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Effect of pulse Chunni based complete diets on growth and biometry of Nellore Ramlambs

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Abstract
The present study was conducted on thirty-two growing Nellore brown ram lambs (96.30±2.70 days of age; 13.27±0.03 kg body weight) to evaluate the effect of pulse chunni inclusion in sorghum-straw-based complete diets on growth performance and biometric traits. The lambs were allotted randomly to four treatment groups and reared under an intensive system for 120 days: T_1 (control)-complete diet without pulse chunni, T_2 (RGCC)-15% red gram chunni, T_3 (GGCC)-15% green gram chunni, and T_4 (BGCC)-15% Bengal gram chunni. Total feed intake and daily dry matter intake were higher in T_2 compared to other treatments. Body weight differed significantly (p<0.01) among groups from the 2nd to 8th fortnights, with T_2 lambs recording the highest values. Total body weight gain was 10.65, 10.98, 10.76, and 10.66 kg for T_1, T_2, T_3, and T_4, respectively, with significantly greater gain in T_2. Average daily gain was also higher (p<0.01) in T_2 (91.46±0.49 g) compared to T_1 (88.75±0.90 g), T_3 (89.69±0.49 g), and T_4 (88.85±0.49 g). Biometric traits (pin-shoulder length, height at withers, heart girth, and paunch girth) increased linearly throughout the study, with higher values observed in T_2. Inclusion of 15% red gram chunni in sorghum-straw-based complete diets significantly improved feed intake, weight gain, ADG, and biometric growth in experimental lambs under intensive rearing, establishing its superiority over green gram and Bengal gram chunnies.

Keywords: Nellore brown ram lambs, pulse chunnies, complete diets, biometric traits

Introduction
Feed cost constitutes about 75% of livestock production expenses, and declining feed resources are a major constraint in India (Naik *et al.*, 2012; Biradar and Kumar, 2013) [16, 4]. Conventional use of cereals and legumes for livestock feeding also intensifies competition with human consumption (Fagbeno and Arowosoge, 1991) [9]. Agro-industrial by-products, particularly pulse chunnies, offer a potential alternative. Chunni, a by-product of pulse processing, consists of broken grains, husk, and germ coat, contributing 15-20% of total pulse weight (Sudhakar Reddy *et al.*, 2000) [27]. Earlier studies have shown its effective inclusion in ruminant diets without adverse effects on nutrient utilization (Padmaja, 1996; Radhakrishna, 1999) [17, 19]. In Telangana, where livestock supports nearly 29.25 lakh households, about 4,06,000 tonnes of brans and chunnies are produced annually (Anonymous, 2016) [1]. However, their utilization in feeding systems remains limited. Considering the poor nutritive value of crop residues, combining them with chunnies in complete rations could reduce feed costs and improve productivity. The present study was undertaken to assess the nutritive potential and feeding value of pulse chunnies in ruminant diets.

Materials and Methods
Preparation of experimental complete rations
Four sorghum-straw based complete rations were formulated Table 2 and Chemical composition of experimental rations presented in Table 3.

Table 1: Experimental details

Parameter	Description
Location	Livestock Research Station, PVNRTVU, Mamnoor, Warangal district Telangana (17.9°N, 79.59°E; 290 m MSL)
Duration	120 days (February-June 2022)
Animals	32 Nellore brown ram lambs (96.3±2.7 days; 13.27±0.03 kg BW)
Design	Completely Randomized Design (CRD); 4 treatments × 8 animals each
Housing	Pens (24' × 10') with equal open yard space; no grazing
Health care	Deworming with Ivermectin and Fenbendazole; PPR vaccination; hygienic management
Treatments (Rations)	T_1: Control (no chunni); T_2: Red gram chunni (15% of concentrate mix); T_3: Green gram chunni (15% of concentrate mix); T_4: Bengal gram chunni (15% of concentrate mix)
Roughage: Concentrate	50:50 (sorghum straw + concentrate mixture)

Table 2: Ingredient composition of experimental rations (kg/100 kg) used for growth study in Nellore ram lambs

Ingredients	Complete diets			
	T_1 (without any chunni: Control)	T_2 (with Red gram chunni: RGCC)	T_3 (with Green gram chunni: GGCC)	T_4 (with Bengal gram chunni: BGCC)
Sorghum straw	50.0	50.0	50.0	50.0
Red gram chunni	-	7.5	-	-
Green gram chunni	-	-	7.5	-
Bengal gram chunni	-	-	-	7.5
Maize	13.0	14.0	15.0	13.0
Ground nut cake	21.5	20.5	19.5	21.5
Wheat bran	7.5	-	-	-
Molasses	5.0	5.0	5.0	5.0
Mineral mixture	2.0	2.0	2.0	2.0
Salt	1.0	1.0	1.0	1.0
Total*	100.0	100.0	100.0	100.0

* Vitamin A supplement was added @ 10 g/100 kg complete diet.

Biometric Measurements

Measurements were taken in centimetres using a flexible standard measuring tape (Freemans®) after ensuring that lambs stood squarely on a level surface. All measurements were recorded in the morning before feeding and watering, as described by Rangamma *et al*. (2022) [21]. The following traits were measured:

- **Pin shoulder length (PSL):** Horizontal distance from the point of shoulder to the point of tuber Ischii on the same side.
- **Height at withers (HAW):** Vertical distance from the base of the hoof to the highest point of the withers.
- **Heart girth (HG):** Chest circumference, measured just behind the elbow joint.
- **Paunch girth (PG):** Distance across the rump, from the tuberosity of the ilium on one side to the other.

Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1994) [26]. Least-square Analysis of variance was used to test the significance of various treatments and the difference between treatment means was tested for significance by Duncan's Multiple Range and F Test (Duncan, 1955) [8].

Table 3: Chemical composition of experimental complete diets (On% DMB) fed to growing Nellore ram lambs

Nutrient	Complete diets*			
	T_1 (without any chunni: Control)	T_2 (with Red gram chunni: RGCC)	T_3 (with Green gram chunni: GGCC)	T_4 (with Bengal gram chunni: BGCC)
Proximate constituents				
Moisture	1.71	3.34	2.39	3.16
Dry matter	98.29	96.66	97.61	96.84
Organic matter	87.88	88.11	88.08	89.17
Crude protein	13.79	13.68	13.88	13.78
Ether extract	2.98	3.24	3.19	2.95
Crude fibre	22.86	20.56	21.03	25.02
Nitrogen free extrac	48.94	48.63	49.99	47.04
Total ash	12.12	11.89	11.92	10.83
Calcium	1.57	1.61	1.13	1.15
Phosphorus	0.83	0.66	0.70	0.80
Cell wall constituents				
Neutral detergent fibre	63.86	60.11	60.85	62.55
Acid detergent fibre	33.82	34.12	33.15	35.95
Cellulose	25.43	23.95	23.27	26.86
Acid detergent lignin	6.25	7.33	5.85	4.83
Silica	2.70	2.93	2.99	3.71
Hemi cellulose	30.04	25.99	27.71	26.60

*Each value is an average of duplicate analysis

Results and Discussion

Table 4: Effect of feeding experimental complete diets on Weight Gain, ADG, DMI, FCR in Nellore ram lambs

Parameters	Complete diets[#]			
	T_1 (without any chunni: Control)	T_2 (with Red gram chunni: RGCC)	T_3 (with Green gram chunni: GGCC)	T_4 (with Bengal gram chunni: BGCC)
Initial weight (Mean±SE; kg)	13.26±0.08	13.28±0.06	13.22±0.01	13.27±0.04
Final weight (Mean±SE; kg)	23.91±0.05	24.26±0.02	23.98±0.05	23.92±0.06
Total weight gain(kg)	10.65	10.98	10.76	10.66
Average daily gain (g)	88.75±0.90	91.46±0.49	89.69±0.49	88.85±0.49
Total feed intake (kg)	108.27	109.55	108.38	108.32
Total DMI (kg)	74.63	79.93	78.45	75.21
DMI/day (g)	621.90	666.08	653.75	626.75
FCR (kg feed/kg gain)	10.17	9.98	10.07	10.16

[#]Each value is an average of eight observations; DMI=Dry matter intake; FCR=Feed conversion ratio

The mean body weight of Nellore brown ram lambs differed significantly (p<0.01) from the 2nd to 8th fortnight, with lambs fed T_2, T_3 and T_4 diets recording higher weights than those on the control (T_1). Total body weight gain was highest in T_2 (10.98 kg), followed by T_3 (10.76 kg), T_4 (10.66 kg) and T_1 (10.65 kg). The overall ADG was significantly higher (p<0.01) in T_2 (91.46 g/day) compared to other treatments. Improved performance in T_2 lambs was likely due to better nutrient utilization and balanced roughage-to-concentrate intake, which supported efficient rumen fermentation and microbial protein synthesis.

Feed intake and DMI were also higher in T_2 lambs, reflecting better acceptability of red gram chunni-based diets. The FCR was most favorable in T_2, indicating efficient conversion of feed into body weight gain.

Biometry of lambs

Table 5: Fortnightly Pin Shoulder Length (PSL) measurements of Nellore ram lambs fed experimental complete diets

Complete diets	N	Initial Pin Shoulder Length (cm)	Fortnightly Pin Shoulder Length[#] (Mean ± SE; cm)							
			1	2	3	4	5	6*	7	8 (Final Pin Shoulder Length)
T_1 (without any chunni: Control)	8	16.63±0.26	17.12±1.02	17.75±0.31	46.00±0.73	47.25±1.11	51.00±0.62	55.13^{ab}±0.63	57.00±0.73	60.87±0.97
T_2 (with Red gram chunni: RGCC)	8	16.62±0.53	17.13±0.63	18.00±0.53	47.25±2.02	48.25±1.37	50.00±1.38	56.12^{b}±0.74	59.8±1.51	64.25±1.39
T_3 (with Green gram chunni: GGCC)	8	16.50±0.18	17.50±0.37	17.75±0.59	44.13±0.97	48.13±1.39	48.50±1.40	56.75^{b}±0.94	60.13±1.51	62.88±0.89
T_4 (with Bengal gram chunni: BGCC)	8	16.63±0.49	18.25±0.49	17.50±0.37	45.50±1.61	47.25±1.73	48.75±0.83	53.25^{a}±0.97	58.62±1.46	62.50±1.34
SEM		0.189	0.229	0.225	0.709	0.681	0.561	0.463	0..679	0.598
P-Value		0.994	0.265	0.901	0.495	0.931	0.373	0.033	0.356	0.264

[#]Each value is an average of eight observations; N=Number of animals in each treatment; P=Probability Value; SEM: Standard Error Mean
[ab]Means with different superscripts column wise differ significantly *(p<0.05)

Pin Shoulder Length (cm)

The final mean pin shoulder length recorded in the present study was 60.87±0.97, 64.25±1.39, 62.88±0.89 and 62.50±1.34 cm in eighth fortnight for T_1, T_2, T_3 and T_4 groups, respectively (Table 5). The present results are in agreement with the findings of Monali Bhaskar (2018) [14], Mohit *et al*. (2019b) [13] and Tharuntej *et al*. (2020) [31] who reported the non-significant effect of different floors on PSL.

The findings of the present study are also corroborating the findings of Sundaram *et al*. (2002) [28], Dass *et al*. (2012) [6] in Muzaffarnagri sheep, Tailor and Yadav (2011 and 2012) [29, 30] in Sonadi sheep. Divate (2014) [7] also reported significant effects of different floors on PSL. On contrary, Rangamma *et al*. (2022) [21] reported lesser PSL in Nellore lambs from 3 to 9 months age group maintained on different rearing systems and Pandu (2021) [18] also reported lesser PSL in Nellore lambs maintained on different flooring systems, whereas Gowane *et al.* (2015) [10] reported higher PSL in Malpura sheep. The rate of weight gain in terms of body weight and average daily gain were reflected in their concomitant growth pattern observed in body length in all the treatment groups.

Height at withers (cm)

Table 6: Fortnightly height at withers (HAW) measurements of Nellore ram lambs fed experimental complete diets

Complete diets	N	Initial HAW (cm)	Fortnightly height at withers [#] (Mean ± SE; cm)							
			1	2	3	4	5	6	7	8[NS] (Final HAW)
T_1 (without any chunni: Control)	8	22.00±0.32	23.87±0.44	24.75±0.36	61.13±0.66	62.63±0.92	63.25±1.04	65.75±0.79	66.75±0.79	68.00±0.46
T_2 (with Red gram chunni: RGCC)	8	21.56±0.63	23.75±0.75	25.13±0.58	55.88±1.26	61.38±1.80	64.00±1.75	65.50±1.25	67.00±1.36	69.75±1.34
T_3 (with Green gram chunni: GGCC)	8	21.13±0.54	23.63±0.65	24.50±0.62	58.63±1.13	62.13±1.07	63.13±1.09	67.13±1.23	67.50±1.32	68.63±1.05
T_4 (with Bengal gram chunni: BGCC)	8	20.88±0.44	22.88±0.39	24.50±0.37	59.38±0.90	62.00±0.65	62.88±0.72	64.00±0.62	66.13±0.74	68.38±1.01
SEM		0.251	0.284	0.243	0.961	0.572	0.581	0.521	0.528	0.499
P-Value		0.418	0.619	0.791	0.283	0.905	0.922	0.213	0.844	0.655

[#]Each value is an average of eight observations; N=Number of animals in each treatment; P=Probability Value; [NS]Non-significant; SEM: Standard Error Mean

The height at withers of lambs was similar (P=0.05) throughout the experiment, where the T_2 group showed higher HAW compared to T_1, T_3 and T_4 in the eighth fortnight. Lower height at withers observed in T_1 group of experimental lambs (Table 6). The present results are in agreement with the findings of Monali Bhaskar (2018) [14], Mohit *et al*. (2019b) [13] and Tharuntej *et al*. (2020) [31] who had stated the non-significant effect of different floors on height at withers. The present findings were disagreed with the findings of Sundaram *et al*. (2002) [28], Divate (2014) [7], Pandu (2021) [18] as they reported significant effects of different floor on height at withers. Several other workers (Raman *et al.*, 2003 and Dass *et al*., 2012) [20, 6] also reported similar values for height at withers, while Mishra *et al*. (2004) [12], Mondal and Kakati (2010) [15], Tailor and Yadav (2011) [29], Pandu (2021) [18] and Rangamma *et al*. (2022) [21], reported lower height at withers of lambs.

Heart girth

Table 7: Fortnightly heart girth measurements of Nellore ram lambs fed experimental complete diets

Complete diets	N	Initial Heart Girth (cm)	Fortnightly heart girth# (Mean ± SE; cm)							
			1	2	3	4	5	6	7	8NS (Final Heart Girth)
T_1 (without any chunni: Control)	8	21.25±0.45	22.87±0.35	24.50±0.42	58.50±1.59	59.75±1.65	65.75±0.72	67.00±0.65	69.25±0.92	72.00±1.40
T_2 (with Red gram chunni: RGCC)	8	21.88±0.29	23.93±0.79	24.50±0.70	61.00±1.93	63.87±1.76	67.13±1.55	68.88±1.02	70.50±1.10	74.00±1.62
T_3 (with Green gram chunni: GGCC)	8	21.75±0.59	23.75±0.64	24.63±0.73	60.38±1.51	62.75±1.53	67.00±1.62	68.38±1.40	70.25±1.64	73.13±1.49
T_4 (with Bengal gram chunni: BGCC)	8	20.63±0.77	23.38±0.59	24.38±0.53	60.30±1.82	61.87±1.79	65.50±1.58	67.25±1.38	70.00±2.30	73.87±2.19
SEM		0.279	0.302	0.291	0.836	0.848	0.688	0.568	0.759	0.824
P-Value		0.391	0.635	0.993	0.387	0.379	0.347	0.621	0.950	0.832

#Each value is an average of eight observations; N=Number of animals in each treatment; P=Probability Value; NSNon-significant; SEM: Standard Error Mean

The heart girth of lambs now recorded was non-significant (p>0.05) throughout the experiment, but higher heart girth was observed in T_2 group, followed by T_4 in the eighth fortnight among the four groups of lambs (Table 7) as this circumference of heart girth of the lambs is an important indicator of animal health, body weight and size, which helps in respiration. The present results were in agreement with Bharambe and Burte (2012) [3] and Kochewad (2015) [11] in Daccani lambs and Rangamma *et al*. (2022) [21] in Nellore lambs who found stall fed animals had higher heart girth gain than semi-stall and grazing animals. Raman *et al.* (2003) [20] and Dass *et al*. (2012) [6] also reported similar values, while Mishra *et al*. (2004) [12], Mondal and Kakati (2010) [15] and Tailor and Yadav (2011) [29] reported lesser values compared to present study. The rate of weight gain in terms of body weight and average daily gain was reflected in their concomitant growth pattern observed in heart girth in all the treatment groups. The present results also in agreement with the findings of Monali Bhaskar (2018) [14], Mohit *et al*. (2019b) [13] and Tharuntej *et al*. (2020) [31] who stated the non-significant effect of different floors on heart girth. The present findings are in disagreement with the findings of Sundaram *et al*. (2002) [28], Divate (2014) [7] and Pandu (2021) [18] as they reported significant effects of different floors on heart girth.

Paunch Girth

The paunch girth of lambs was increased linearly throughout the experimental period and was non-significant (p>0.05), but higher paunch girth was observed in T_2 group, followed by T_4, T_3 and T_1 groups of lambs in the eighth fortnight of the study (Table 8). The present findings are in agreement with the reports of Monali Bhaskar (2018) [14], Mohit *et al*. (2019b) [13] and Tharuntej *et al*. (2020) [31] who stated the non-significant effect of different floors on paunch girth. The present results were consistent with Singh *et al*. (2014) [25] in Koraput sheep and Rangamma *et al*. (2022) [21] in Nellore lambs, who reported higher paunch girth in intensively reared lambs compared to semi-intensive and extensive systems. Arora *et al*. (2007) [2], Ravimurugan and Devendran (2009) [23], Ravimurugan *et al*. (2010) [24], Rani *et al*. (2014) [22], Yadav *et al*. (2014) [33], Thorat (2015) [32] and Dasari (2017) [5] reported similar paunch girth values. On contrary, Sundaram *et al*. (2002) [28], Divate (2014) [7] and Pandu (2021) [18] reported significant effects of different floors on paunch girth.

Table 8: Fortnightly paunch girth measurements of Nellore ram lambs fed experimental complete diets

Complete diets	N	Initial Paunch Girth (cm)	Fortnightly paunch girth# (Mean ± SE; cm)							
			1	2	3	4	5	6	7	8NS (Final Paunch Girth)
T_1 (without any chunni: Control)	8	20.00±0.26	22.37±0.77	25.25±0.41	55.50±1.50	59.87±1.20	63.13±1.18	64.75±1.16	69.75±1.53	73.00±1.62
T_2 (with Red gram chunni: RGCC)	8	21.13±0.39	22.50±0.84	25.00±0.75	55.88±1.57	59.38±1.78	66.63±0.80	68.00±1.01	70.13±1.59	76.38±1.70
T_3 (with Green gram chunni: GGCC)	8	21.62±0.86	21.88±0.97	24.38±0.67	54.75±1.35	57.38±1.26	65.75±1.81	67.88±1.78	71.50±1.16	74.38±1.41
T_4 (with Bengal gram chunni: BGCC)	8	20.25±0.64	23.12±0.95	24.75±0.75	56.87±1.84	60.25±1.77	65.13±2.20	66.87±2.70	70.75±2.69	74.50±2.39
SEM		0.305	0.431	0.321	0.763	0.740	0.793	0.884	0.882	0.891
P-Value		0.202	0.801	0.813	0.815	0.543	0.469	0.558	0.913	0.632

#Each value is an average of eight observations; N=Number of animals in each treatment; P=Probability Value; NSNon-significant; SEM: Standard Error Mean

Conclusion

The Pin Shoulder Length (PSL) of all the experimental ram lambs increased linearly from 1st to 8th fortnights and was non-significant throughout the experiment. The data also shown higher PSL in T_2 group when compared with other groups in the eighth fortnight and significantly higher (p<0.05) PSL in lambs of T_2 and T_3 groups in sixth fortnight compare to other groups. The height at withers of lambs was similar (P=0.05) throughout the experiment, where the T_2 group showed higher height at weathers compared to other three groups in the eighth fortnight. Lower height at withers observed in T_1 group experimental lambs. The paunch girth was increased linearly throughout the experimental period and was non-significant (p>0.05), but higher paunch girth was observed in T_2 group of lambs, followed by T_4, T_3 andT_1 group in the eighth fortnight of the study. The rate of weight gain in body weight and average daily gain were reflected in their concomitant growth pattern observed in body length in all the treatment groups.

Overall, biometry traits increased linearly with age and body weight, reflecting the growth performance of lambs across all dietary treatments. The non-significant differences among groups indicate that incorporation of pulse chunnies in complete rations did not adversely affect skeletal and muscular development. These findings are in agreement with earlier reports on Deccani and Nellore lambs under different feeding and management systems (Monali Bhaskar, 2018; Mohit *et al.*, 2019b; Tharuntej *et al.*, 2020; Rangamma *et al.*, 2022) [14, 13, 31, 21]. The study evaluated the effect of pulse chunni inclusion in sorghum-straw-based diets on growth of Nellore brown ram lambs. Among treatments, inclusion of 15% red gram chunni (T_2) significantly improved feed intake, body weight gain, ADG, and biometric traits compared to control and other pulse chunnies. Thus, red gram chunni proved superior as a feed resource under intensive rearing.

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Conflict of Interest

Not available

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