01[b]
Feed intake (kg)	141.06 ± 0.28[a]	146.13 ± 1.57[a]	128.64 ± 1.13[b]
Feed efficiency (intake/gain)	9.43 ± 0.28[a]	7.83 ± 0.53[b]	7.03 ± 1.34[b]

[a-b]Values in the same row without a common superscript letter are significantly different (P<0.05).

Table 3. Hot and carcass weight and dressing percentage of lambs fed finishing diets with magnesium oxide and sodium bicarbonate.

Carcass trait	NA	MgO	SB
Slaughter weight (kg)	52.46 ± 0.28[c]	58.35 ± 0.83[a]	55.41 ± 1.31[b]
Hot carcass weight (kg)	26.06 ± 0.87[c]	30.38 ± 0.63[a]	28.71 ± 1.34[b]
Chilled carcass weight (kg)	25.03 ± 1.18[c]	29.36 ± 0.53[a]	27.76 ± 1.29[b]
Hot dressing (%)	49.67 ± 1.65[b]	52.07 ± 0.99[a]	51.79 ± 1.29[a]
Chilled dressing (%)	48.34 ± 3.04[a]	50.68 ± 1.41[a]	50.08 ± 1.19[a]

[a-b]Values in the same row without a common superscript letter are significantly different (P<0.05).

significant (p>0.05). DM intake was different among treatments (p<0.05) during the entire 60- days period. Dry matter intake was 141.06±0.28, 146.13±1.57 and 128.64±1.13 (kg) for NA, MgO and SB treatments. Body weightof lambs during 30-60 and 0-60 days was different (p<0.05) among treatments, so that during days 30-60 and 0-60, body weight was significantly greater (p<0.05) for treatments with MgO. Weight gain of lambs was change (p<0.05) among treatments. Average weight gain was 199±0.01, 247±0.14 and 206±0.01 g/d for NA, MgO and SB treatments.

Carcass weights and dressing percentage

The effects of MgO and SB in ration on carcass weight and dressing percentage are presented in Table 3. Weight (kg) of lambs slaughtered was different among treatments (p<0.05). Weights were 52.46±0.28, 58.35±0.83 and 55.41±1.31 kg for NA, MgO and SB, respectively. Hot and cold carcass weight were affected (p<0.05) by treatments in the diet. Hot carcass weights of 26.06±0.87, 30.38±0.63 and 28.71±1.34 kg and cold carcass weights of 25.03±1.18, 29.36±0.53 and 27.76±1.29 kg were for NA, MgO and SB, respectively. Hot dressing percentages affected (p<0.05) by treatments in the diet. Hot dressing percentages were 49.67±1.65, 52.07±0.99 and 51.79±1.29% for NA, MgO and SB. Chilled dressing percentages were not affected (p>0.05) by treatments.

Fat distribution (weight in gram)

The depot (non- carcass) fat distribution in both control and treated lambs are presented in Table 4. There was no significant difference in visceral fat contents kidney fat, mesenteric fat and rumen fat control and treated groups (p>0.05). Scrotal fat (g) were affected by treatments (p<0.05). Scrotal fat weights of 24.66±14.01, 44.83±17.27 and 36.5±3.61 g for NA, MgO and SB, respectively.

Visceral organ weight

Weights of skin (kg), heart (g), legs (kg) and head (kg) were affected (p<0.05) by MgO and SB in the ration (p<0.05). Experimental results showed no significant difference on liver weight, lungs, blood and lie (p>0.05).

Table 4. Fat distribution (weight in gr) of lambs fed fattening diets with magnesium oxide (MgO) and sodium bicarbonate (SB).

Trait	NA	MgO	SB
Scrotal around fat (g)	24.66 ± 14.01[b]	44.83 ± 17.27[a]	36.5 ± 3.61[ab]
kidney around fat (g)	81.33 ± 20.59[a]	90.16 ± 15.35[a]	94 ± 3.84[a]
Rumen around fat (g)	0.347 ± 0.173[a]	0.604 ± 0.258[a]	0.486 ± 0.137[a]
Mesentric around fat (g)	46.20 ± 9.58[a]	46.21 ± 6.65[a]	41.75 ± 12.3[a]

[a-b]Values in the same row without a common superscript letter are significantly different (P<0.05).

Table 5. Weight of visceral organs of lambs fed finishing diets with magnesium oxide and sodium bicarbonate.

Item	NA	MgO	SB
Skin (kg)	3.845 ± 0.21[b]	4.483 ± 0.26[a]	4.375 ± 0.37[a]
Liver (kg)	0.873 ± 0.04[a]	0.797 ± 0.22[a]	0.777 ± 0.06[a]
lungs (kg)	0.562 ± 0.03[a]	0.553 ± 0.09[a]	0.556 ± 0.06[a]
Blood (kg)	2.618 ± 0.25[a]	2.726 ± 0.21[a]	2.611 ± 0.25[a]
Heart (kg)	0.209 ± 0.01[b]	0.227 ± 0.01[a]	0.226 ± 0.02[a]
Lie (kg)	0.09 ± 0.003[a]	0.08 ± 0.006[a]	0.07 ± 0.009[a]
Foots (kg)	1.20 ± 0.08[b]	1.32 ± 0.07[a]	1.25 ± 0.09[ab]
Head (kg)	2.62 ± 0.12[b]	2.73 ± 0.09[a]	2.58 ± 0.05[b]

[a-b]Values in the same row without a common superscript letter are significantly different (P<0.05).

DISCUSSION

Dry matter intake, body weight (0-30, 30-60, 0-60 days), average daily gain and feed efficiency

Dry matter intake (DMI), body weight (30- 60 and 0-60 days) and daily weight gain was increase in fed lambs with MgO supplement (p<0.05). Supplementation of MgO in the diet of animals is known to increase the number of total ruminal as well as cellulolytic bacteria which could have contributed to better cellulose digestibility (Koul et al., 1998). In addition, in agreement with the results of the present study Linda and Wohlt (1985) also reported that the addition 0.18% MgO in diet finishing lambs improved the dry matter intake of lambs. Body weight 30-60 and 0-60 days vs. 0-30 increased linearly (p<0.05) with increasing MgO supplementation. However, Fisher and Mackay (1983) reported that the addition of MgO improved weight gain in animals feed diet low in protein, with no benefit with high protein diets. The addition of MgO in the diet did not improve feed efficiency of lambs in this study. Feed efficiency of lambs fed with SB diet improved in comparative with control group. Nicholson and Cuningham (1961) observed that the addition of 2 to 6% SB to ruminant ration improve the feedlot calves performance.

Carcass weight and dressing percent

Pre-slaughter weight was higher in MgO supplement group than in the control group. Hot and chilled carcass weight and hot dressing percentages were affected by the addition MgO and SB to the diets of lambs. Higher dressing percentage in MgO and SB in the present study resulted mainly from pre-slaughter weight differences as well as the proportion of gastro intestinal tract and its content with respect to live weight. Neither Fimbres et al. (2002) nor Petit et al. (1997) found differences in carcass dressing percentage of lambs fed diets with various levels of forage and concentrate.

Fat distribution (weight in gram)

The depot (non- carcass) fat distribution in both control and treated lambs are presented in Table 4. There was no significant difference in visceral fat contents (kidney, rument and mesenteric fat) in lambs of control and treated groups. No significant effect in visceral fat content was also observed by Mandebvu and Galbraith (1999) in young male lambs supplemented with sodium bicarbonate. Subcutaneous fat was poorly developed in control and treated groups and may be due to breed-specific characteristics. It is established that the adapted tropical breed in order to facilitate thermolysis by cutaneous evaporative codling, deposits more fat in the viscera rather than in the subcutaneous region.

Effect on the size of internal organs

In our study, weights of liver, lungs, blood, lie did not differ (p>0.05) between the treatment and control groups (Table 5). In a study by Fimbres et al. (2002) with feedlot lambs, no difference in visceral organ weight was observed. In both our study and that of Fimbres et al. (2002), feed was offered adlibitum. The reduction in visceral organ mass seemed to be partly responsible for lowered maintenance energy requirements. Large proportion of animal maintenance energy requirements can be attributed to the visceral organs, especially the liver and the gastro-intestinal treat (GIT), and seem to be associated with the high rates of protein synthesis and degradation in these tissues (Ferrel and Jenkins, 1985).

Conflict of Interests

The author(s) have not declared any conflict of interests.

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