



Studies on Productive Performance and Biometry in Traditionally Reared Indigenous Goats of Andhra Pradesh

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ABSTRACT

Data collected on body weights and biometrical measurements i.e., height at withers, chest girth, body length, hip width, paunch girth, face length, ear length and tail length of 1421 goats at milk teeth, 2, 4, 6 and 8-teeth of age reared under field conditions in Rayalaseema region (Chittoor, YSR Kadapa, Anantapur and Kurnool) of Andhra Pradesh were subjected to least squares analysis to study the effect of district and sex. The least squares analysis of variance revealed significant effects of district and sex on body weights and measurements at one or the other ages studied. The overall least squares mean body weights (kg) at milk teeth, 2, 4, 6 and 8-teeth ages were 13.97 ± 0.16 , 20.57 ± 0.38 , 26.56 ± 0.68 , 30.66 ± 0.62 and 34.64 ± 0.85 , respectively. The overall least squares means for height at withers, chest girth, body length, hip width, paunch girth, face length, ear length and tail length at milk teeth age were 66.60 ± 0.29 , 61.08 ± 0.25 , 53.24 ± 0.25 , 13.02 ± 0.08 , 61.05 ± 0.27 , 16.65 ± 0.10 , 14.66 ± 0.08 and 14.51 ± 0.09 cm, respectively and the corresponding means at 8 teeth were 84.07 ± 0.72 , 82.83 ± 0.69 , 69.66 ± 0.99 , 18.05 ± 0.56 , 83.50 ± 0.95 , 20.78 ± 0.24 , 16.39 ± 0.30 and 16.56 ± 0.32 cm. The least squares mean were higher in males than in females and increased as age advances.

HIGHLIGHTS

- The body weights and biometrical measurements linearly increased with age.
- All the biometrical parameters revealed increase in trend with the advancement of the age.

Keywords: Biometrical measurements, Body weight and Indigenous goats

Goats play a substantial role in food production systems and are often recognized as a multipurpose animal capable of enhancing rural economy. Low input, high prolificacy, easy marketing and consumer acceptance for goat products gained much popularity to goat breeding. In India, more than 70 per cent of marginal farmers prefer to rear small ruminants rather than cows or buffaloes. A large number of rural households' rear goats with the flock size varying from 3 to 4 breeding does on an average. These flocks represent more than 90% of the goat population. India is a rich repository of goat germplasm with 34 defined goat breeds with 148.88 million populations (Livestock Census, 2019) and constitutes 24.40 % of total livestock of the country. Andhra Pradesh possesses about 64.27

laks goats which constitutes 2.316 percent of the total country's goat population. Breed characterization has traditionally been recognized as the first approach for the sustainable use of animal genetic resources. Although, goats are extensively reared by the farmers to meet their nutritional as well as economic needs, no information is available on habitat, distribution, phenotypic characters and performance of the indigenous goats of Andhra Pradesh and further Andhra Pradesh does not possess any

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recognized breed of goats. Therefore, the present study is aimed to assess the performance of indigenous goats under field conditions.

MATERIALS AND METHODS

Collection of data

The data on body weights and linear body measurements of 1421 indigenous goats (1081 does and 340 bucks) of various age groups (milk teeth, 2, 4, 6 and 8 teeth age) from 40 villages spread over 20 mandals of four districts (Chittoor, YSR Kadapa, Anantapur and Kurnool) of Rayalaseema region of Andhra Pradesh were recorded during November 2017 to April 2018. The goat population of the Rayalaseema region is highest in the Andhra Pradesh. Hence, the Rayalaseema region is selected as study area. Data on body weights and biometrical measurements *viz.*, height at wither (HW), chest girth (CG), paunch girth (PG), hip-width (HPW), body length (BL), face length (FL), ear length (EL) and tail length (TL) were collected. Biometrical measurements were recorded using a measuring tape after the animals were made to stand squarely on an even surface. Since, the particulars of the date of birth of animal were not available under field conditions; the eruption of permanent incisor teeth was taken as an indicator of the age of the animal (Turner, 1937). Body weight was measured with the help of a weighing balance with 500 g accuracy. The body measurements were recorded as per Banait *et al.* (2002) and Narasimham *et al.* (2003) as mentioned below:

- 1. Height at withers:** Distance from the base of the hoof to the highest point of withers.
- 2. Chest girth:** Body circumference around the chest, just behind the elbow joint.
- 3. Body length:** Distance from point of shoulder to the point of tuber ischi.
- 4. Hip width:** Distance from the tuberosity prominence to ileum of one side to the other, across the rump.
- 5. Paunch girth:** Body circumference in front of the sacrum.
- 6. Face length:** Distance from midpoint of poll between 2 horns to tip of nose.

7. Ear length: Length of straight line drawn from tip to base of the ear.

8. Tail length: Distance from base to the tip of the tail.

The data on body weights and various biometric measurements were grouped according to the districts and sexes within age groups. The data generated on various traits were subjected to least squares technique (Harvey, 1987) to study the effect of district and sex within each age group by using the following statistical model.

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

Where,

Y_{ijk} = the measurement on k^{th} animal belonging to j^{th} sex and i^{th} district;

μ = Overall mean;

D_i = Effect of i^{th} district ($i = 1$ to 4)

1 = Chittoor district

2 = YSR Kadapa district

3 = Anantapur district

4 = Kurnool district

S_j = Effect of j^{th} sex ($j = 1$ for male and 2 for female);

e_{ijk} = random error.

Duncan's multiple range test as modified by Kramer (1957) was employed to make pair wise comparisons of least-squares means.

RESULTS AND DISCUSSION

Productive Performance

The overall least squares mean body weights (kg) at milk teeth, 2, 4, 6 and 8-teeth ages were 13.97 ± 0.16 , 20.57 ± 0.38 , 26.56 ± 0.68 , 30.66 ± 0.62 and 34.64 ± 0.85 , respectively. Districts had significant ($p < 0.01$) effect on body weights of 6 and 8 teeth age groups. The mean body weights varied from 28.74 ± 0.82 to 33.09 ± 0.96 kg at 6-teeth and 33.24 ± 0.97 to 36.76 ± 1.00 kg at 8-teeth age in Anantapur and Kurnool, respectively (Table 1). The mean body weights recorded in present study coincided with the previous findings of Ravimurugan *et al.* (2009) in Pallai Adu goat, but, higher than those reported by Freitas *et al.* (2004) in Saanen, Fajemilehin and Salako (2008) in West African Dwarf goat, Kumari *et al.* (2015) in Black Bengal

Table 1: Least squares mean for body weights (kg) and biometrical measurements (cm) at various ages in indigenous goats

Factors	Age groups									
	n	Milk Teeth	n	2-Teeth	n	4-Teeth	n	6-Teeth	n	8-Teeth
Body Weights (Kgs)										
Overall	533	13.97 ± 0.16	172	20.57 ± 0.38	198	26.56 ± 0.68	218	30.66 ± 0.62	300	34.64 ± 0.85
Districts										
Chittoor	162	14.17 ^a ± 0.28	44	20.74 ^a ± 0.75	57	26.00 ^a ± 1.01	61	31.31 ^b ± 0.91	58	34.35 ^b ± 1.07
YSRKadapa	135	14.31 ^a ± 0.30	41	18.55 ^a ± 0.70	43	26.18 ^a ± 1.11	46	29.48 ^{ab} ± 0.99	76	34.22 ^{ab} ± 0.97
Anantapur	93	13.27 ^a ± 0.36	50	21.09 ^a ± 0.68	47	26.27 ^a ± 1.08	64	28.74 ^a ± 0.82	79	33.24 ^a ± 0.99
Kurnool	143	14.11 ^a ± 0.31	37	21.89 ^a ± 0.73	51	27.78 ^a ± 1.13	47	33.09 ^c ± 0.96	87	36.76 ^c ± 1.00
Sex										
Male	232	14.50 ^b ± 0.23	50	23.06 ^b ± 0.66	26	32.06 ^b	22	36.29 ^b ± 1.19	10	40.24 ^b ± 1.66
Female	301	13.43 ^a ± 0.21	122	18.08 ^a ± 0.42	172	21.05 ^a	196	25.02 ^a ± 0.39	290	29.04 ^a ± 0.31
Height at withers (cms)										
Overall	533	66.60 ± 0.29	172	74.65 ± 0.42	198	79.50 ± 0.48	218	82.80 ± 0.55	300	84.07 ± 0.72
Districts										
Chittoor	162	65.76 ^{ab} ± 0.52	44	73.27 ^a ± 0.83	57	78.24 ^a ± 0.72	61	82.49 ^a ± 0.80	58	83.76 ^a ± 0.91
YSRKadapa	135	69.32 ^c ± 0.57	41	75.47 ^{ab} ± 0.78	43	80.91 ^a ± 0.79	46	84.64 ^a ± 0.86	76	85.52 ^a ± 0.83
Anantapur	93	66.61 ^b ± 0.69	50	76.20 ^b ± 0.76	47	79.09 ^a ± 0.77	64	81.71 ^a ± 0.72	79	82.69 ^a ± 0.85
Kurnool	143	64.71 ^a ± 0.58	37	73.67 ^a ± 0.81	51	79.76 ^a ± 0.80	47	82.37 ^a ± 0.85	87	84.30 ^a ± 0.86
Sex										
Male	232	67.44 ^b ± 0.44	50	77.06 ^b ± 0.73	26	83.88 ^b ± 0.91	22	88.35 ^b ± 1.04	10	88.66 ^b ± 1.42
Female	301	65.77 ^a ± 0.39	122	72.25 ^a ± 0.47	172	75.11 ^a ± 0.35	196	77.26 ^a ± 0.35	290	79.47 ^a ± 0.27
Chest girth (cms)										
Overall	533	60.08 ± 0.25	172	69.55 ± 0.39	198	76.07 ± 0.43	218	79.96 ± 0.51	300	82.83 ± 0.69
Districts										
Chittoor	162	59.69 ^a ± 0.43	44	67.95 ^a ± 0.76	57	74.36 ^a ± 0.64	61	79.18 ^a ± 0.75	58	82.39 ^a ± 0.87
YSRKadapa	135	62.39 ^b ± 0.47	41	68.74 ^{ab} ± 0.71	43	77.07 ^c ± 0.70	46	79.98 ^a ± 0.81	76	83.49 ^a ± 0.78
Anantapur	93	62.42 ^b ± 0.57	50	72.11 ^c ± 0.69	47	76.85 ^{bc} ± 0.68	64	80.22 ^a ± 0.67	79	82.23 ^a ± 0.81
Kurnool	143	59.83 ^a ± 0.49	37	69.39 ^b ± 0.74	51	76.01 ^b ± 0.71	47	80.45 ^a ± 0.79	87	83.19 ^a ± 0.81
Sex										
Male	232	61.75 ^b ± 0.37	50	71.73 ^b ± 0.67	26	81.07 ^b ± 0.80	22	85.03 ^b ± 0.97	10	87.19 ^b ± 1.35
Female	301	60.41 ^a ± 0.32	122	67.36 ^a ± 0.43	172	71.07 ^a ± 0.31	196	74.88 ^a ± 0.32	290	78.46 ^a ± 0.25
Body length (cms)										
Overall	533	53.24 ± 0.25	172	59.07 ± 0.50	198	63.84 ± 0.57	218	67.13 ± 0.57	300	69.66 ± 0.99
Districts										
Chittoor	162	52.42 ^{ab} ± 0.44	44	58.92 ^a ± 0.98	57	62.79 ^a ± 0.85	61	67.82 ^a ± 0.84	58	69.32 ^a ± 1.25
YSRKadapa	135	54.61 ^c ± 0.48	41	58.30 ^a ± 0.92	43	64.23 ^a ± 0.94	46	67.00 ^a ± 0.91	76	69.72 ^a ± 1.13
Anantapur	93	53.81 ^{bc} ± 0.58	50	59.82 ^a ± 0.89	47	63.42 ^a ± 0.91	64	65.91 ^a ± 0.75	79	68.62 ^a ± 1.17
Kurnool	143	52.11 ^a ± 0.49	37	59.24 ^a ± 0.96	51	64.92 ^a ± 0.95	47	67.80 ^a ± 0.89	87	70.97 ^a ± 1.18
Sex										
Male	232	53.19 ^a ± 0.37	50	60.40 ^b ± 0.86	26	67.03 ^b ± 1.07	22	70.95 ^b ± 1.09	10	73.72 ^b ± 1.95
Female	301	53.28 ^a ± 0.33	122	57.74 ^a ± 0.55	172	60.64 ^a ± 0.41	196	63.32 ^a ± 0.36	290	65.59 ^a ± 0.36
Hip width (cm)										
Overall	533	13.02 ± 0.08	172	15.04 ± 0.14	198	16.71 ± 0.38	218	17.55 ± 0.21	300	18.05 ± 0.56
Districts										
Chittoor	162	12.73 ^a ± 0.15	44	14.74 ^a ± 0.27	57	16.00 ^a ± 0.57	61	17.63 ^b ± 0.31	58	17.68 ^{ab} ± 0.71
YSRKadapa	135	13.62 ^c ± 0.16	41	15.19 ^a ± 0.26	43	16.64 ^a ± 0.63	46	17.95 ^{bc} ± 0.34	76	18.16 ^b ± 0.64
Anantapur	93	12.58 ^a ± 0.20	50	14.80 ^a ± 0.25	47	17.01 ^a ± 0.61	64	16.44 ^a ± 0.28	79	16.78 ^a ± 0.66
Kurnool	143	13.14 ^b ± 0.17	37	15.43 ^a ± 0.27	51	17.20 ^a ± 0.64	47	18.18 ^c ± 0.33	87	19.57 ^c ± 0.67



Sex										
Male	232	13.00 ^a ± 0.12	50	15.19 ^a ± 0.24	26	17.47 ^a ± 0.72	22	18.54 ^b ± 0.41	10	18.34 ^a ± 1.10
Female	301	13.04 ^a ± 0.11	122	14.89 ^a ± 0.15	172	15.96 ^a ± 0.27	196	16.57 ^a ± 0.13	290	17.76 ^a ± 0.21
Paunch girth (cms)										
Overall	533	61.05 ± 0.27	172	69.11 ± 0.45	198	74.37 ± 0.74	218	79.02 ± 0.68	300	83.50 ± 0.95
Districts										
Chittoor	162	60.10 ^a ± 0.48	44	67.02 ^a ± 0.87	57	74.11 ^a ± 1.11	61	77.63 ^a ± 1.00	58	83.40 ^a ± 1.20
YSRKadapa	135	62.39 ^b ± 0.53	41	69.02 ^{ab} ± 0.82	43	73.18 ^a ± 1.22	46	77.93 ^a ± 1.08	76	84.22 ^a ± 1.09
Anantapur	93	61.97 ^b ± 0.63	50	71.35 ^b ± 0.80	47	75.76 ^a ± 1.19	64	80.63 ^b ± 0.89	79	83.05 ^a ± 1.12
Kurnool	143	59.75 ^a ± 0.54	37	69.06 ^b ± 0.86	51	74.41 ^a ± 1.24	47	79.91 ^b ± 1.06	87	83.31 ^a ± 1.13
Sex										
Male	232	61.89 ^b ± 0.40	50	70.09 ^b ± 0.77	26	77.59 ^b ± 1.39	22	82.25 ^b ± 1.30	10	87.36 ^b ± 1.87
Female	301	60.21 ^a ± 0.36	122	68.13 ^a ± 0.49	172	71.14 ^a ± 0.53	196	75.80 ^a ± 0.43	290	79.63 ^a ± 0.35
Face length (cms)										
Overall	533	16.65 ± 0.10	172	18.42 ± 0.12	198	19.88 ± 0.20	218	20.28 ± 0.22	300	20.78 ± 0.24
Districts										
Chittoor	162	16.67 ^a ± 0.18	44	18.14 ^a ± 0.24	57	19.63 ^a ± 0.30	61	20.24 ^a ± 0.33	58	20.53 ^{ab} ± 0.30
YSRKadapa	135	16.53 ^a ± 0.20	41	17.95 ^a ± 0.23	43	20.06 ^a ± 0.33	46	20.10 ^a ± 0.35	76	20.89 ^b ± 0.27
Anantapur	93	16.57 ^a ± 0.24	50	18.84 ^b ± 0.22	47	19.72 ^a ± 0.32	64	20.09 ^a ± 0.29	79	20.45 ^a ± 0.28
Kurnool	143	16.86 ^a ± 0.20	37	18.78 ^b ± 0.24	51	20.12 ^a ± 0.33	47	20.69 ^a ± 0.35	87	21.26 ^c ± 0.28
Sex										
Male	232	16.78 ^a ± 0.15	50	19.25 ^b ± 0.21	26	21.22 ^b ± 0.38	22	21.45 ^b ± 0.43	10	21.61 ^b ± 0.46
Female	301	16.52 ^a ± 0.13	122	17.60 ^a ± 0.14	172	18.55 ^a ± 0.14	196	19.11 ^a ± 0.14	290	19.96 ^a ± 0.09
Ear length (cms)										
Overall	533	14.66 ± 0.08	172	15.31 ± 0.14	198	15.90 ± 0.17	218	16.06 ± 0.18	300	16.39 ± 0.30
Districts										
Chittoor	162	14.18 ^a ± 0.14	44	14.41 ^a ± 0.28	57	15.61 ^a ± 0.26	61	15.77 ^a ± 0.26	58	16.51 ^a ± 0.37
YSRKadapa	135	14.88 ^b ± 0.15	41	15.41 ^b ± 0.27	43	15.71 ^a ± 0.28	46	16.08 ^a ± 0.29	76	16.50 ^a ± 0.34
Anantapur	93	15.25 ^b ± 0.18	50	15.76 ^b ± 0.26	47	16.16 ^a ± 0.28	64	16.43 ^a ± 0.24	79	16.31 ^a ± 0.35
Kurnool	143	14.35 ^a ± 0.15	37	15.68 ^b ± 0.28	51	16.10 ^a ± 0.29	47	15.95 ^a ± 0.28	87	16.25 ^a ± 0.35
Sex										
Male	232	14.73 ^a ± 0.11	50	15.53 ^a ± 0.25	26	16.44 ^b ± 0.32	22	16.55 ^b ± 0.34	10	17.01 ^b ± 0.58
Female	301	14.59 ^a ± 0.10	122	15.09 ^a ± 0.16	172	15.35 ^a ± 0.12	196	15.56 ^a ± 0.11	290	15.78 ^a ± 0.11
Tail length (cms)										
Overall	533	14.51 ± 0.09	172	15.11 ± 0.16	198	15.42 ± 0.20	218	15.84 ± 2.59	300	16.56 ± 0.32
Districts										
Chittoor	162	13.87 ^a ± 0.16	44	14.74 ^a ± 0.31	57	15.59 ^a ± 0.31	61	15.81 ^a ± 3.78	58	17.23 ^c ± 0.40
YSRKadapa	135	14.56 ^b ± 0.17	41	15.05 ^a ± 0.29	43	15.24 ^a ± 0.34	46	15.47 ^a ± 4.09	76	16.65 ^{bc} ± 0.36
Anantapur	93	15.20 ^c ± 0.21	50	15.06 ^a ± 0.28	47	15.02 ^a ± 0.33	64	15.77 ^a ± 3.39	79	16.08 ^a ± 0.37
Kurnool	143	14.40 ^b ± 0.18	37	15.59 ^a ± 0.30	51	15.84 ^a ± 0.34	47	16.31 ^a ± 4.00	87	16.27 ^{ab} ± 0.38
Sex										
Male	232	14.84 ^b ± 0.13	50	15.75 ^b ± 0.27	26	16.41 ^b ± 0.38	22	17.05 ^a ± 4.92	10	17.88 ^b ± 0.62
Female	301	14.17 ^a ± 0.12	122	14.48 ^a ± 0.17	172	14.44 ^a ± 0.15	196	14.63 ^a ± 1.64	290	15.24 ^a ± 0.12

Means followed by same superscript(s) do not differ significantly ($p < 0.05$); n = number of animals

and Jharkhand black, Selolo *et al.* (2015) in goats of South Africa, while, Freitas *et al.* (2004) in Anglonubian, Pesmen and Yardimci (2008) in Saanen, Thiruvenkadan and Panneerselvam (2009) in Kanni Adu, Chitra *et al.* (2012) in Malabari, Gopu *et al.* (2013) in Salem Black, Hilal *et al.* (2013) in Beni Arrous local goats, Kuralkar *et al.* (2013) in Berari, Siddalingamurthy *et al.* (2017) in Karnataka local goats and Vinod and PunyaKumari (2019) in local goats of Andhra Pradesh reported higher body weights than those observed in the present study. The variation of body weights at different ages among males and females might be due to the dominant and aggressive behavior of males, anabolic effect of hormones presents in males and variation in genetic constitution of the animals (Hafez, 1962).

Biometrical measurements

All the biometrical parameters revealed increasing trend with the advancement of the age. Sexual dimorphism was observed for all the biometrical traits, where males recorded significantly ($p < 0.01$) higher means than females. Considerable variation between districts was also observed for all the parameters under study (Table 1).

Height at withers

The overall least squares mean for height at withers at milk teeth, 2, 4, 6 and 8 teeth of age were 66.60 ± 0.29 , 74.65 ± 0.42 , 79.50 ± 0.48 , 82.80 ± 0.55 and 84.07 ± 0.72 cm, respectively (Table 1). The height at withers increased with age and significant ($p < 0.01$) differences were recorded among geographical (districts) locations. The means recorded in the current findings were higher than those reported by Jimmy *et al.* (2010) in goats of Uganda, Chacon *et al.* (2011) in Cuban Creole goats, Manzi *et al.* (2011) in goats of Rwanda, Chitra *et al.* (2012) in Malabari goat. Males were taller by 1.67, 4.81, 8.77, 11.09 and 9.19 cm than females at milk teeth to 8- teeth of age, respectively. Thiruvenkadan and Panneerselvam (2009) in Kanni Adu goat recorded higher means for height at withers in males at 8- teeth than those observed in the present study. The indigenous goats of Andhra Pradesh recorded higher means for height at withers which might be due to variation in the germplasm/genetic base of the populations, growth rate and the habitat under which the animals are maintained.

Chest girth

The overall least squares mean for chest girth at milk teeth, 2, 4, 6 and 8 teeth age groups were 61.08 ± 0.25 , 69.55 ± 0.39 , 76.07 ± 0.43 , 79.96 ± 0.51 and 82.83 ± 0.69 cm, respectively. Chest girth is one of the important contributors for prediction of body weight which indicates the lung capacity and rib cage circumference. The mean chest girth recorded in the present study coincided with the findings of Verma *et al.* (2015) in Singharey and Vinod and PunyaKumari (2019) in local goats of Andhra Pradesh, but higher to those reported by Jimmy *et al.* (2010) in goats of Uganda, Manzi *et al.* (2011) in goats of Rwanda, Chitra *et al.* (2012) in Malabari goat, Gopu *et al.* (2013) in Salem black males. The present findings revealed significant ($p < 0.01$) variations among flocks maintained in four districts of Andhra Pradesh at milk teeth, 2- and 4- teeth of ages, which could be attributed to the variation in environmental factors, plane of nutrition, breeding and managerial practices being adopted by the farmers of different districts. Highly significant ($p < 0.01$) variations between males and females was observed for chest girth at all age groups studied. Males had higher chest girth than the females at all ages studied, which could be due to the effect of differential expression of sex hormones on the chest girth and higher body weights in males.

Body length

The overall least squares mean for body length at milk teeth, 2, 4, 6 and 8 teeth of age were 53.24 ± 0.25 , 59.07 ± 0.50 , 63.84 ± 0.57 , 67.13 ± 0.57 and 69.66 ± 0.99 cm, respectively and were lower compared to earlier findings of Dixit *et al.* (2013) in Surti, Gopu *et al.* (2013) in Salem black, Verma *et al.* (2015) in Singharey, Mandakmale *et al.* (2016) in Kathewadi, Vinod and PunyaKumari (2019) in local goats of Andhra Pradesh, while, the values reported in the present study were higher compared to findings in Pantja goat by Ravimuragan *et al.* (2009). The body length among the goat populations of Chittoor, YSR Kadapa, Anantapur and Kurnool districts showed non-significant ($p \leq 0.05$) differences at all age groups except at milk teeth age. Body length of males were significantly ($p < 0.01$) higher than females by the difference of 2.66, 6.39, 7.63 and 8.13 cm at 2-, 4-, 6- and 8- teeth age, respectively, which could be attributed to sexual dimorphism.



Hip width

The overall least squares means for hip width at milk teeth, 2, 4, 6 and 8 teeth of age were 13.02 ± 0.08 , 15.04 ± 0.14 , 16.71 ± 0.38 , 17.55 ± 0.21 and 18.05 ± 0.56 cm, respectively and were higher than the mean values recorded in West African Dwarf Goat of South western Nigeria (Fajemilehin and Salako, 2008), goat breeds of Uganda (Jimmy *et al.*, 2010) and local goats of Andhra Pradesh (Vinod and Punya Kumari 2019). The hip width of the goats was significantly influenced ($p < 0.01$) by districts at milk teeth, 6 and 8-teeth ages studied. Sex had no significant effect at all ages except at 6 teeth of age, where males shown higher hip width than females by 1.97 cm. highest hip widths (19.57) was noticed in Kurnool district at 8 teeth age group. Varied climatic conditions, plane of nutrition and managerial practices being followed by the farmers might have resulted in variation of body weights, growth rate and hip width among different districts studied.

Paunch girth

The least squares mean for paunch girth at milk teeth, 2, 4, 6 and 8 teeth of age were 61.05 ± 0.27 , 69.11 ± 0.45 , 74.37 ± 0.74 , 79.02 ± 0.68 and 83.50 ± 0.95 cm, respectively. The means calculated in the present study were lower compared to the values observed in Singharey goat of Sikkim (Verma *et al.*, 2015), Karnataka goats (Siddalingamurthy *et al.*, 2017).

In contrast to the present findings, lower means for paunch girth were recorded in Bakerwali female goats at 8-teeth (Reotheia *et al.*, 2013) and higher values were recorded in Bakerwali male goats by Reotheia *et al.* (2013). The sex effect on paunch girth was highly significant ($p \leq 0.01$) and indeed males had higher paunch girth than females at all ages studied. The increase of paunch girth from milk teeth to 8-teeth was 25.47 cm in males and 19.42 cm in females in present study revealed that the skeletal frame and muscular growth of the bucks and does is different and increased with the age.

Face length

The overall least-squares means of face length at milk teeth, 2, 4, 6 and 8-teeth age were 16.65 ± 0.10 , 18.42 ± 0.12 , 19.88 ± 0.20 , 20.28 ± 0.22 and 20.78 ± 0.24 cm,

respectively. The mean face length recorded in the present study was higher than those reported in Surti (Dixit *et al.*, 2013), Singharey (Verma *et al.*, 2015) and local goats of AP (Vinod and Punya Kumari 2019), while, Gopu *et al.* (2013) in Salem black males and females at 8-teeth and 6-teeth of age recorded higher means than the present study and Reotheia *et al.* (2013) in female Bakerwali at all ages. Males had slightly higher face length values than females at all ages except at milk teeth age which corroborated with the findings of Reddy (2004) in Mahabubnagar goats.

Ear length

The overall least squares mean for ear length at milk teeth 2, 4, 6 and 8-teeth age were 14.66 ± 0.08 , 15.31 ± 0.14 , 15.90 ± 0.17 , 16.06 ± 0.18 and 16.39 ± 0.30 cm, respectively. There was not much growth in length of ear from 4-teeth age to 8-teeth age in indigenous goats of Andhra Pradesh. Males recorded higher mean values for ear length than females at 4, 6 and 8-teeth ages. The means in the present study were nearly close to the observations reported in Mahabubnagar goats Berari goats (Kuralkar *et al.*, 2013), but, lower compared to earlier findings Hassen *et al.* (2016) in Syrian goat breeds (Baladi, Jabali, Shami) and AP local goats (Vinod and Punya Kumari 2019).

Tail length

The overall least-squares mean of tail length at milk teeth, 2, 4, 6 and 8-teeth age were 14.51 ± 0.09 , 15.11 ± 0.16 , 15.42 ± 0.20 , 15.84 ± 2.59 and 16.56 ± 0.32 cm, respectively (Table 1) and these values were coincided with earlier findings of Ravimurugan *et al.* (2009) in Pallai Adu, but, higher than those reported by Kuralkar *et al.* (2013) in Berari, Verma *et al.* (2015) in Singharey goats of Sikkim and Vinod and PunyaKumari (2019) in local goats of Andhra Pradesh. The effect of district was significant on tail length at milk teeth and 8-teeth of age studied. Sex had significant effect ($p < 0.01$) on tail length and males expressed higher mean values over females at all ages studied except at 6-teeth which can be correlated with higher growth and other biometrical measurements and sex hormones.

CONCLUSION

The overall least squares mean body weights (kg) at milk teeth, 2, 4, 6 and 8-teeth ages were 13.97 ± 0.16 , 20.57

± 0.38 , 26.56 ± 0.68 , 30.66 ± 0.62 and 34.64 ± 0.85 , respectively. The least squares analysis of variance revealed significant effects of district and sex on body weights and measurements at one or the other ages studied. The body weights and biometrical measurements linearly increased with age. Sexual dimorphism was evident, where males recorded significantly higher means than females at all the stages of growth. The animals in YSR Kadapa district showed higher mean values for body weights all the ages studied.

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