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Effect of flooring type on growth performance & FCR of weaned Vizianagaram lambs

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Abstract

A study was conducted to evaluate the effect of flooring type on growth performance of weaned Vizianagaram lambs reared on moorum (T_1), concrete (T_2) and rubber-mat flooring (T_3). The overall mean body weights (kg) were 14.65 ± 0.30 (T_1), 14.50 ± 0.27 (T_2) and 14.69 ± 0.28 (T_3) with no significant differences. Total weight gain was 8.00 ± 0.35 , 7.80 ± 0.44 and 8.47 ± 0.20 kg for T_1 , T_2 and T_3 respectively, with lambs on rubber mats showing 8.6% higher gain than concrete-reared lambs. Average daily gain was 87.89 ± 3.32 , 85.71 ± 3.10 and 93.11 ± 3.60 g/day across T_1 , T_2 and T_3 groups, respectively. Daily feed intake, dry matter intake (kg/day) were 1.42 ± 0.12 , 1.38 ± 0.11 and 1.50 ± 0.11 , 0.58 ± 0.17 , 0.57 ± 0.17 and 0.60 ± 0.17 while DMI per metabolic body weight (g/day) was 77.34 ± 6.16 , 76.67 ± 6.20 and 79.87 ± 6.07 for T_1 , T_2 and T_3 , respectively. Feed conversion ratio was 6.90 ± 0.24 , 6.83 ± 0.24 and 6.61 ± 0.18 for T_1 , T_2 and T_3 , with no-significant differences. Results indicate that lambs reared on rubber-mat flooring exhibited numerically superior growth and feed efficiency, though differences were statistically non-significant.

Keywords: Vizianagaram lambs, average daily gain, dry matter intake, feed conversion ratio

Introduction

Andhra Pradesh ranks second in India's sheep population with 17.6 million sheep, accounting for 23.7% of the national flock (DAH, GOI, 2019). The state is the native tract of the Vizianagaram sheep, known for their hardiness, ability to utilize coarse fibrous feeds, adaptability to local conditions and superior meat quality. These sheep are traditionally reared under extensive systems, but declining grazing resources have reduced productivity, highlighting the need for intensive management. Intensive systems have demonstrated higher growth rates and body weight gains than extensive or semi-intensive systems (Karthik *et al.*, 2021) [17]. Housing, particularly flooring, plays a key role in moderating the microclimate and influencing animal comfort and welfare. Floor type significantly affects welfare and bedding quality, making proper floor design an essential aspect of sheep housing (Stefanowska *et al.*, 2002) [30].

Materials and Methods

The study evaluated the effect of flooring types on growth, feed intake, DMI, and FCR of Vizianagaram lambs under intensive rearing. Twenty-four 3-4-month-old lambs (10.54 ± 0.27 kg), of either sex, were randomly assigned into three groups ($n = 8$): moorum floor (T_1), concrete floor (T_2), and concrete floor with rubber mats (T_3 ; 11 mm thick, diamond-shaped surface). The 90-day trial (24 April-22 July 2023) was conducted in conventional sheds ($1.7 \text{ m}^2/\text{lamb}$) with asbestos roofing. Lambs were dewormed (Albendazole 10 mg/kg), tagged, and maintained under hygienic conditions with *ad libitum* feeding and clean water throughout the study.

Feeding and watering management

Experimental lambs were fed the routine concentrate mixture with *ad libitum* green fodder

(Super Napier grass) twice daily at 8:00 AM and 3:00 PM, following ICAR (2013) nutrient requirements. Leftovers were recorded every 24 hours to calculate total feed intake. Clean, potable water was provided in separate troughs throughout the experiment.

Body weight gain: Lamb body weight was recorded weekly using a digital electronic balance before feeding. Total weight gain was calculated by subtracting initial body weight from final body weight, allowing assessment of growth performance under moorum (T_1), concrete (T_2), and rubber mat (T_3) flooring systems.

Table 1: Body weight of Vizianagaram lambs under different flooring systems

S. No.	Treatment	Details of treatment group	Number of lambs in each group	Average initial body weight(kg)
1	T_1	Lambs maintained on moorum floor	8	10.57±0.55
2	T_2	Lambs maintained on concrete floor	8	10.55±0.43
3	T_3	Lambs maintained on concrete floor with rubber mat (black with diamond shape rough surface, 11 mm thickness)	8	10.50±0.45
Total			24	10.54±0.27

Average Daily Gain (ADG)

The average daily gain was calculated by using the following formula.

$$ADG = \frac{\text{Final weight(kg)} - \text{Initial weight (kg)}}{\text{Number of days}}$$

ADG was calculated weekly as well as for the total experimental period.

Feed Intake

Feed offered and feed refusal were monitored daily for each group of lambs and feed intake was calculated weekly.

Dry Matter Estimation and Feed Conversion Ratio

Dry matter (DM) of feeds was determined by drying a weighed sample in a moisture cup overnight at $100 \pm 2^\circ\text{C}$ to constant weight. DM (%) was calculated as:

$$\text{Dry matter\%} = \frac{\text{weight of the dry sample}}{\text{weight of sample before drying}} \times 100$$

Dry matter intake (DMI): Dry matter intake (DMI) was

recorded weekly and over the total experimental period. Feed conversion ratio (FCR) was calculated by dividing total DM intake (kg) by total body weight gain (kg) of lambs. Body weight was recorded weekly using a digital balance before feeding, and total gain was calculated by subtracting initial from final weight.

Statistical analysis

Data were analysed by ANOVA (Snedecor and Cochran, 1994), and means compared using Duncan's multiple range test (Duncan, 1955) [6] with SPSS version 20.0 (SPSS, 2020).

Results

Body weight and weight gain

Initial body weights (kg) of lambs on moorum (T_1), concrete (T_2), and rubber mat (T_3) floors were 10.57 ± 0.55 , 10.55 ± 0.43 , and 10.50 ± 0.45 , respectively, increasing to 18.57 ± 0.81 , 18.35 ± 0.68 , and 18.98 ± 0.53 by the end of the 90-day trial (Table 2). Overall mean body weights were 14.65 ± 0.30 , 14.50 ± 0.27 , and 14.69 ± 0.28 , with total gains of 8.00 ± 0.35 , 7.80 ± 0.44 , and 8.47 ± 0.20 kg for T_1 , T_2 , and T_3 , respectively. Lambs on rubber mats exhibited 8.59% higher total weight gain than those on concrete, though differences were non-significant ($p > 0.05$).

Table 2: Body weight of Vizianagaram lambs under different flooring systems

Weekly body weight (kg)	Flooring type			Standard error mean	Probability value
	Moorum (T_1)	Concrete (T_2)	Rubber Mat (T_3)		
Initial	10.57±0.55	10.55±0.43	10.50±0.45	0.265	0.995
1	11.33±0.65	11.16±0.51	11.19±0.46	0.301	0.973
2	12.05±0.73	11.87±0.54	11.91±0.50	0.332	0.976
3	12.72±0.78	12.59±0.57	12.45±0.49	0.346	0.957
4	13.27±0.84	13.13±0.58	12.96±0.48	0.360	0.947
5	13.98±0.82	13.77±0.58	13.72±0.48	0.355	0.955
6	14.43±0.76	14.36±0.58	14.29±0.52	0.349	0.987
7	15.07±0.74	14.94±0.62	14.99±0.56	0.355	0.991
8	15.49±0.72	15.42±0.63	15.71±0.54	0.351	0.945
9	15.93±0.73	15.91±0.63	16.26±0.55	0.356	0.911
10	16.55±0.76	16.43±0.66	16.91±0.55	0.367	0.870
11	17.29±0.82	17.01±0.65	17.51±0.54	0.378	0.875
12	17.86±0.83	17.58±0.69	18.21±0.54	0.388	0.816
13	18.57±0.81	18.35±0.68	18.98±0.53	0.382	0.806
Overall mean	14.65±0.30	14.50±0.27	14.69±0.28	0.161	0.891
Total gain in weight	8.00±0.35	7.80±0.44	8.47±0.20	0.200	0.385

Average daily gain

Weekly ADG (g) varied from 108.39 ± 20.41 (T_1) to 98.57 ± 4.64 (T_3) in the first week, with overall means of $87.89 \pm$

3.32 , 85.71 ± 3.10 , and 93.11 ± 3.60 for T_1 , T_2 , and T_3 , respectively (Table 3). Differences among groups were non-significant.

Feed intake, dry matter intake and feed conversion ratio

Average daily feed intake (kg) was 1.42 ± 0.12 , 1.38 ± 0.11 , and 1.50 ± 0.11 , DMI (kg/day) was 0.58 ± 0.17 , 0.57 ± 0.17 , and 0.60 ± 0.17 , DMI per 100 kg BW was 3.95 ± 0.31 , 3.8 ± 0.30 , and 4.08 ± 0.31 ; DMI per kg metabolic weight

(BW^{0.75}) was 77.34 ± 6.16 , 76.67 ± 6.20 , and 79.87 ± 6.07 g for T₁, T₂, and T₃, respectively. Overall FCR was 6.90 ± 0.24 , 6.83 ± 0.24 , and 6.61 ± 0.18 , with no significant differences among treatments (Table 4).

Table 3: Average daily gain (ADG) of Vizianagaram lambs under different flooring systems

Weekly ADG (g)	Flooring type			Standard error mean	Probability value
	Moorum (T ₁)	Concrete (T ₂)	Rubber Mat (T ₃)		
1	108.39±20.41	87.95±13.52	98.57±4.64	8.125	0.611
2	103.13±15.36	101.43±13.61	102.95±7.49	6.961	0.995
3	94.82±11.25	101.79±13.84	76.96±8.52	6.662	0.305
4	78.75±10.84	77.68±8.09	73.04±15.75	6.631	0.938
5	101.43±7.84	91.79±14.16	107.68±15.86	7.346	0.692
6	65.18±8.75	83.93±12.89	81.61±12.46	6.590	0.468
7	90.36±7.27	83.57±14.49	99.79±25.23	9.652	0.803
8	60.36±7.04	68.21±6.63	88.25±18.96	7.815	0.090
9	63.21±10.57	70.36±4.98	89.93±13.40	5.820	0.765
10	87.86±8.31	74.11±7.09	92.14±9.17	4.817	0.291
11	105.59±14.13	82.68±3.08	85.89±5.86	5.410	0.167
12	81.25±8.62	81.25±12.31	100.00±8.73	5.833	0.331
13	101.96±5.50	109.46±9.55	109.64±6.27	4.107	0.703
Overall mean	87.89±3.32	85.71±3.10	93.11±3.60	1.935	0.277

Table 4: Feed intake, dry matter intake (DMI) and feed conversion ratio (FCR) of Vizianagaram lambs under different flooring systems

Flooring type	Moorum (T ₁)	Concrete (T ₂)	Rubber Mat (T ₃)	Standard error mean	Probability value
Overall Body weight(kg)	14.65±0.30	14.50±0.27	14.69±0.28	0.161	0.891
Feed intake (kg)	1.42±0.12	1.38±0.11	1.50±0.11	0.064	0.745
DMI (kg/day)	0.58±0.17	0.57±0.17	0.60±0.17	0.001	0.457
DMI (kg/100kg B.W)	3.95±0.31	3.8±0.30	4.08±0.31	0.174	0.877
DMI/kg W ^{0.75} (g/day)	77.34±6.16	76.67±6.20	79.87±6.07	3.461	0.927
FCR	6.90±0.24	6.83±0.24	6.61±0.18	0.129	0.631

Discussion**Body weight**

Body weight is a key indicator of animal health. In this study, the overall mean body weights (kg) of Vizianagaram lambs were 14.65 ± 0.30 (T₁, moorum), 14.50 ± 0.27 (T₂, concrete), and 14.69 ± 0.28 (T₃, rubber mat), with no significant differences. Lambs on rubber mats exhibited 1.3% higher body weight than concrete at the end of the experiment, likely due to enhanced comfort and rest, allowing optimal periods of REM sleep, which can influence growth hormone secretion and Ghrelin release from the gastrointestinal tract (Rutters *et al.*, 2012) [27].

The present findings align with Kulkarni *et al.* (2000) [20], Jaborek *et al.* (2016) [15], Tharuntej *et al.* (2020) [32], and Dash *et al.* (2022) [8], who reported that floor type had no significant effect on body weight in domesticated lambs.

In contrast, Yasotha and Sivakumar (2013) [36], Deshmukh (2017) [9], Vijayalakshmi (2023) [34], and Sundaram *et al.* (2002) [31] observed significant differences in lambs, possibly due to variations in housing and flooring comfort affecting feed utilization. Similarly, Kovnerev and Smironov (1988) [19], Yanar *et al.* (2010) [35], Kartal and Yanar (2011) [16], Divate (2014) [12], Archana (2018) [2], and Tony (2023) [33] reported significant differences in body weight across flooring systems, likely influenced by diverse external climatic conditions.

The total weight gain of lambs in this study was 8.00 ± 0.35 , 7.80 ± 0.44 , and 8.47 ± 0.20 kg for moorum, concrete, and rubber mat floors, respectively, with an 8.59% higher gain on rubber mats compared to concrete. This increase may be

attributed to greater comfort and reduced stress on rubber mats, promoting optimal feed and fodder utilization. These findings align with Kulkarni *et al.* (2000) [20], Jaborek *et al.* (2016) [15], Tharuntej *et al.* (2020) [32], and caprine studies by Di Grigoli *et al.* (2003) [11], Chikwanda and Muchenje (2017) [4], Modi *et al.* (2019) [23], and Antil *et al.* (2019a) [1], which reported no significant differences in total weight gain across flooring types. In contrast, Hanninen *et al.* (2005) [14], Yanar *et al.* (2010) [35], Kartal and Yanar (2011) [16], and Archana (2018) [2] observed significant gains in calves on rubber mats, likely reflecting species differences.

Average Daily Gain (ADG)

The overall mean ADG (g) of rubber mat (T₃) lambs was 8.64% higher than concrete (T₂), though not significant, likely due to better feed conversion on rubber mats. Similar non-significant effects were reported in lambs by Kulkarni *et al.* (2000) [20], Tharuntej *et al.* (2020) [32], Pandu (2021) [24], and in kids by Antil *et al.* (2019a) [1], Kumari *et al.* (2013) [21], Chikwanda and Muchenje (2017) [4], Hanninen *et al.* (2005) [14], Elmore *et al.* (2015) [13], and Arvind Kumar *et al.* (2019) [3]. In contrast, Sundaram *et al.* (2002) [31], Cozzi *et al.* (2013) [5], and Yasotha and Sivakumar (2013) [36] reported significant differences in weaned lambs, while Divate (2014) [12] and Jaborek *et al.* (2016) [15] found dissimilar results in kids. Keane *et al.* (2015) [18], Archana (2018) [2], Lowe *et al.* (2019) [22], Sorathiya *et al.* (2019) [29], and Tony (2023) [33] reported significant differences in calves, likely due to varying feed efficiency and FCR under different climatic conditions.

Feed Intake, Dry Matter Intake (DMI), and Feed Conversion Ratio (FCR): Feed and DMI were non-significant among lambs on moorum, concrete, and rubber mat floors, in line with Antil *et al.* (2019a)^[1] in Barbari kids and Tharuntej *et al.* (2020)^[32] in Deccani lambs. Conversely, Di Grigoli *et al.* (2003)^[11] in goats, Divate (2014)^[12] in kids, Chikwanda and Muchenje (2017)^[4] in goats, Ramachandran *et al.* (2017)^[26] in goats, and Vijayalakshmi (2023)^[34] in Nellore brown lambs observed significant increases in feed and DMI under different flooring, likely due to feed type and lineage. The overall mean FCR was 6.90 ± 0.24 , 6.83 ± 0.24 , and 6.61 ± 0.18 for moorum, concrete, and rubber mat floors, respectively, without significant differences. These results align with Antil *et al.* (2019a)^[1] in Barbari kids and Patel *et al.* (2020)^[25] in Mehasana goats. In contrast, Deshmukh *et al.* (2017)^[9] and Vijayalakshmi (2023)^[34] found significant differences in lambs, possibly due to higher DMI, improved feed assimilation, and climatic variations.

Conclusion

The body weight, average daily gain, feed intake, dry matter intake and feed conversion ratio of growing Vizianagaram lambs were similar among the three treatment groups. However, lambs reared on rubber mat floor were superior but similar to the moorum floor in terms of growth and feed efficiency.

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