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Effect of Different Energy Levels of Diet on Feed Efficiency, Growth Rate and Carcass Characteristics of Fattening Bahmaei Lambs

[1]Sayed-Majid Hosseini, [2]Sayed-Mostafa Akbary, [3]Naser Maheri-Sis and [3]Afshar Mirzaei Aghsaghali
[1]Research Center of Agriculture and Natural Resources, Kohgiloyeh and Bovir Ahmad, Iran
[2]Department of Animal Science, Islamic Azad University, Yasouj-Branch, Yasouj, Iran
[3]Department of Animal Science, Islamic Azad University, Shabestar-Branch, East Azerbaijan, Shabestar, Iran

Abstract: This study was conducted to evaluate the effect of 3 experimental treatment including different metabolizable energy levels (T_1 = 2.34, T_2 = 2.47 and T_3 = 2.6 Mcal kg^{-1} DM) on performance and carcass characteristics of Iranian native sheep (Bahmaei). At the beginning of the experimental period the body weight of lambs on average was 26±1.7 kg and 90 days of age. Forty-eight Bahmaei male lambs were randomly distributed into 3 dietary treatments with 4 replicates based on completely randomized design. Total experimental period was 90 days. Average Daily Gain (ADG), Average Daily Feed Intake (ADFI), Feed Conversion Ratio (FCR), live weights at slaughter, cold carcass weights and body fat weight (abdominal fat + tallow) were recorded during experimental period and after slaughtering. Metabolizable energy levels did influence the all of above mentioned parameters. The ADG in treatment 3 (T_3) was significantly ($p<0.05$) higher than that of treatment 1 and 2 (T_1 and T_2). The ADFI in T_1 was significantly ($p<0.05$) higher than that of T_2 and T_3. Carcasses from the T_2 and T_3 diet lambs were similar and higher than that T_1 diet. Live weight at slaughter and cold carcasses weight in T_3 was significantly higher than that of T_1 ($p<0.05$) while, T_2 was similar to T_1 and T_3. The body fat weight were significantly ($p<0.05$) higher for carcasses from T_3 diet lambs compared with those from T_1 and T_2. This study indicated that ADG, FCR, live weights at slaughter, cold carcass weights and body fat weight (abdominal fat + tallow) were altered by different energy levels and under intensive feeding, the Bahmaei male lambs were produced desirable carcass and ADG using T_3 diet.

Key words: Feed efficiency, growth rate, carcass, male lambs, metabolizable energy

INTRODUCTION

Small ruminants, especially sheep, are growing in importance for animal production worldwide. The proper growth and development of growing lambs and goats depends heavily on the animals' level of nutrition. Based on the nutrient requirements of sheep, the suggested nutritional regimen of young finishing lambs weighing approximately 30 kg should be comprised of a 60% concentrate and 40% forage diet (NRC, 1985; Louvandini *et al*., 2006).

It also is inherent that these concentrate: Forage diet is balanced to obtain optimum animal performance. Protein is an essential dietary element that is necessary for proper soft tissue development in growing lambs. Ruminal microbes possess the ability to digest feeds and synthesize proteins. These microorganisms can either use protein or non-protein nitrogen to synthesize microbial protein. Microbial protein so produced, coupled with other dietary proteins that escape ruminal degradation pass through the digestive tract to be absorbed in the small intestine. The majority of this dietary escape protein is incorporated from the concentrate portion of the diet. The protein requirement of male lambs declines from 18% crude protein in the dry matter in the early stage of life to 12% at liveweights above 40 kg, while those of female lambs are about 2% units lower. Male kids responded linearly to increased protein level in the diet whereas female response was marginal. Growth responses of kids to level of protein tend to decline at higher live weight and/or age than lambs (Timon and Hanranhan, 1985; NRC, 1985; Schilling, 2005).

Energy is another major dietary element that is responsible for the efficient utilization of nutrients and thereby the productivity and gain of an animal. Dietary energy comes from the starches, simple sugars, cellulose,

Corresponding Auhtor: Naser Maheri-Sis, Department of Animal Science, Islamic Azad University, Shabestar-Branch, East Azerbaijan, Shabestar, Iran

hemicellulose and fructans that are provided by the grain and forage fractions of the diet. Energy can be divided into 2 categories: Energy needed for maintenance and energy needed for growth. The NRC (1985) defines energy for maintenance as an animal's energy requirements for maintenance are that amount of dietary energy it must consume daily to neither gain nor lose body energy. The energy obtained from the diet that exceeds the energy required for maintenance is then defined as energy for gain. Inadequate nutrition, particularly of energy, depressed the reproductive performance of extensively or intensively managed sheep. Sexual maturity of sheep and goats is advanced by good feeding and the energy stimulates oestrus activity within the normal breeding season, ovulation rate, fertilization and survival of ova and the maintenance of the resultant embryos to term as viable lambs. The performance of lambs grazing poor pastures is low because of low feed intake (inadequate feed supply and low quality roughage) resulting in low energy intake. The importance of adequate nitrogen intake in relation to energy intake for the performance of lambs and kids has been extensively studied. Energy intake is the most important factor determining milk production in intensive systems, particularly in the early stages of lactation in sheep and goats. Mineral and vitamin concentrations also are an important component of a balanced diet (Owen, 1976; Orskov, 1982; NRC, 1985; Timon and Hanranhan, 1985).

The aim of present study, was to evaluate effects of different energy levels in diets on performance (growth rate, feed conversion ratio and feed intake) and carcass characteristics of Bahmaei male lambs.

MATERIALS AND METHODS

Animals and diets: Forty-eight Bahmaei male lambs (initial BW 26±1.7 kg and 90 days old) were randomly distributed into 3 dietary treatments with 4 replicates. The lambs were housed in groups of 4 in 12 cages under standard conditions of temperature, humidity and ventilation. Pens were assigned at random to the diets. The 3 different energy levels as treatments (T_1 = 2.34, T_2 = 2.47 and T_3 = 2.6 Mcal kg^{-1} DM) witch used in the study are presented in Table 1. The lambs were adapted each diet for 10 days and used over a period of 90 days. All diets contained 12% crude protein in the dry matter. The diet was formulated according to requirements recommended by the NRC (1985) (Table 1). Data was collected every week on live weight gain and feed consumption. These were used to compute the Average Daily Gain (ADG), Average Daily Feed Intake (ADFI) and Feed Conversion Ratio (FCR). Because of a curvilinear relationship between

Table 1: Composition and chemical analysis of the experimental diets

Ingredient (%)	T_1	T_2	T_3
Barley	41.26	52.90	60.80
Alfalfa hay	37.35	25.73	14.94
Beep pulp	7.65	5.27	3.06
Wheat barn	12.74	15.10	20.20
Vitamin-mineral mix	1.00	1.00	1.00
Chemical analysis (%)			
Dry matter	91.00	91.00	91.00
Crude protein	12.00	12.00	12.00
Crude fat	3.22	2.91	2.71
ADF	18.56	15.21	12.35
Ash content	5.90	5.17	4.55
Calcium	0.70	0.74	0.78
Phosphorus	0.23	0.25	0.26
Metabolizable energy (Mcal kg^{-1})	2.34	2.47	2.60

ADF = Acid Detergent Fiber; ADG = Average Daily Gain; ADFI = Average Daily Feed Intake; FCR = Feed Conversation Ratio

Average Daily Gain (ADG) and cumulative feed intake, feed efficiency was estimated using the allometric equation (Roux, 1976) and defined as the ratio of the relative change in body weight (g) over time to the relative change in cumulative feed intake (kg) over time.

Carcass characteristics: At the age of 180 days, 4 animals were randomly selected from each of the treatments and starved for 24 h, while water was provide *ad libitum*. Live weights at slaughter, cold carcass weights and body fat weight (abdominal fat + tallow) were recorded.

Statistical analysis: Statistical analysis was performed using SPSS (2002) for a Completely Randomized Design (CRD). Since, all animals were slaughtered at the same age, carcass characteristics were analyzed using the Completely Randomized Design (CRD). Analysis of variances was carried out on all the parameters and means separated by the Least Significant Difference (LSD) as described Little and Hills (1978).

RESULTS AND DISCUSSION

Growth performance and feed intake: Results for growth traits are presented in Table 2. Lambs that received the highest energy level diet (T_3) had a higher ($p<0.05$) ADG than that received the low and middle energy diets (T_2 and T_3). This finding is in agreement with several previous studies (Tatum *et al*., 1988; McClure *et al*., 1994). Besides nutrient supply, hormonal or environmental factors may indirectly or directly alter growth rate. Precisely how factors such as environmental temperature, day length, breed type, parasites, disease, competition and exercise influence size of specific organs and site of lipid deposition during growth or at maturity, remain largely unknown. Some may act through controlling feed intake

Table 2: Growth rate and feed intake of lambs fed diets with three different levels of energy during experimental period (90 days)

Parameters	T_1	T_2	T_3
ADG (g day^{-1})	197.25^c	209.25^b	218.25^a
ADFI (kg day^{-1})	1.42^a	1.36^b	1.32^c
FCR (%)	7.20^c	6.50^b	6.04^a

^{a,b,c}Means in the same row with different superscripts differ ($p<0.05$). ADG = Average Daily Gain; ADFI = Average Daily Feed Intake; FCR = Feed Conversation Ratio

Table 3: Effects of different energy levels of diets on live weights at slaughter, cold carcass weights and body fat weight of Bahmaei male lambs

Parameters	T_1	T_2	T_3
Live weight at slaughter (kg)	43.75^b	44.83^{ab}	45.64^a
Cold carcass weight (kg)	21.24^b	21.78^{ab}	22.21^a
Body fat weight (abdominal fat + tallow) (kg)	4.34^b	4.42^b	4.57^a

^{a,b,c}Means in the same row with different superscripts differ ($p<0.05$)

of animals and the supply of nutrients above maintenance; others may alter blood hormone concentrations, blood flow and nutrient supply to specific body organs or locations (Owens, 1976). Additionally, lambs that received the T_1 diet had a more desirable FCR than the T_3 lambs, while the T_2 diet lambs were intermediate ($p<0.05$). These results can be explained, in part, by the finding of Fluharty *et al.* (1999). In this study, lambs that received the T_1 diet (low energy) had a higher ($p<0.05$) ADFI than received T_2 and T_3 diets (high energy). Level of feed intake can greatly affect bottom-line costs in livestock production. Although, lowered amounts of daily intake relate to corresponding decreases in costs of feeding, they also affect ADG and days on feed required to reach a target endpoint (Schilling, 2005). There are 2 major considerations affecting the amount of feed-other than milk-consumed directly by a lamb per lb. live weight produced. The first is its rate of growth. Naturally the faster a lamb grows the less time it takes to reach slaughter weight and therefore, the greater the saving in the costs of body maintenance. The second is the weight to which the lamb is carried before slaughter. As the lamb grows, the weight gains become progressively more expensive (Wallace, 1955).

Carcass traits: The results for carcass traits are presented in Table 3. High energy content was a significant ($p<0.05$) main effect for live weights at slaughter, cold carcass weights and body fat weight. Carcasses from the T_2 and T_3 diet lambs were similar and higher than that T_1 diet. Carcasses from the T_2 and T_3 diet lambs also had a significantly larger cold carcass weight than the T_1 diet. Lambs also, body fat weight (abdominal fat + tallow) were significantly ($p<0.05$) higher for carcasses from T_3 diet lambs due to the greater energy density of the diet (Louvandini *et al.*, 2006) compared with those from T_1 and T_2 diet lambs. Fat in the carcass has beneficial effects in terms of flavour and reduces dehydration, which occurs during the colding process. This dehydration makes the meat dark and dry, undesirable to the customer. Higher fat levels found in adult sheep are not desirable for sale purposes, because of poor texture and consistency, due to a high degree of saturated fatty acids, which adhere to the palate when not served hot (Louvandini *et al.*, 2006).

These results are in agreement with research, which showed that cattle (Smith *et al.*, 1987) and lambs (Crouse *et al.*, 1978) fed high-energy diets had a more rapid fat deposition and showed greater back fat thickness and kidney and pelvic fat than those fed a roughage diet. Although, quality and yield grades are the primary factors involved in assigning carcass value, many other measurements may be taken to more closely define the lean muscle mass and proportion of weight in carcasses. These include various fat and muscle measurements such as body wall thickness, leg circumference, longissimus muscle area and even individual primal cut weights (Schilling, 2005).

The slaughter weight of lambs and kids depends on the desired carcass quality and on seasonal price trends and also on the live weight, which minimizes total cost kg^{-1} carcass. Generally, lambs are slaughtered at about half the mature weight of the parents, whereas in the United States lambs are slaughtered at even higher live weights. With increasing carcass weight the fat content and calorific value of carcass increase and water content, ash and protein contents decrease. The dressing percentage and chemical fat content were increased by fattening in the feedlot and diets deficient in protein increased the fat to lean ratio in growing lambs. Goat carcasses have less fat than those of lambs. Females have fatter carcasses, at the same live weight, than males with castrates intermediate. Sheep and goats, unlike all species, are producing meat at an increasing rate but far below their potential. Again increases are more rapid in developing countries. Meat production does tend to decline as numbers increase, as more replacement animals mean fewer slaughter animals. Nutrition is a key point in the standardization of lamb carcasses that is required to improve market value of the product and to attract consumers. Carcass must have a high percentage of muscle, uniform subcutaneous fat deposit and adequate fat levels to fulfill market requirements. All these traits are influenced by the degree of maturity of the genotype. Conformation and fattening score of carcasses are criteria that define quality and carcass finished with good conformation tends to have better prices at sale, especially in countries with tradition in lamb and mutton production (Owen, 1976; Timon and Hanranhan, 1985; Louvandini *et al.*, 2006).

CONCLUSION

In an over all conclusion it can be said that increasing metabolizable energy levels in lamb's diets resulted in increasing growth and carcass performance. Of course the economical analysis should be doing in different environmental and economical conditions. Therefore, further researches with economical consideration can be required.

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