



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.03

TPI 2019; 8(7): 334-337

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www.thepharmajournal.com

Received: 28-05-2019

Accepted: 30-06-2019

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Udder morphology and its association with milk production in malabari, attappaddy black and crossbred (Sannen x Alpine x Malabari) goats of Kerala

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Abstract

A study was conducted in Malabari, Attappaddy Black and crossbred goats to find out the association between the udder morphology and milk production. The udder morphological traits included were Teat diameter (TD), Teat Length (TL), Udder Row Width (URW), Udder Column Width (UCW), Udder Depth (UD), Udder Circumference (UC), and Teat Height from Ground (THG). The mean daily milk yield were 252.80 ± 39.58 ml, 339.41 ± 40.66 ml, 373.22 ± 44.24 ml in Attappady, Malabari and crossbred goats, respectively. Milk yield was positively correlated with URW in Malabari goats while, Attappaddy goats with higher TD and TL produced more milk. In crossbred goats, milk yield had positive correlation with URW, UCW and UD.

Keywords: Udder morphology, milk yield, Malabari, Attappaddy black, crossbred goats

1. Introduction

India has a goat population of 135.17 million goats and ranks second in the world. There are 34 (NBAGR report 2018) well established goat breeds apart from the large number of non-descript goats in many parts of the country. According to the livestock census 2012, the goat population in Kerala is 12.46 lakhs, next to cattle with 13.29 lakhs. Malabari and Attappaddy Black are the twonative goat breeds of Kerala. Malabari goat has its origin at Tellicherry (Thalassery) in the Malabar coast of Kannur district in North Kerala, also known as Tellicherry goat. It is mainly reared for meat and milk, famous for low fat meat and high prolificacy. They are well adapted to the hot and humid conditions of the state. Attappaddy Black goat is a meat type breed, known for its hardiness and disease resistance. It is reared by tribes in Attappaddy hills of palakkad district. The productive and reproductive performances of these breeds are shown at their maximum in their home tract. The goat milk has high value in Kerala compared to cow milk because of its medicinal properties. Farmers are showing interest to select the animals with reasonably good milk production potential along with high prolificacy. In addition to the non-genetic factors like parity, age, breed etc. Morphological traits, such as udder circumference, udder shape, teat length, and teat width, are moderately heritable and are significantly correlated with milk production potential (Carta *et al.*, 2009) [2]. A relationship between morphological udder measures and milk production has also been noted in goats, although diverse criteria exist. Hence, the present study was carried out to find out the relationship between udder morphological traits and milk production in three genetic groups of goats.

2. Materials and Methods

2.1 Experimental animals and data

Data were collected from 154 does belonging to Malabari (52), Attappady (45) and crossbred goats (57) maintained at University Goat and Sheep Farm, Mannuthy. Animals at early to mid-lactation (2-5 weeks post-partum) were included in the study. They were reared under semi intensive system of management with 4 hours of grazing and supplementary concentrate feeding in the morning. Cultivated fodder and ad libitum water were made available during the period. All goats were vaccinated against PPR and ET as per the schedule.

Milking was done manually once in a day and kids were allowed to suckle after milking. Milk yield was recorded on daily basis from each doe for 21 days and mean milk yield was calculated.

A total of eight traits related with udder morphology were recorded on the goats during the study. They were Teat Length (TL); length from point of attachment with udder to teat tip; Teat Diameter (TD); Measured at the upper and lower end of the teat using a measuring tape; Udder length (UL): length from rear to the front attachment of udder along with its sole, where the udder blends smoothly with the body; Udder row width (URW): distance between the widest part of the udder measured from the rear end; Udder column width (UCW): distance between the widest part of the udder measured from the lateral side; Udder depth (UD): distance from the base to the lowest point of the udder at the place of attachment of the teats; Udder circumference (UC): measured at maximum diameter of udder using measuring tape; Teat height from ground (THG): minimum distance between teat end and ground measured with the help of rigid measuring scale. The measurements were taken on 15th day post-partum and one hour prior to milking. Details on parity, litter size and kidding period were collected from the records maintained by the field units

2.2 Statistical analysis

The means and standard error of body weight and udder traits were estimated using statistical procedures suggested by Snedecor and Cochran (1994)^[7].

Data was analyzed using One-way ANOVA (SPSS version 24) to estimate the effect of parity, litter size and kidding period on milk production and udder morphology. Least-square maximum likelihood programme (Harvey, 1990)^[3] was used to correct the effects of parity, litter size and period of kidding factors on production traits of Malabari goats. The following mixed model was used:

$$Y_{ijk} = \mu + \pi_i + l_j + k_k$$

Where, Y_{ijk} is the trait measured on ijk th animal

μ is the overall mean

π_i is the fixed effect associated with i th parity

l_j is the fixed effect associated with j th litter size

k_k is the fixed effect associated with k th period of kidding

The Pearson's correlation coefficient was calculated using SPSS software version 24 to analyse the association between milk yield and udder biometrical parameters.

3. Results and Discussion

Mean \pm SE for udder and teat traits, body weight as well as milk yield of Malabari, Attappady Black and crossbreds are given in table 1.

Table 1: Least square means of udder morphological traits and milk yield in Malabari, Attappady and crossbred goats

Traits	Abbreviations	Malabari	Attappaddy Black	Crossbred
Milk Yield (ml)	MY	339.41 \pm 40.66	252.83 \pm 39.58	373.22 \pm 44.24
Body Weight (kg)	BW	30.12 \pm 1.28	32.24 \pm 1.13	32.55 \pm 1.34
Left Teat Diameter- Upper (cm)	LTDU	9.68 \pm 0.28	7.81 \pm 0.43	8.02 \pm 0.37
Right Teat Diameter - Upper (cm)	RTDU	9.72 \pm 0.22	7.35 \pm 0.28	7.82 \pm 0.37
Left Teat Diameter - Lower (cm)	LTDL	4.24 \pm 0.17	4.01 \pm 0.20	3.42 \pm 0.12
Right Teat Diameter - Lower (cm)	RTDL	4.14 \pm 0.15	3.67 \pm 0.17	3.26 \pm 0.09
Left Teat Length (cm)	TLL	6.38 \pm 0.36	6.50 \pm 0.37	6.64 \pm 0.26
Right Teat Length (cm)	TLR	6.46 \pm 0.34	6.33 \pm 0.40	6.57 \pm 0.26
Udder Row Width (cm)	URW	7.00 \pm 0.50	9.58 \pm 0.34	9.0 \pm 0.84
Udder Column Width (cm)	UCW	7.75 \pm 0.31	9.64 \pm 0.33	8.79 \pm 0.43
Udder Depth (cm)	UD	15.92 \pm 1.32	15.14 \pm 0.77	15.00 \pm 0.43
Udder Circumference (cm)	UC	24.67 \pm 0.67	28.59 \pm 1.02	27.86 \pm 1.50
Teat- Ground Distance (cm)	THG	22.50 \pm 0.89	31.59 \pm 1.13	26.50 \pm 0.96

The mean values for the different udder morphological traits like LTDU, LTDL, RTDU, RTDL, TLL, TLR, URW, UCW, UD, UC and THG were 9.68 \pm 0.28, 4.24 \pm 0.17, 9.72 \pm 0.22, 4.14 \pm 0.15,

6.38 \pm 0.36, 6.46 \pm 0.34, 7.00 \pm 0.50, 7.75 \pm 0.31, 15.92 \pm 1.32, 24.67 \pm 0.67, 22.50 \pm 0.89 for Malabari goats, 7.81 \pm 0.43, 4.01 \pm 0.20, 7.35 \pm 0.28, 3.67 \pm 0.17, 6.50 \pm 0.37, 6.33 \pm 0.40, 9.58 \pm 0.34, 9.64 \pm 0.33, 15.14 \pm 0.77, 28.59 \pm 1.08, 31.59 \pm 1.13 for Attappaddy Black goats and 8.02 \pm 0.37, 3.42 \pm 0.12, 7.82 \pm 0.37, 3.26 \pm 0.09, 6.64 \pm 0.26, 6.57 \pm 0.26, 8.79 \pm 0.71, 8.79 \pm 0.43, 15.00 \pm 0.44, 27.86 \pm 1.50, 26.50 \pm 0.96 for crossbred goats, respectively.

The LTDU was highest in Malabari with 9.68 cm followed by crossbreds with 8.02 cm and Attappaddy Black with 7.81 cm. Malabari goats had highest LTD of 4.24 cm followed by Attappaddy Black with 4.01 cm and crossbreds with 3.42 cm. TLL was highest in crossbreds with 6.64 cm followed by Malabari 6.38 cm and Attappaddy Black with 6.50 cm. Attappaddy Black goats had the highest URW (9.58 cm) followed by crossbreds (8.79 cm) and Malabari goats (7 cm). UCW also followed the same order with Attappaddy goats having the highest (9.64 cm) and Malabari goats with the lowest value (7.75 cm).

UD was comparable in all the three groups and ranged from 15 cm in crossbreds to 15.92 cm in Malabari goats. UC was highest in Attappaddy (28.59) followed by crossbreds (27.86) and Malabari (24.67) goats. The THG was highest in Attappaddy Black with 31.59 cm followed by crossbred (25.90 cm) and Malabari (23.50 cm). Decrease in THG in Malabari goats might be due to increased milk production attributed to increased litter size when compared to Attappaddy goats. Peris *et al.*, (1999)^[5] also had observed that the teat-to-floor distance and the udder volume were affected by prolificacy ($P < 0.05$). Goats that had kidded twins had a significantly more voluminous udder and a lower distance between the teat and the floor.

Crossbred goats were heavier with 32.55 kg followed by Attappaddy Black (32.24 kg) and Malabari (30.12 kg). The mean daily milk yield recorded were 252.80 \pm 39.58 ml, 339.41 \pm 40.66 ml, 373.22 \pm 44.24 ml in Attappady, Malabari and crossbred goats, respectively.

The correlation coefficient between udder morphology, milk yield and body weight in Malabari, Attappaddy Black and Crossbred goats are given in Tables 2-4.

Table 2: Correlation co-efficient between udder morphology, body weight and milk yield in Malabari goats

	MY/d	LTDU	LTDL	RTDU	RTDL	TLL	TLR	B.wt	URW	UCW	UD	UC	TGH
MY/d	1.000	-0.092	-0.330	-0.064	-0.060	-0.002	0.002	-0.023	.909*	0.077	-0.563	0.593	0.589
LTDU		1.000	.470*	.745**	0.316	.545*	.529*	.484*	-0.485	0.673	-0.027	0.518	-0.274
LTDL			1.000	0.387	.679**	0.278	0.277	0.458	-0.709	0.430	0.639	0.112	-0.736
RTDU				1.000	0.092	0.387	0.442	.525*	-0.313	0.568	0.298	0.644	-0.571
RTDL					1.000	0.276	0.352	0.092	-0.552	-0.166	0.759	-0.303	-0.739
TLL						1.000	.911**	0.312	-0.534	0.216	0.466	0.069	-0.572
TLR							1.000	0.370	-0.541	-0.175	0.660	-0.369	-0.612
B.wt								1.000	-0.239	0.691	0.272	0.551	-0.357
URW									1.000	-0.269	-0.581	0.250	0.716
UCW										1.000	-0.173	0.808	-0.091
UD											1.000	-0.347	-.935**
UC												1.000	0.113
TGH													1.000

Milk yield had a negative correlation with TGH in crossbred goats. Perris (1994) also reported similar results in Murciano-Granadina dairy goats. Milk yield was positively correlated with URW in Malabari goats while, Attappaddy goats having higher TD and TL produced more milk. Fernandez et al. (1995) also observed that TD tent to increase with milk yield. In crossbred goats, milk yield tent to increase with URW, UCW, UD and decreased with TGH. Siddik et al., (2005) [6] also showed a positive significant ($P < 0.01$) correlation between udder traits viz. Udder depth, udder circumference, teat circumference and daily milk yield in Murciano-Granadina goats. However, Upadhyay et al. reported positive

and significant ($P < 0.01$) correlation of milk yield with all udder morphological traits except for teat height from ground (THG) in local goats of Rohilkhand region. TD (upper) is positively correlated ($P < 0.05$) with TL and body weight in Malabari goats. Udder depth had a significant negative correlation ($P < 0.01$) with teat height from ground. It was observed that TD increased with TL and body weight in Attappaddy Black goats. There was significant increase in TD (lower) with decreasing TGH. UC was negatively correlated with TGH but found to increase with increase in body weight. UD is observed to increase with UC in Attappaddy goats.

Table 3: Correlation co-efficient between udder morphology, body weight and milk yield in Attappaddy black goats

	MY/d	LTDU	LTDL	RTDU	RTDL	TLL	TLR	B.wt	URW	UCW	UD	UC	TGH
MY/d	1	.684**	.691**	.543*	.467	.632**	.669**	.037	-.424	.200	-.294	-.334	.083
LTDU		1	.659**	.877**	.767**	.715**	.550*	.245	-.264	.243	-.170	-.081	-.396
LTDL			1	.607**	.485*	.507*	.474*	.208	-.434	.000	-.011	-.159	-.164
RTDU				1	.715**	.673**	.458	.127	-.405	-.050	-.321	-.314	-.264
RTDL					1	.740**	.476*	.498*	-.062	.163	-.128	.145	-.621*
TLL						1	.823**	.462	.012	.535	-.253	.175	-.509
TLR							1	.446	-.162	.641*	-.292	-.113	-.064
B.wt								1	.229	.254	.481	.672*	-.718*
URW									1	.095	.450	.626*	-.264
UCW										1	.073	.507	-.394
UD											1	.683*	-.215
UC												1	-.693*
TGH													1

Crossbred goats with higher body weight had increased URW, UD and UC. URW was found to have a positive

($P < 0.05$) association with UD and UC. UD was positively correlated with UC as in case of Attappaddy goats.

Table 4: Correlation co-efficient between udder morphology, body weight and milk yield in crossbred goats

	MY/day	LTDU	LTDL	RTDU	RTDL	TLL	TLR	B.wt	URW	UCW	UD	UC	TGH
MY/day	1.000	0.128	-0.143	0.153	0.139	0.261	0.313	0.126	.832*	.889**	.929**	0.707	-0.204
LTDU		1.000	0.143	.696**	0.337	0.079	0.185	0.011	-0.497	-.777*	-0.473	-0.103	-0.050
LTDL			1.000	0.276	.570*	-0.231	-0.196	0.162	0.190	-0.138	-0.023	-0.133	0.635
RTDU				1.000	0.327	0.187	0.320	-0.104	-0.326	-0.310	0.009	-0.002	-0.332
RTDL					1.000	-0.172	-0.316	0.068	0.317	0.093	0.000	-0.026	0.601
TLL						1.000	.842**	0.039	0.056	0.058	0.470	0.304	-0.520
TLR							1.000	0.143	0.124	0.175	0.538	0.539	-0.675
B.wt								1.000	.826*	0.722	.772*	.891**	-0.194
URW									1.000	0.596	.850*	.803*	0.167
UCW										1.000	0.691	0.521	-0.258
UD											1.000	.835*	-0.313
UC												1.000	-0.281
TGH													1.000

4. Conclusions

Milk yield was positively correlated udder morphological traits in Malabari, Attappaddy and Crossbred goats. Milk yield was correlated with URW in Malabari goats while, Attappaddy goats with higher TD and TL produced more milk. In crossbred goats, milk yield had positive correlation with URW, UCW and UD.

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