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Effect of feedlotting on nutrient intake and growth performance of sheep raised under temperate climatic conditions

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Abstract
The objective of present study was to explore the effect of feedlotting on growth parameters of crossbred lambs in temperate climate. The term "feedlotting" is basically a management practice in which frequent efforts are made by lamb producers to accomplish an unfailing supply of lamb that encounters weight and fat score as per market specifications A total of 10 crossbred lambs (around one year of age) were randomly divided in two equal groups *viz*. Control (CON) and treatment (FL) with 5 replicates in each group. In CON group the experimental lambs were fed by thumb rule method and FL group was fed under feedlot. To estimate the growth parameters fortnightly, a growth trial of 74 days (including 14 days adaptation) was conducted. At the end of experiment a metabolic trail of 7-days was conducted. The study indicated non-significant difference in terms of DMI, OMI, gain in body weight, ADG, FCR, digestibility coefficients of different nutrients, intake of nutrients (DDMI and TDNI), except DCPI (g/d) which differ significantly showing better results in FL group. Thus, it can be concluded from the present experiment that feedlotting had no contrary influence on the performance of crossbred lambs and can be successfully reared in feedlots under temperate climatic conditions.

Keywords: Feedlot, finishing lamb, growth performance, digestibility, nutrient intake

1. Introduction

To increase the live weight and enhance the carcass quality, the strategic intensive feeding of animals for a short span of time can be employed when locally available feedstuffs are in abundance. This short term of feeding animals intensively before sale is much more economically feasible when compared to the rearing systems where animals are kept on maintenance diets for a longer period of time. Finishing of sheep and goats in feedlot involves intensive feeding upto the slaughter weight with satisfactory finish (fat deposit) is attained. Feedlotting is a management practice in which frequent efforts are made by lamb producers to accomplish an unfailing supply of lamb that encounters weight and fat score as per market specifications (Barros *et al*., 2009) [5]. It permits producers to uphold production when there is limited pasture accessibility, to attain rapid growth when there are low feed prices, to create cash flow and value addition to ration components like grains and offers flexibility to finish lambs irrespective of seasonal conditions (Duddy *et al.*, 2007) [9].

Today farmers are increasingly adapting the technology of finishing lambs in feedlot, however, the demand of nutrients by the animals is very high. The feedlots bring various benefits in finishing lambs like greater weight gain, lower age at slaughter, higher carcass yield, lower mortality, and lower worm infestations (Barros *et al*., 2009) [5]. To meet the energy demands needed for the growth of lambs in feedlots, feed constituents with less fibre and high starch are incorporated in the diets (Kleen *et al*., 2003) [18]. The desirable period for feedlotting is usually 60 to 80 days in which animals normally gain about 15-20 kg of live weight. In this system, normally ADG is above 250g/day, nevertheless, 400 g/day or higher can also be reached by animals with higher genetic potential (Gallo *et al*., 2014) [14]. Even the lambs with poor conformation can be reared under feedlots and it helps to promote the growth of muscle tissues and deposition of fat, so that desirable meat product is obtained (Van Der Merwe *et al.*, 2020) [25]. Another advantage of feedlotting is that various by-products such as dietary dried distiller's grains solubles (DDGS) (Felix *et al*., 2012) [11], soybean, molasses (Arruda *et al*., 2020) [3], cottonseed cake (Brant *et al*., 2021) [6], etc. can be used in feedlot diets.

2. Material and Methods

2.1 Selection and distribution of experimental animals

The study was conducted on ten crossbred lambs (around 1 year of age) at MRCSG (Mountain Research Centre for Sheep and Goat), Shuhama, SKUAST-Kashmir. The animals were distributed randomly into two equal groups of five replicates each *viz*., control (CON), treatment (FL). The design of experiment was CRD.

2.2 Feeding schedule of experimental animals

The diets offered to the experimental animals were formulated as per ICAR (2013) recommendations. The TMR (total mixed ration) was prepared by mixing concentrate and roughage, and TMR was offered individually to all experimental animals twice daily in equal amounts in morning and evening, and clean drinking water were also provided thrice daily throughout the experimental period of 74 days.

The dietary treatments were control (CON) and treatment (FL). In CON group, experimental animals were fed by thumb rule method i.e., 60% roughage and 40% concentrate (TMR-1), while in the FL group, experimental animals were fed on feedlot diets i.e., 20% roughage and 80% concentrate (TMR-2). The experimental rations *viz*. TMR-1 and TMR-2 were analysed for proximate composition (AOAC, 2005) [2], fibre fractions (*van* Soest *et al*., 1991) [26] and mineral estimation *viz*., calcium and phosphorous.

2.3 Growth studies

At the start of the feeding experiment, body weights of the lambs were noted for two successive days and the average body weight was considered as initial body weight. For growth study, body weights of the lambs were recorded individually at a fortnightly interval for two consecutive days before feeding and watering during 74 days study period.

2.4 Statistical analysis

The statistical analysis of experimental data was done by using the protocols given by Snedecor and Cochran (1994) [21] and significance of mean difference was analyzed by SPSS Software, Base 23.0 for macOS.

3. Result and Discussion

3.1 Chemical composition of experimental ration

To assess the quality of any feed ingredient, evaluating its chemical composition is considered to the primary index. The detailed chemical composition of experimental ration on % dry matter (DM) basis is presented in Table 1.

Table 1: Chemical composition of experimental ration on % DM basis

Attributes		TMR-1	TMR-2 (Feedlot)
Proximate composition	Dry Matter	86.61	88.31
	Organic Matter	81.17	83.34
	Crude Protein	11.52	16.48
	Ether Extract	2.68	4.17
	Crude Fibre	22.75	11.35
	Nitrogen Free Extract	57.61	63.04
	Total Ash	5.44	4.97
	Acid Insoluble Ash	1.32	0.55
Fibre fractions	Neutral Detergent Fibre	45.44	28.08
	Acid Detergent Fibre	28.62	16.14
	Hemicellulose	16.82	11.94
	Cellulose	22.32	11.84
	Lignin	6.04	4.68
Minerals	Calcium	0.45	0.35
	Phosphorus	0.33	0.49

3.2 Dry matter and Organic matter intake

To determine the palatability of experimental ration, feed intake is one of the main parameters. Dry matter intake was recorded daily for entire period of 74 days (including 14 days adaptation period) and was assessed fortnightly as g/d, % b.wt. and g/ kgW$^{0.75}$ and has been presented in Table 2. The valued of DMI and OMI (g/d) averaged 1032.36 and 858.44, and 963.19 and 794.06 at the end of 74 days of experimental feeding in control (CON) and treatment (FL) group, respectively. Statistically, the data revealed non-significant difference ($p>0.05$) in DMI and OMI between treatment groups. But, numerically the gain in body weight was found to be higher in FL group than that of CON group.

Identical results were found by Omar *et al.* (2019) [20] who carried out a study to evaluate the effect of feeding sheep on different ratios of concentrate and roughage, and reported that different concentrate: roughage ratio had no influence on average DMI. The results also showed harmony with previous studies of goats where DMI was unaffected with increasing concentrate from 30% to 70% in diet (Cantalapiedra-Hijar *et al.* 2009) [7] and studies related to Holstein cows showed no effect on DMI by rearing them on diverse roughage: concentrate ratios (47:53, 54:46, 61:39 and 68:32) (Aguerre *et al.* 2011) [1]. Babu *et al.* 2013 [4] in their study observed that on increasing the level of concentrate in the diet of lambs, there was no effect of on feed intake. In contrast, Ferdous *et al.* (2011) [12] reported that on feeding high concentrate diet in goat the level of DM intake increase, moreover, Desnoyers *et al.* (2008) [8] in his studies found that increasing concentrate from 30% to 60% in diet of dairy goats increases DMI. Similarly, Murphy *et al.* (2000) [19] reported that the cows fed on diet containing 50% roughage: 50% concentrate had significantly lower DMI than those cows fed on diet containing 30% roughage and 70% concentrate.

Table 2: Average dry matter intake (g/d, % b.wt. and g/kg $W^{0.75}$) and organic matter intake (g/d, % b.wt. and g/kg $W^{0.75}$) of experimental animals in different treatment groups

Attributes		CON	FL	*P* value
Dry matter intake	g/d	1032.36±10.93	858.44±92.83	0.100
	% body weight	4.12±0.29	3.38±0.27	0.099
	g/kg $W^{0.75}$	91.92±4.64	75.63±6.59	0.078
Organic matter intake	g/d	963.19±10.20	794.06±85.86	0.086
	% body weight	3.85±0.27	3.12±0.25	0.088
	g/kg $W^{0.75}$	85.76±4.33	69.96±6.10	0.068

Note: Values with different superscripts in the row show significant difference (P≤0.05)

3.3 Growth performance
To assess the performance of experimental animals fed on different diets, the changes in body weight proves a reliable measure. The mean body weight and cumulative body weight gain during the study period, are presented in Table 3. The result showed no significant difference ($p>0.05$) between the treatment groups in terms of body weight (kg) and body weight gain (kg). But, numerically the gain in body weight was found to be higher in FL group.

The mean cumulative ADG (gpd) and FCR during the study period due to feedlotting is presented in Table 3. The data revealed non-significant difference ($p>0.05$) statistically in terms of ADG (GPD) and FCR between the treatment groups. However, numerically better ADG (GPD) and FCR was found in FL group in comparison to that of CON group.

The present results show harmony with the findings of Sultana *et al.* 2012 [21], who witnessed the growth rate of kids when fed different levels of concentrate did not differ significantly. Study conducted by Babu *et al.* 2013 [4] revealed that on increasing levels of concentrate in the ratio of lambs showed no effect of on final live weight, ADG, FCR. The results on FCR also showed similarity with the results of El Khidir *et al.* (1998) [10] who carried out comparative study on the feedlot performance and carcass characteristics of Sudanese desert sheep and goats, and concluded that feed conversion efficiency showed non-significant but superior results in desert sheep.

Table 3: Average gain in body weight (kg), ADG (gpd) and FCR of experimental animals

Attributes	CON	FL	*P* value
Initial body weight (kg)	20.50±1.74	20.53±0.65	0.988
Final body weight (kg)	29.61±2.08	29.95±1.82	0.907
Gain in body weight (kg)	9.11±0.56	9.42±1.68	0.867
ADG (GPD)*	121.51±7.55	125.59±22.42	0.867
FCR**	7.54±0.32	7.14±0.80	0.672

*Average daily gain
**Feed conversion ratio
Note: Values with different superscripts in the row show significant difference (P≤0.05)

3.4 Digestibility of nutrients
The most important parameter in assessing the nutritional worth of feed is to quantify the amount of digestible nutrients present in that feed. Therefore, metabolism trail was carried out to reveal the digestibility coefficients of dry matter, gross nutrients and various fibre fractions in experimental feeds, offered to various treatments (CON and FL) to evaluate the effect of finishing lambs in feedlots. While comparing the mean values, data revealed statistically non-significant difference ($p>0.05$) between treatment groups, but numerically higher values of digestibility were found in FL group.

Table 4: Average digestibility coefficients of dry matter, gross nutrients and fibre fractions in different treatment groups

Attributes	CON	FL	*P* value
Digestibility coefficients			
Dry Matter	57.17±1.70	61.71±5.98	0.493
Organic Matter	68.95±0.80	69.91±3.26	0.784
Crude Protein	62.58±4.51	68.49±7.94	0.542
Ether Extract	58.09±3.74	59.47±16.56	0.938
Crude Fibre	58.20±4.21	61.96±9.20	0.723
Nitrogen Free Extract	71.14±0.56	71.49±6.32	0.958
Neutral Detergent Fibre	54.01±3.01	43.64±12.18	0.440
Acid Detergent Fibre	50.20±3.72	35.54±15.59	0.396
Hemi-cellulose	60.51±2.46	54.60±7.92	0.750
Cellulose	56.13±3.61	58.28±8.72	0.504

Note: Values with different superscripts in the row show significant difference (P≤0.05)

The digestible nutrient intake was estimated in terms of digestible dry matter intake (DDMI), digestible crude protein intake (DCPI) and total digestible nutrient intake (TDNI), and are presented in Table 5. The analysis of data revealed statistically non-significant difference ($P>0.05$) in terms of DDMI (kg/d) and TDNI (kg/d) between the treatment groups, but the average values of DCPI (g/d) showed significant difference between the treatment groups. Numerically, the mean values DCPI (g/d) showed significantly higher values in FL group as compared to that of CON group.

Table 5: Intake of digestible nutrients in different treatment groups

Attributes	CON	FL
DDMI (kg/d)*	0.85±0.03	0.84±0.14
DCPI (g/d)**	92.88±7.41^{a}	137.50±24.96^{b}
TDNI (kg/d)***	0.84±0.03	0.83±0.15

*Digestible dry matter intake
**Digestible crude protein intake
***Total digestible nutrient intake
Note: Values with different superscripts in the row show significant difference (P≤0.05)

Sultan *et al.* (2010) [22] conducted a trial on assessing the digestibility of nutrients and performance of lambs fed on diets containing varying protein and energy contents in feedlots, the reported results showed harmony with the present study and also reported that low digestibility of DM in groups maintained on low-energy diets might be due to higher content of lignin. Griswold *et al.* (2003) [15] reported that the increase in DM digestibility might be the result of improved microbial activity.

The present results were in harmony with the results of Karim and Santra (2003) [17], who reported that digestibility of CP showed no statistical difference among dietary groups with different energy levels. Increase in nitrogen digestibility from 57.6% to 64.3% is the result of increasing the dietary protein concentration from 12% to 14%. The digestibility of nitrogen was also affected by the relation between energy and protein levels, and highest nitrogen digestibility (65.3%) was observed in animals fed high energy-high protein diet.

It is well known that reduction in ruminal pH depresses the fiber digestion, thus the lambs fed with high energy diet showed low ruminal pH and reduced digestibility of NDF (Javaid *et al*. 2008) [16]. Studies of Firkins *et al.* (1986) [13] revealed that when the experimental animals were fed with diets based on roughage but high in energy showed reduced ruminal pH with decreased NDF digestibility. When the dietary protein levels were increased from 12% to 14%, the digestibility of NDF declined from 62.0% to 60.8%.

4. Conclusion

From the results of the present experiment, it could be concluded that feedlotting can be done successfully under temperate climate showing no adverse effect on feed intake, nutrient utilization and growth of lambs. However, further studies using large number of animals for long duration are recommended to ascertain the physiological, productive and slaughter performance of the animals under study and develop a general feeding schedule for finishing of lambs under feedlot.

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