Comparative study on biometrical measurements of Nellore Jodipi sheep in RKVY and non-RKVY flocks in field conditions

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Abstract

Nellore sheep is a popular mutton breed and widely distributed in Nellore, Prakasam and Tirupati districts of Andhra Pradesh. The present study was aimed to study the biometrical measurements of Nellore Jodipi sheep maintained under farmer's flocks in Chittor district of Andhra Pradesh. The data on biometrical measurements *i.e.,* height at withers, chest girth, paunch girth, hip width and body length at milk teeth, 2, 4, 6 and 8-teeth of age of 1115 Nellore Jodipi sheep were recorded. The present study revealed significant effect of flock and sex on biometrical measurements at majority of the ages studied. All the biometrical measures of sheep showed an increasing trend with the progression of age and also showed considerable sexual dimorphism, with males having much greater mean values than females.

Keywords: Nellore sheep, body length, height at withers, heart girth, paunch girth, hip width

Introduction

The indigenous breeds of small ruminants are ubiquitous and contribute significantly to the subsistence, economic and social upliftment, livelihood and food security of landless, small and marginal farmers especially in arid, semiarid and other eco-fragile region of the country, where crop production is always at risk. Sheep rearing with very low investments and its multi facet utility for meat, wool, skins and manure provides a dependable source of income to the shepherds and resource poor farmers. Sheep contributes 8.94% of India's overall meat production with 8.60 million tonnes in 2019-20 and Andhra Pradesh is the second largest mutton producing state (BAHFS, 2020) [1]. Of the three strains of Nellore sheep *viz.*, Palla, Jodipi and Dora, Jodipi is widely distributed in all the regions of the Andhra Pradesh and adjoining areas of Telangana.

Biometrical measurements of animals can be used to determine live weight up to the nearest value (Berge, 1977; Buvanendran *et al*., 1980; Goonerwardene and Sahaayuraban, 1983) [2, 3, 4] under field conditions where facilities for weighing are not available. Therefore, the present research study is framed to ascertain the impact of the RKVY Programme on the biometrical measurements of Nellore Jodipi Sheep under field settings in the farmer's flocks, which will further indicate the productivity of the sheep in terms of growth and meat production.

Materials and Methods

The present study was conducted in the Chittoor district of Andhra Pradesh. The farmers flocks which have received the superior Nellore Jodipi rams from Livestock Research Station (LRS), Palamaner are designated as RKVY flocks and those without as non-RKVY flocks. The data was collected from 28 farmer families spread over eight villages in Srikalahasti and Yerpedu mandals in the Chittoor district. Biometrical measurements were recorded in 316 males and 799 females belonging to both RKVY and non-RKVY flocks.

The body measurements were taken by a single recorder on each animal and recorded to the nearest centimetre. After restraining and holding the animal in an unforced stance, to stand firmly on the even ground, different body dimensions were measured using a 152-cm long flexible plastic measuring tape, early in the morning before the animals were sent for grazing. Pregnant animals were excluded from the study to avoid the error in body measurements. The data were classified according to flocks and sex, within the age groups *viz.,* Milk teeth, 2 teeth, 4 teeth, 6 teeth and 8 teeth.

The following table (Table 1) lists the different body measurements studied, along with their points of measurement.

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Table 1: Biometrical measurements

Traits	Definition	Figures
Height at withers	Vertical distance from ground to the withers.	Fig 1
Chest/ Heart girth	Circular distance or circumference of the chest just behind the fore legs and wither	Fig 2
Body length	Distance from point of shoulders to the point of pin bones.	Fig 3
Paunch girth	Circular distance or circumference measured around the abdomen, at the stomach just before the hind legs or in front of the sacrum.	Fig 4
Hip width	Distance between the outer edges of the major hip bones on the right and left side	Fig 5

Figures depicting Biometrical Measurements and their recording

Fig 1: Height at Withers

Fig 3: Body Length

Fig 2: Chest Girth

Fig 4: Paunch Girth

Fig 5: Hip Width

The data pertaining to biometrical measurements was subjected to least squares analysis (Harvey, 1987) [5] to know the significant differences between flocks (RKVY and Non-RKVY) and sexes.

Statistical Model

$$Y_{ijk} = \mu + F_i + S_j + e_{ijk}$$

Where,

Y_{ijk} = is the record of kth observation of jth sex and i^{th} flock.

μ = Overall mean.

F_i = Effect of ith Flock (i= 1 for RKVY flock and 2 for non-RKVY flock)

S_j = Effect of jth sex. (j=1 for Male and 2 for Female)

e_{ijk} = Random error associated with each observation and

assumed to be normally and independently distributed with mean zero and variance $(0, \sigma^2_e)$.

Results and Discussion
The biometrical measurements for the five selected traits are summarised in Tables 2 to 6. All the biometrical measures of sheep showed an increasing trend with the advancement of age. All physical attributes showed considerable sexual dimorphism, with males having much greater mean values than females. For many of the variables studied, there was significant variation between flocks (P≤0.01).

Height at withers
The overall least squares means for height at withers at milk teeth, 2, 4, 6 and 8- teeth of age were 46.60 ± 0.28, 68.21 ± 0.35, 74.07 ± 0.20, 79.54 ± 0.25 and 83.12 ± 0.15 cm, respectively. The flock had a significant (P≤0.01) influence on height at withers at milk, 2 and 4 teeth ages, but not at 6

and 8 teeth ages. Sheep from RKVY flocks were taller than the sheep from non-RKVY flocks. Variations between the two flocks could be due to differences in feeding resources, breeding with superior germplasm rams and other management methods used amongst farmers. Males were significantly (P≤0.05) taller than females at all age groups except at 2 teeth of age. This disparity could be owing to the action of growth hormones, which resulted in bone and muscular development.

The present findings gained the support of Narasimham (2002) [6], Sireesha et al. (2017) [7] and Illa et al. (2020) [8] in Nellore breed of sheep. In contrast to the present findings, lower values for height at withers were recorded in Nellore sheep (Rajanna et al., 2013) [9] and Batur sheep (Ibrahim et al., 2020) [10]. Higher value for height at withers were reported by Rani et al. (2014) [11] and Harini et al. (2019) [12] in Nellore Jodipi and Palla strains, respectively.

Table 2: Least squares means of height at withers (cm) at various ages in Nellore Jodipi sheep

	Milk teeth			2 teeth			4 teeth			6 teeth			8 teeth		
	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.
Overall	257	46.60	0.28	207	68.21	0.35	228	74.07	0.20	234	79.54	0.25	189	83.12	0.15
Flocks	**			**			**			NS			NS		
RKVY	110	47.90a	0.42	118	76.65a	0.49	137	76.63a	0.28	108	79.79a	0.39	78	83.74a	0.23
Non-RKVY	147	45.20b	0.36	89	59.77b	0.48	91	71.51b	0.27	126	79.28b	0.31	111	82.50b	0.18
Sex	**			NS			*			**			**		
Male	100	47.70a	0.43	56	69.99a	0.59	59	75.30a	0.33	57	80.43a	0.44	49	84.87a	0.25
Female	157	45.50b	0.34	151	66.43b	0.36	169	72.83b	0.21	177	78.65b	0.24	140	81.40b	0.15

* Significant at P ≤ 0.05 ** Significant at P ≤ 0.01 NS – Non significant
n = number of animals
Means with different superscripts in each effect within the same age group differ significantly

Body Length
The overall least squares means for body length at milk teeth, 2, 4, 6 and 8 teeth of age were 37.00 ± 0.32, 57.18 ± 0.26, 63.15 ± 0.27, 67.11 ± 0.28 and 71.61 ± 0.26 cm, respectively and were closely related to the earlier findings of Arora and Garg (1998) in Pugal, Sahana et al. (2004) [13] in Jalauni, Arora et al. (2007) [14] in Jaisalmeri, Rajanna et al. (2013) [9] in Deccani and Nellore breeds of sheep. But higher than those reported by Dass (2008) in Pugal, Devendran et al. (2009) [15] in Coimbatore, Ganai et al. (2009) [16] in Karnah, Shirzeyli et

al. (2013) [17] in Iranian sheep, Sireesha et al. (2017) [7] in Nellore, Asaduzzaman et al. (2020) [18] in Jamuna Basin Indigenous and Muzaffarnagari cross sheep breeds, Illa et al. (2020) [8] in Nellore sheep. Flocks had significant (P ≤ 0.01) effect on body length at all ages except 2 and 8 teeth age. Sex had a significant effect (P ≤ 0.05) at all ages except 4 and 6 teeth. These findings revealed that the males are longer than females at all ages studied, which could be due to sexual dimorphism.

Table 3: Least squares means of body length (cm) at various ages in Nellore Jodipi sheep

	Milk teeth			2 teeth			4 teeth			6 teeth			8 teeth		
	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.
Overall	257	37.00	0.32	207	57.18	0.26	228	63.15	0.27	234	67.11	0.28	189	71.61	0.26
Flocks	**			NS			**			**			NS		
RKVY	110	38.20a	0.48	118	57.42a	0.37	137	64.89a	0.38	108	68.13a	0.45	78	71.89a	0.40
Non-RKVY	147	35.80b	0.41	89	56.95b	0.36	91	61.41b	0.37	126	66.10b	0.35	111	71.33b	0.32
Sex	*			**			NS			NS			**		
Male	100	37.90a	0.50	56	58.51a	0.44	59	63.47a	0.46	57	67.76a	0.50	49	72.90a	0.44
Female	157	36.10b	0.39	151	55.86b	0.27	169	62.82b	0.28	177	66.47b	0.27	140	70.32b	0.26

* Significant at P ≤ 0.05 ** Significant at P ≤ 0.01 NS – Non significant
n = number of animals
Means with different superscripts in each effect within the same age group differ significantly

Chest Girth
The overall least squares means for chest girth at milk teeth 2, 4, 6 and 8 teeth of age were 46.50 ± 0.31, 71.75 ± 0.33, 75.34 ± 0.27, 84.40 ± 0.26 and 84.83 ± 0.47 cm, respectively. At 2, 4 and 6 teeth of age, there was a significant effect (P≤0.01) of flocks on chest girth, but it is not evident at milk and 8 teeth of age. The results obtained in the present study revealed a

significant effect (P≤0.05) of sex at all ages, with the exception of 4 teeth. These results were in consonance with the findings of Illa et al. (2020) [8] in Nellore sheep while, the values reported in the present study were lower compared to Nellore sheep (Sireesha et al., 2017; Harini et al., 2019) [7, 12], However, Narasimham (2002) [6], Rajanna et al. (2013) [9] and Asaduzzaman et al. (2020) [18] observed lower averages than

those obtained in the present study. At all ages studied, males had a larger chest girth than females, which could be related to the effect of differential sex hormone expression on chest girth and higher body weights in males.

Table 4: Least squares means of chest girth (cm) at various ages in Nellore Jodipi sheep

	Milk teeth			2 teeth			4 teeth			6 teeth			8 teeth		
	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.
Overall	257	46.50	0.31	207	71.75	0.33	228	75.34	0.27	234	84.40	0.26	189	84.83	0.47
Flocks	NS			**			**			**			NS		
RKVY	110	47.10[a]	0.47	118	76.65[a]	0.46	137	76.49[a]	0.39	108	85.16[a]	0.41	78	85.74[a]	0.74
Non-RKVY	147	45.80[b]	0.40	89	66.84[b]	0.46	91	74.20[b]	0.38	126	83.64[b]	0.33	111	83.92[b]	0.58
Sex	**			*			NS			**			**		
Male	100	47.80[a]	0.48	56	73.45[a]	0.55	59	75.91[a]	0.47	57	85.30[a]	0.46	49	87.70[a]	0.81
Female	157	45.10[b]	0.38	151	70.05[b]	0.34	169	74.77[b]	0.29	177	83.50[b]	0.25	140	81.96[b]	0.47

* Significant at P ≤ 0.05 ** Significant at P ≤ 0.01 NS – Non significant

n = number of animals

Means with different superscripts in each effect within the same age group differ significantly

Paunch Girth

The overall least squares means of paunch girth at milk, 2, 4, 6 and 8-teeth age groups were 42.50 ± 0.43, 72.06 ± 0.33, 77.42 ± 0.37, 82.76 ± 0.27 and 85.70 ± 0.25 cm, respectively. Higher value for this trait were observed by Arora *et al.* (2007) [14] in Jaisalmeri, Rani *et al.* (2014) [11] in Nellore Jodipi and Harini *et al.* (2019) [12] in Nellore Palla sheep.

The sex effect on paunch girth was highly significant (*p*<0.05) at majority of ages, but it was not evident at 2 teeth of age and indeed males had higher paunch girth than females at all ages studied. At milk teeth, 2 and 8 teeth of age investigated, flocks had a significant (P≤0.01) effect on paunch girth. The RKVY flocks had larger paunch girth values than the non-RKVY flocks.

Table 5: Least squares means of Paunch girth (cm) at various ages in Nellore Jodipi sheep

	Milk teeth			2 teeth			4 teeth			6 teeth			8 teeth		
	n	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**
Overall	257	42.50	0.43	207	72.06	0.33	228	77.42	0.37	234	82.76	0.27	189	85.70	0.25
Flocks	**			**			NS			NS			**		
RKVY	110	47.50[a]	0.66	118	77.56[a]	0.47	137	77.96[a]	0.52	108	83.07[a]	0.43	78	87.40[a]	0.39
Non-RKVY	147	37.40[b]	0.56	89	66.56[b]	0.47	91	76.87[b]	0.51	126	82.44[b]	0.34	111	84.01[b]	0.30
Sex	*			NS			*			**			**		
Male	100	43.90[a]	0.68	56	73.79[a]	0.56	59	78.44[a]	0.62	57	84.35[a]	0.48	49	87.42[a]	0.42
Female	157	41.10[b]	0.54	151	70.32[b]	0.35	169	76.39[b]	0.38	177	81.17[b]	0.26	140	83.99[b]	0.25

* Significant at P ≤ 0.05 ** Significant at P ≤ 0.01 NS – Non significant

n = number of animals

Means with different superscripts in each effect within the same age group differ significantly

Hip Width

The results of present study revealed the overall least squares means for hip width at milk teeth, 2, 4, 6 and 8 teeth of age were 8.42 ± 0.09, 13.26 ± 0.13, 14.94 ± 0.12, 16.06 ± 0.35 and 17.34 ± 0.10 cm, respectively. At 2, 4, 6, and 8 teeth, the flock had a significant influence (P≤0.01) on hip width. Sex showed significant effect (P≤0.01) at milk and 8 teeth of ages only. The hip width increased linearly with advancement of age in rams and ewes.

The overall least squares means for hip width in present study were lower than those reported by Narasimham *et al.* (2002) [6] in Nellore, Rajanna *et al.* (2012) [19] in Deccani and Nellore, Rani *et al.* (2014) [11] in Nellore Jodipi sheep. These results showed that hip width increased linearly with age from milk teeth to 8-teeth in both the sexes, but growth in males was higher when compared to females.

Table 6: Least squares means of Hip width (cm) at various ages in Nellore Jodipi sheep

	Milk teeth			2 teeth			4 teeth			6 teeth			8 teeth		
	n	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**	**n**	**Mean**	**S.E.**
Overall	257	8.42	0.09	207	13.26	0.13	228	14.94	0.12	234	16.06	0.35	189	17.34	0.10
Flocks	NS			**			**			**			**		
RKVY	110	8.55[a]	0.13	118	15.76[a]	0.18	137	17.35[a]	0.17	108	17.72[a]	0.55	78	18.28[a]	0.16
Non-RKVY	147	8.29[b]	0.11	89	10.77[b]	0.18	91	12.54[b]	0.17	126	14.41[b]	0.43	111	16.41[b]	0.13
Sex	**			NS			NS			NS			**		
Male	100	8.78[a]	0.14	56	13.93[a]	0.22	59	15.42[a]	0.21	57	16.35[a]	0.61	49	17.97[a]	0.18
Female	157	8.07[b]	0.11	151	12.60[b]	0.14	169	14.47[b]	0.13	177	15.78[b]	0.33	140	16.72[b]	0.10

* Significant at P ≤ 0.05 ** Significant at P ≤ 0.01 NS – Non significant

n = number of animals

Means with different superscripts in each effect within the same age group differ significantly

Conclusion

On the whole, the mean body weights and all the biometrical parameters are higher in RKVY flocks than that of non-RKVY flocks, which may be due to the inclusion of superior germplasm of Nellore Jodipi Rams in the RKVY flocks, periodic follow-up of the farmers managemental practices,

technical inputs to the farmers regarding improved feeding, breeding and managemental practices. Further, in the current study, males were shown to be taller (P≤0.05) and heavier ((P ≤ 0.01) than females across all age categories. Similarly, body length (P≤0.05) and chest girth (P≤0.05) are also bigger in males than their female counterparts. As they have a greater impact on productivity, further research was therefore required to determine the degree of the relationship between various body measures and sheep body weight, which will aid in the economic upliftment of the rural sheep farmers.

Acknowledgement (if any)

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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