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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(2): 381-383

www.thepharmajournal.com
Received: 28-12-2019
Accepted: 30-01-2020

Priya
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

Mandeep Singla
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

Sandeep Kaswan
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

RS Grewal
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

DS Malik
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

Neeraj Kashyap
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

Corresponding Author:
Priya
Department of Livestock Production Management, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India

Evaluation of dry matter intake, feed conversion ratio and protein efficiency ratio in beetal kids fed total mixed ration under intensive feeding system

Priya, Mandeep Singla, Sandeep Kaswan, RS Grewal, DS Malik and Neeraj Kashyap

Abstract
This experiment was aimed to investigate the effect of feeding Total Mixed Ration (TMR) on dry matter intake, feed conversion ratio and protein efficiency ratio in Beetal kids. This whole study was carried out under intensive feeding system i.e. stall fed conditions where Beetal kids were kept in stalls for feeding purposes. Conventional feeding method (control group), Hay based TMR (T_1) and Fresh fodder based TMR (T_2) were the experimental diets given to the selected Beetal kids which were randomly distributed in the treatment groups on basis of average body weight, gender and age. The kids under treatment groups T_1 and T_2 showed 6.84% and 11.30%, respectively higher total dry matter intake (DMI in kg) over the control group. Feed conversion ratio (FCR) was significantly better in animals fed T_1 ($P<0.05$) over the T_2 and control group. Protein efficiency ratio (PER) was also found to be significantly higher in T_1 group ($P<0.01$) than T_2 and control group.

Keywords: Total mixed ration, beetal kids, stall feeding, dry matter intake, FCR, PER

Introduction
In developing countries like India, goats are valued mainly for meat, followed by milk, fibre and skin. Their small size is especially relevant and relates directly to economic, managerial and biological advantage over other species. Poor and landless marginal farmers often increase the size of their flocks to provide greater food and economic security (Devendra and Solaiman 2010) [3].

Efforts need to be directed towards encouragement of the adoption of the labour-intensive stall-feeding for the small ruminants rearing. However, intensive feeding to small ruminants is a challenging job to the nutritionists. Small ruminants mainly goats tend to select the feed under stall fed conditions (Wahed and Owen 1986) [13] Moreover, labour for planting, maintaining and cutting grass and other pastures, carrying the fodder to the zero-grazing unit, feed wastage, improper nutrient utilization and high risk of ruminal acidosis due to consumption of high proportion of concentrates are the most determinate factors in the stall feeding of small ruminants. So, this often leads to feeding of nutritionally imbalanced ration either in excess or less relevant to nutrient requirement of animal. This imbalanced feeding may adversely affect productivity of goats (Kumar *et al*. 2014) [8].

Therefore, feeding of basal diet in form of Total Mixed Ration (TMR) could be an important management manipulation as poor feeding under stall-fed is affecting the nutrient utilization of goats to a great extent. Feeding of concentrates and roughages in form of TMR can result in steady supply of nutrients, simplifies feeding, further adding in better efficiency of nutrient utilization and improved productivity. TMR feeding reduces the wastage, improves the density and decreases the dustiness (Wadhwa and Bakshi 1996) [12]. Moreover, in order to simplify labor intensive stall-fed system TMR seems to be only answer for economizing productive performance in goats.

Materials and Methods
Experimental Details
The following experiment was conducted at Goat Research Farm, Department of Livestock Production Management, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana 141004, Punjab, India during November 2018 to March 2019.

Selection of Animals and Experimental Design

Before the beginning of trial, weaned Beetal kids were weighed and examined for any abnormal health condition in November, 2018. A total number of minimum 23 weaned kids were taken and randomly distributed in three treatment groups on basis of average body weight, gender and age. The selected Beetal kids were put in the adaptation trial under stall-fed for about 15 days. During this period, the feeding requirements of all the kids were standardized.

Methodology

The selected Beetal kids were allocated to three groups. The selected groups were further sub-grouped for the feeding purposes. The basal diet of each kid was formulated as per recommendations (NRC 2007) [10]. Diet of each animal under study was reviewed and formulated at fortnightly interval. Feeding of all the kids was done by taking dry matter requirement as 4% of body weight. The kids were fed ration containing Roughage: Concentrate in the ratio of 60:40 on the DM basis (Malisetty *et al*. 2014). Further, feed requirement for each pair was calculated for animals of all the groups.

Feeding Schedule of Kids under Control Group: The kids under the control group were fed basal diet as per routine conventional method in which green fodder and concentrate were fed separately.

Feeding Schedule of Kids under T_1 and T_2: The kids under the treatment groups T_1 and T_2 were fed basal diet based on dry fodder based TMR and fresh fodder based TMR, respectively. The available fresh fodder was dried for hay making to be incorporated in basal diet as dry fodder based TMR.

Processing of Feedstuffs

a) Preparation of Hay

Good quality available green fodder i.e. berseem (*Trifolium alexandrinum*), mustard (*Brassica rapa sub* sp. *oleifera*) and oat (*Avena sativa*) was procured daily from Directorate of Livestock Farm, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana and chaffed to 2.0-2.5cm and spread in thin layers on the concrete floor for sun drying. It was turned upside down 4-5 times a day. The dried hay was stored in gunny bags.

b) Preparation of Concentrate Mixture

Concentrate mixture was prepared using conventional feed ingredients. This concentrate mixture having same ingredient composition was fed to all the kids.

Table 1: Ingredient composition of concentrate offered to the experimental kids

Ingredients	Composition (%)
Maize	45
Soybean Meal	20
Wheat Bran	14
De Oiled Rice Bran	18
Mineral mixture	2
Salt	1

Average Daily Gain (ADG), Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER)

Feed Conversion Ratio is defined as gram of dry matter intake per gram of average daily gain. It was calculated by using the following formula:

$$FCR = \frac{\text{Daily DM intake (g)}}{\text{ADG (g)}}$$

$$PER = \frac{\text{ADG (g)}}{\text{Average daily protein consumption (g)}}$$

$$\text{Where, ADG} = \frac{\text{Body weight gain (kg)}}{\text{Interval between two BW recordings (days)}} \times 1000$$

Statistical analysis

The collected data was analysed using Software Package SAS available in University Library, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana to determine the effect of TMR feeding on nutrient utilization of Beetal kids fed dry and fresh fodder based TMR under intensive feeding system.

Results and Discussion

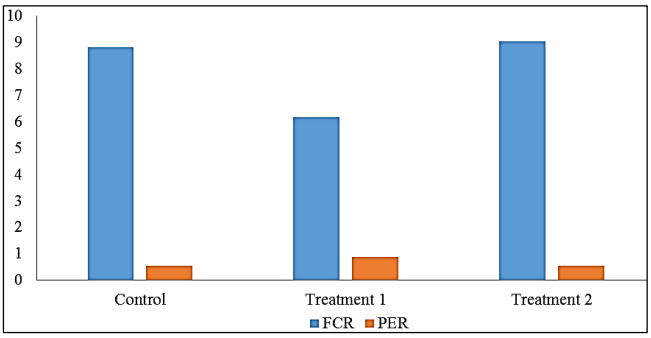

Fig 1: FCR (DM basis) and PER (DM basis) of all Beetal kids sorted under different groups

Table 2: Effect of feeding total mixed ration on Average DMI (g/day), Average DMI (g/kg metabolic live weight), Total DMI (kg), FCR (DM basis) and PER (DM basis) of kids in different treatments

Particulars	Treatments→	C	T_1	T_2	SEM	P value
Average DMI (g/day)	M	1340.32	1494.80	1565.47	400.60	0.92
	F	945.24	947.07	1011.23	276.01	0.98
	Overall	1142.78	1220.94	1288.35	211.85	0.89
Average DMI (g/kg metabolic live weight)	M	80.69	87.56	101.23	6.72	0.28
	F	71.65	74.57	90.17	4.60	0.12
	Overall	76.17^{b}	81.07^{b}	95.70^{a}	3.56	0.01
Total DMI (kg)	M	160.84	179.38	187.86	48.07	0.92
	F	113.43	113.65	121.35	33.12	0.98
	Overall	137.13	146.51	154.60	25.42	0.89
FCR	M	8.60	6.35	9.80	0.86	0.14
	F	9.01	5.97	8.26	1.26	0.34
	Overall	8.80^{ab}	6.16^{c}	9.03^{a}	0.70	0.04
PER	M	0.56	0.88	0.49	0.10	0.12
	F	0.54	0.91	0.60	0.09	0.13
	Overall	0.55^{bc}	0.89^{a}	0.55^{c}	0.06	0.005

SEM: Standard Error of Means; Means bearing different superscripts in a row differ significantly.

Average DM intake (gram per day) was numerically higher in T_2 group (1288.35) and T_1 (1220.94) over the control (1142.78) group and didn't differ significantly as shown in Table 2. Phipps *et al*. (1984) reported that cows when offered the complete diet and separate ingredients *ad libitum* consumed 16·5 kg DM/day and 14·3 kg/day, respectively

which differ significantly. Kolver and Muller (1998) [7] indicated the performance of grazing cows differed significantly from that of cows fed on TMR in dry matter (DM) intake (19.0 vs. 23.4 kg/d of DM).

The average DM intake (g/kg metabolic live weight) was highest for T_2 group (95.70) followed by T_1 group (81.07) at $P<0.05$ over the control group (76.17) as shown in Table 15. The results were in agreement with Kirubanath *et al.* (2011) who found that the DM intake per kg metabolic body weight was higher ($P<0.01$) on complete diet than conventional diet.

As per data depicted in Table 2, it was found that Total DMI (kg) by the kids being higher for T_2 group as compared to T_1 and control groups. The kids under treatment groups T_1 and T_2 showed 6.84% and 11.30%, respectively higher total DMI (kg) over the control group. Bargo *et al.* (2002) [2] found that total dry matter intake was highest for TMR fed group than PC (pasture plus concentrate) and pTMR (pasture plus partial TMR) fed group. On the contrary, Fan *et al.* (2002) [5] in his study to determine the effect of concentrate feeding frequency versus Total Mixed Ration in Holstein cows showed no significant differences among the concentrate feeding frequency versus Total Mixed Ration in terms of dry matter intake. Liu *et al.* (2016) [9] reported that cattle receiving TMR consumed 13.42% and 6.59% less total DMI than those receiving SI1 (cattle fed concentrate firstly then roughage) and SI2 (cattle fed roughage firstly then concentrate) treatment, respectively ($P<0.05$).

Feed efficiency was an important index reflecting digestion and absorption efficiency of a given dietary (Dong *et al.* 2006). The feed conversion ratio (FCR) as depicted in Table 2 indicated that it was significantly better ($P<0.05$) in T_1 group (6.16) than T_2 group (9.03) and control group (8.80). However, FCR for males and females of T_1 group was better over the control and T_2 group, though statistically non-significant. These findings were in close agreement with observations of Xu *et al.* (2017) [14] whose results indicated that feed efficiency of TMR (7.65) was better as compared to OH (oats hay: 15.89) and OS (oats silage: 11.92) for Tibetan sheep. Alhidary *et al.* (2016) [1] found significantly ($P<0.05$) higher total feed conversion ratio (TFCR) in lambs fed TMR with different alfalfa hay feeding protocols compared with TMR alone.

The protein efficiency ratio (PER) was significantly higher ($P<0.01$) in T_1 group (0.89) than T_2 or control group, where values for T_2 and control group (0.55) didn't differ significantly. PER was 61.81% higher in T_1 group than T_2 and control group. Although the results were statistically insignificant separately for males and females enrolled under the different groups, PER for males and females of T_1 group was higher than the males and females of T_2 and control group.

Conclusions

From the results of the present study, it could be inferred that TMR feeding of kids may have a beneficial impact on feed intake compared with control group and thus increased weight gain and feed efficiency in the T_1 group.

Acknowledgments

Authors are thankful to Vice Chancellor and Director of Research, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (India) for providing the necessary funding and facilities.

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