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Evaluation of Morphometric and Reproductive Traits of Indigenous Dairy Goat Types in North Western Amhara, Ethiopia

Research Article

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ABSTRACT

The objective of this study was to evaluate the morphometric and reproductive traits of indigenous dairy goat types. It was conducted in three districts (Ebnat, Gonji-kolela and Farta) based on the agro-ecological differences, goat population potentials and experience of the farmers using goat milk. Semi-structured questionnaires, field observations, morphological and reproductive trait measurements were used. The results revealed that the average age at sexual maturity of male in Farta district, (Mean±SE) was 7.04 ± 0.41 months. However, age at first service of male goats was longer in Gonji kolela (9.84±0.95) and Ebnat (11.54±1.28) districts. The average body length (BL) for dairy, dual and meat type goats were 59.65 ± 0.58, 54.87 ± 0.69 and 55.52 ± 0.74 cm. The mean rear udder length, udder circumference and teat length were 17.14 ± 0.28, 31.39 ± 0.59 and 3.71 ± 0.07 cm, 14.21 ± 0.48, 26.75 ± 1.01 and 3.41 ± 0.12 cm and 13.44 ± 0.38, 24.67 ± 0.81 and 3.01 ± 0.09 cm, respectively. Whereas, the mean rear udder diameter for dairy, dual and meat types for female goats were 10.04 ± 0.22, 8.66 ± 0.37 and 8.01 ± 0.30 cm, respectively. Dairy type female goats had significantly higher ($P<0.001$) values for all udder and teat measurements than dual and meat type female goats. In conclusion, goat breeding and reproduction was not identified as dairy, meat and dual purpose types and there is no specialized dairy goat breeding, reproduction with corresponding production system. Therefore, evaluation of morphometric and reproductive traits of indigenous dairy type goats with specialized and intensive production system are crucial to increase the milk production and productivity.

KEY WORDS goat types, morphometric, reproductive, traits.

INTRODUCTION

Goat is a good source of meat (Chevon), milk, yoghurt, cheese and other by-products such as hide and skin. Goat population has witnessed a positive growth rate in the last 20 years (Morand-Fehr, 2003). The number of goats has increased by almost 50% at world level, cattle increased by just 9%. However, sheep population decreased by 4% (Morand-Fehr and Boyazogly, 1999; Devendra, 2001). In Ethiopia, indigenous Ethiopian goats have been phenotypically classified into 12 types, although genetic characterization indigenous goats of Ethiopia are grouped into eight distinct genetic entities (Tesfaye, 2004). There are many types of dairy and meat goat breeds introduced to Ethiopia from outside for crossbreeding. The main purpose of crossing with local goats was to improve milk production in areas where goat milk is known to be consumed (Adane and Girma, 2008). Amhara National Regional State also has six goat ecotypes i.e. Gumuz, Awi, Central Abergelle, Abergelle, Begiamedir and Bati (Hassen *et al.* 2012). The region endowed 5291571 goats; particularly the south Gonder zone and western Gojam have 434230 and 315142 goats,

respectively (CSA, 2014), however milk production from goat in this region is insignificant. In Ethiopia, human population increases from time to time. Grazing lands are decreasing and changed to residents and small pieces of farm land. These lead to shortage of grazing and farm land which created difficulty to grow subsistence cash crops and dairy cattle feeds (Alemayehu *et al.* 2015). Many farmers would like to keep dairy cows but do not have sufficient land to grow enough feed. Climate change is also becoming a challenge for dairy cattle producer as it is directly linked with feed shortage and climate induced stress (Alemayehu and Fantahun, 2012). Climate change in Amhara region causes heat stress that cattle and sheep are getting difficulties to survive. However, indigenous goats are able to withstand the stress as goat have low surface to volume ratio. Hence, the number of goats is increasing (Alemayehu and Fantahun, 2012). Besides, dairy goats require less land than dairy cows (CTA, 2007). As a result, keeping dairy goats are becoming more affordable and appropriate option (Legesse *et al.* 2008).

It has been also reported that goat milk as a much less allergenic alternative to cow milk due to its differing protein structure, namely its casein micelle components (Park, 1994). Goat milk has demonstrated significant improvements in colic, minor digestive disorders, asthma and eczema over cow milk, as well as in infants and children with cow milk sensitivities (McCullough, 2003). Haenlein *et al.* (2004) indicated that treatment with goat milk typically resolves between 30 and 40% of problem cases of childhood cow milk allergy, which can be higher in some cases (one study showed improvements in 49 out of 55 children treated with goat milk). Dairy goat farming can contribute to food security of farming families and become an income source through commercialization of raw milk and dairy products. The characteristics of goat milk, both from a nutritional and social standpoint are important and encourage studies to evaluate its production and quality (Fernandes *et al.* 2008). Goat's milk is reported to have higher digestibility and lower allergenic properties compared to cow's milk (Senaka Ranadheera *et al.* 2012). It has also a higher content of short chain fatty acids in milk fat, higher content of zinc, iron, and magnesium, and antibacterial characteristics (Slacanac *et al.* 2010). In addition, these benefits may be further enhanced by using goat's milk as a vehicle for delivering probiotics and prebiotics.

Even though the country as well as the region has large size of goat population, the productivity per unit of animal especially milk production is very low. The contribution of this sector to both the national and the regional economy is relatively low too. Because of less productivity, local goat breeds were subjected to replacement and crossbreeding with imported goat breeds like Anglo-Nubian, Saanen and Toggenburg introduced at different periods by different organization. But this did not improve the productivity except that indiscriminate crossbreeding caused genetic erosion, loss of genetic diversity and reduction of adaptive value for efficient utilization of the existing adapted goat genetic resources (Hassen *et al.* 2012). Therefore, the objective of this paper was to evaluate morphometrically and reproductive traits of indigenous dairy goat type to enhance food security at small holder level.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Ebnat, Farta and Gonji-kolela districts of Amhara region in 2014. These districts were purposively selected based on agro-ecology, goat population potentials and experience of the farmers of using goat milk. Ebnat district considered as lowland, Gonji kolela as midland and Farta as highland. Ebnat and Farta districts are located in the South Gondar administrative zone and Gonji kolela is located south of Bahir Dar in the west Gojjam Zone (Table 1; Figure 1). Ebnat, Farta and Gonhi-kolela districts have 131505 40193 and 52350 indigenous goats respectively (EDARDO, 2013; FDARDO, 2013; GDARDO, 2013).

Data collection methods

The data was collected through individual interviews using questionnaire, focus group discussion and field observations. Focus group discussion and field observation were used to support individual interview to assess and collect information on reproductive performance traits. Focus group discussion were composed of greater than 10 people believed to be knowledgeable about past and present social and economic status of the area, community elders and story tellers and it has to be done in each PA. To supplement the primary data and for background information for the district, secondary data were collected from each district agriculture and rural development offices. About five kebele administrations were selected each. Semi-structured questionnaires, field observations and morphometric trait measurements were conducted based on international dairy goat measurement criteria. A total of 235 dairy (109), dual (50) and meat (76) type goats were identified. The measurements of rear udder diameter (RUD), rear udder length (RUL), udder circumference (UCC), teat length (TTL), Scrotum length (SL), scrotum width (SW) and scrotum circumference (SCC) were highly considered. Besides, morphological quantitative characters such as body length (BL), diagonal body length (DBL), heart girth (HG), pelvic width (PW), pelvic height (PH), rump width (RW) and - rump length (RL) were measured.

Reproductive performance traits such as age at sexual maturity for male and female, age at first kidding, reproductive lifetime of doe's and buck's, number of kidding per doe's life time and kidding interval were evaluated. Mean and standard error were used for reproductive performance analysis.

Data analysis

Multivariate analysis of SPSS version 20 was used for quantitative data ascertain the goat type, district, dentition (1PPI, 2PPI, 3PPI 4PPI and broken teeth) and sex. General linear model (GLM) of multivariate analysis of SAS (2000) was used to quantify fixed effects such as the goat type, agro-ecology and sex. Pair wise comparison was employed when it was significant to reveal the difference between means. The model used for GLM analysis was in the following formula:

$$Y_{ijkl} = \mu + A_i + S_j + D_k + B_{l + AiBi + BiDk} + e_{ijkl}$$

Where:

Y_{ijk}: observed measurement.

μ: overall mean.

A_i: effect of i^{th} age group.

S_j: effect of j^{th} sex (male and female).

D_k: effect of k^{th} district or agro-ecology.

B_l: effect of l^{th} breed (dairy type goat, dual purpose goat and meat type goat).

AiBi: effect of age by breed interaction.

BiDk: effect of breed by district interaction.

e_{ijkl}: random residual error.

RESULTS AND DISCUSSION

Flock structure

The proportion of goats at different sex and age classes follow similar trends, where breeding did represent the largest class, followed by kids (Table 2). These results were in line with Tesfaye, (2009); Dhaba *et al.* (2012) and Solomon (2014). The sampled goat population structure by age and sex. About 22.2% older females' ages structured with 3PPI and 47.8% with 4PPI. The younger males structured (39.3%) with 1PPI and 39.3% with 2PPI. The younger females (1PPI and 2PPI) and extreme older females accounted 9.7% 1PPI, 18.8% 2PPI and 1.4% broken teeth, respectively. The older male goats 3PPI, 4PPI and broken teeth accounted 14.3%, 3.6% and 3.6%, respectively (Table 3). The proportions of breeding were higher in a sampled population and followed by kids. Similar results were reported in Ethiopia indicating that herders keep more proportion of females than males (Dhaba *et al.* 2013; Dereje *et al.* 2013).

Reproductive performances of goats

In Farta district, the average age at sexual maturity of male (Mean±SE) was 7.04 ± 0.41 months. This was in line with the result of Solomon (2014) who reported 7.4 ± 2.01 months for western Lowland male goats. However, age at first service of male goats was longer in Gonji kolela (9.84±0.95) and Ebnat (11.54±1.28) districts (Table 4).

The two districts show delayed age at sexual maturity of males compared to Farta district but younger than male Abergelle goats which were reported 12.3 months (Solomon, 2014).

The overall average age at sexual maturity of female goats was 7.36 ± 0.26 months. This was closer to the report of Tesfaye (2009).

Goat types characterization based on morphometric traits

Average body length (BL) for dairy, dual and meat type goats were 59.65 ± 0.58, 54.87 ± 0.69 and 55.52 ± 0.74 cm, respectively (Table 5). There were significantly higher ($P<0.05$) values of average body length for dairy type goats than dual and meat type goats. When compared from the exotic goats, the body length of indigenous dairy goat type was lower than Alpine and Saanen goats which have 74.33 ± 3.93 cm and 74.28 ± 4.78 cm, respectively (Nemeth *et al.* 2010).

About 25-36 months and above female goats have 69.31 ± 1.85 cm body lengths in Peshawar, Pakistan which was also higher than this result (Hamayun *et al.* 2006). However significance difference observed among indigenous goat types in the study population.

Average diagonal body length (DBL) for dairy, dual and meat type goats were 64.52 ± 0.62, 59.93 ± 0.73 and 61.22 ± 0.78, respectively. Average heart girth (HG) in these breeds was 79.27 ± 0.69, 75.44 ± 0.81 and 75.31 ± 0.87 cm, respectively. There were significantly higher ($P<0.05$) values of average diagonal body length and heart girth for dairy type goats than dual and meat type goats. Heart girth of the present dairy goats was lower than Beetal goats in Pakistan which have 82.0 ± 3.49 cm heart girth (Abdul, 2011).

Heart girth of Jamnapari female goats in India was 76.1 ± 0.38 cm, which was lower than the result of dairy type goats (FAO, 1982). About 25-36 months and above Beetal goats have 74.89 ± 0.93 cm heart girth which was lower than the present dairy type goats (Hamayun *et al.* 2006).

Dairy type goats was significantly higher ($P<0.05$) average pelvic width (15.05±0.20 cm) than dual (13.09±0.24 cm) and meat (12.70±0.25 cm) type goats (Table 5). Alpine and Saanen goats have 17.21 ± 1.07 and 18.49 ± 2.29 cm, respectively pelvic width in Hungary, which is higher than the present finding (Nemeth *et al.* 2010).

Table 1 Description of the study areas

Study area characteristics	Agro-ecology		
	Lowland (Ebnat)	Midland (Gonji-kolela)	Highland (Farta)
Distance from Regional city (Bahir Dar)	122	70	97
Altitude a.s.l (m)	< 2216	2216	1920-4135
Rainfall (mm)	500-900	1338	900-1099
Temperature (co)	25-30	21	9-25
Area (ha)	249837	64186	103457
Human population (No)	122514	21333	281280
Livestock population (No)	562040	260685	432822
Indigenous goat population	131505	52350	40193

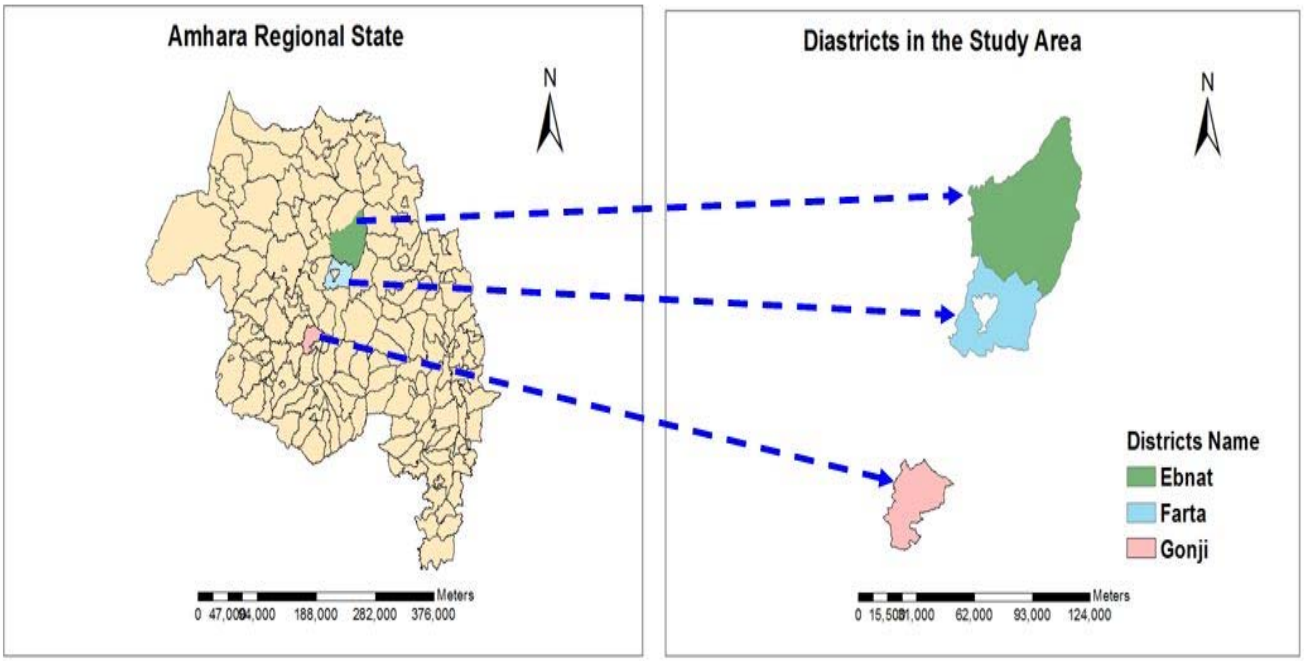

Figure 1 Map of the study areas

Similarly, pelvic height (PH) of dairy type goats (73.37±0.54 cm) was significantly higher (P<0.05) than dual (71.42±0.64 cm) and meat (71.44±0.68 cm) type goats.

Average rump width (RW) and rump length (RL) were 19.31 ± 0.19 cm and 16.61 ± 0.16 cm for dairy type goat, 17.61 ± 0.23 cm and 15.29 ± 0.19 cm for dual type goat and 17.35 ± 0.25 cm and 15.37 ± 0.21 cm for meat type goats (Table 6). Dairy type goats have significantly higher (P<0.001) values for rump width and rump length than dual and meat type goats. The present result of rump width for dairy type goats was higher than Beetal goats which have a rump width of 15.4 ± 2.60 and 17.6 ± 3.55 cm in the front and 14.7 ± 1.15 and 16.5 ± 1.68 cm towards back in females and males, respectively (Abdul, 2011). However, the finding of rump length of dairy type goatwas comparable to Beetal goats which have a rump length of 15.8 ± 1.12 and 17.3 ± 1.12 cm, for females and males, respectively (Abdul, 2011).

Table 2 Flock structure of goats by age and sex group (Mean±SE)

Goat categories	Ebnat		Farta		Gonji-kolela	
	Mean±SE	%	Mean±SE	%	Mean±SE	%
Kids < 6 months	11.62±4.06[a]	31.86	1.77±0.32[b]	25.84	2.68±0.25[b]	27.42
Male kids 6-12 months	2.38±0.83[a]	6.54	0.38±0.14[b]	5.62	1.05±0.23[b]	10.75
Female kids 6-12 months	3.69±0.91[a]	10.13	0.31±0.17[b]	4.49	1.21±0.34[b]	12.37
Bucks	3.85±0.68[a]	10.55	0.77±0.39[b]	11.24	0.95±0.19[b]	9.68
Does	14.08±4.97[a]	38.61	2.92±0.40[b]	42.7	3.00±0.26[b]	30.65
Castrates	0.85±0.34[a]	2.32	0.69±0.40[a]	10.11	0.89±0.21[a]	9.14

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SE: standard error.

Table 3 10 goat flock proportion / structure by age and sex groups in a sampled population

Age	Ebnat			Farta			Gonji-kolela			Over all		
	F (%)	M (%)	Total (%)	F (%)	M (%)	Total (%)	F (%)	M (%)	Total (%)	F (%)	M (%)	Total (%)
1PPI	2 (2.8)	4 (26.7)	6 (6.9)	11 (16.7)	7 (53.8)	18 (22.8)	7 (10.1)	0 (0.0)	7 (10.1)	20 (9.7)	11 (39.3)	31 (13.2)
2PPI	15 (20.8)	5 (33.3)	20 (23.0)	12 (18.2)	6 (46.2)	18 (22.8)	12 (17.4)	0 (0.0)	12 (17.4)	39 (18.8)	11 (39.3)	50 (21.3)
3PPI	13 (18.1)	4 (26.7)	17 (19.5)	16 (24.2)	0 (0.0)	16 (20.3)	17 (24.6)	0 (0.0)	17 (24.6)	46 (22.2)	4 (14.3)	50 (21.3)
4PPI	42 (58.3)	1 (6.7)	43 (49.4)	26 (39.4)	0 (0.0)	26 (32.9)	31 (44.9)	0 (0.0)	31 (44.9)	99 (47.8)	1 (3.6)	100 (42.6)
Broken	0 (0.0)	1 (6.7)	1 (1.1)	1 (1.5)	0 (0.0)	1 (1.3)	2 (2.9)	0 (0.0)	2 (2.9)	3 (1.4)	1 (3.6)	4 (1.7)
Total	72 (82.8)	15 (17.2)	87 (37.0)	66 (83.6)	13 (16.4)	79 (33.6)	69 (100.0)	0 (0.0)	69 (29.4)	207 (88.1)	28 (11.9)	235 (100.0)

PPI: pair of permanent incisors.

Table 4 Reproductive performances of goats

Parameters estimated	Ebnat	Farta	Gonji-kolela	Overall
Age at sexual maturity for male (months)	11.54±1.28[a]	7.04±0.41[b]	9.84±0.95[a]	9.52±0.60
Age at sexual maturity for female (months)	7.54±0.50[a]	7.46±0.53[a]	7.16±0.40[a]	7.36±0.26
Age at first kidding (months)	12.54±0.47[a]	12.42±0.46[a]	12.16±0.40[a]	12.34±0.25
Reproductive lifetime of doe's (year)	8.69±0.62[a]	7.38±0.62[a]	8.53±0.50[a]	8.24±0.33
Reproductive lifetime of buck's (year)	4.23±0.44[a]	3.73±0.56[a]	4.13±0.24[a]	4.04±0.22
Number of kidding per doe's life time	17.77±1.45[a]	12.00±0.95[b]	15.47±1.58[ab]	15.13±0.88
Kidding interval (months)	5.80±0.13[a]	8.61±0.42[b]	6.21±0.14[a]	6.79±0.22

The means within the same row with at least one common letter, do not have significant difference (P>0.05).

Table 5 LSM ± SE body length, neck length, diagonal body length, heart girth and height at wither for goat type, district, age, sex and age by goat type interaction

Effect and level	BL	NL	DBL	HG	HW
	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE
Grand	57.08±0.42	30.58±0.26	62.23±0.43	77.04±0.47	70.80±0.41
Goat type	***	***	***	***	**
Dairy	59.65±0.58[a]	32.26±0.37[a]	64.52±0.62[a]	79.27±0.69[a]	72.16±0.61[a]
Dual	54.87±0.69[b]	29.62±0.43[b]	59.93±0.73[b]	75.44±0.81[b]	69.05±0.72[b]
Meat	55.52±0.74[b]	29.01±0.46[b]	61.22±0.78[b]	75.31±0.87[b]	70.66±0.77[ab]

BL: body length; NL: neck length; DBL: diagonal body length; HG: heart girth and WH: wither height.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).
* (P≤0.05) ** (P≤0.01) and *** (P≤0.001).
LSM: least square mean; Nm: not measured; NS: non significant and SE: standard error.
PPI: pair of permanent incisors.

Dairy specific reproductive trait characterization

The mean rear udder length (RUL), udder circumference (UCC) and teat length (TTL) in these breeds averaged were 17.14 ± 0.28, 31.39 ± 0.59 and 3.71 ± 0.07 cm, 14.21 ± 0.48, 26.75 ± 1.01 and 3.41 ± 0.12 cm and 13.44 ± 0.38, 24.67 ± 0.81 and 3.01 ± 0.09 cm, respectively.

Whereas, the mean rear udder diameter (RUD), for dairy, dual and meat type female beetal goats were 10.04 ± 0.22, 8.66 ± 0.37 and 8.01 ± 0.30 cm, respectively (Table 7). Dairy type female goats had significantly higher (P<0.001) values for all udder and teat measurements than dual and meat type female goats.

Table 6 LSM ± SE pelvic width, pelvic height, rump width, rump length, for goat type, district, by goat type interaction

Effect and level	PW	PH	RW	RL
	LSM±SE	LSM±SE	LSM±SE	LSM±SE
Grand	13.82±0.15	72.26±0.36	18.27±0.14	15.88±0.12
Goat type	***	*	***	***
Dairy	15.05±0.20[a]	73.37±0.54[a]	19.31±0.19[a]	16.61±0.16[a]
Dual	13.09±0.24[b]	71.42±0.64[b]	17.61±0.23[b]	15.29±0.19[b]
Meat	12.70±0.25[b]	71.44±0.68[b]	17.35±0.25[b]	15.37±0.21[b]
Disrtict	*	**	NS	***
Ebnat	13.69±0.20[a]	72.68±0.46[a]	18.24±0.21	15.39±0.16[a]
Farta	13.88±0.21[a]	71.68±0.49[a]	18.20±0.22	16.36±0.17[b]
Gonji-kolela	14.47±0.23[ab]	74.07±0.52[b]	18.35±0.24	16.33±0.18[b]

PW: pelvic width; PH: pelvic height; RW: rump width and RL: rump length.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).
* (P≤0.05) ** (P≤0.01) and *** (P≤0.001).
LSM: least square mean; NS: non significant and SE: standard error.

Table 7 LSM ± SE rear udder diameter, rear udder length, udder circumference, teat length, scrotum length, scrotum width and scrotum circumference for goat type, district, age, sex and age by goat type interaction

Effects and level	RUD	RUL	UCC	TTL	SL	SW	SCC
	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE
Grand	9.21±0.17	15.55±0.24	28.63±0.48	3.46±0.05	12.69±0.42	8.88±0.35	23.56±0.66
Goat type	***	***	***	***	NS	NS	NS
Dairy	10.04±0.22[a]	17.14±0.28[a]	31.39±0.59[a]	3.71±0.07[a]	13.75±1.09	9.37±0.89	23.75±1.74
Dual	8.66±0.37[b]	14.21±0.48[b]	26.75±1.01[b]	3.41±0.12[b]	12.85±0.69	9.20±0.56	24.26±1.10
Meat	8.01±0.30[b]	13.44±0.38[b]	24.67±0.81[b]	3.01±0.09[c]	12.21±0.63	8.44±0.52	22.92±1.00
District	NS	NS	NS	NS	NS	*	*
Ebnat	9.07±0.29	15.78±0.40	28.52±0.82	3.42±0.09	13.03±0.56	9.45±0.43[a]	24.71±0.82[a]
Farta	9.10±0.31	15.24±0.43	28.14±0.88	3.52±0.10	12.23±0.65	8.09±0.50[b]	22.00±0.95[b]
Gonji-kolela	9.45±0.29	15.60±0.40	29.16±0.82	3.44±0.09	Nm	Nm	Nm

RUD: rear udder diameter; RUL: rear udder length; UCC: udder circumference; TTL: teat length; SL: scrotum length; SW: scrotum width and SCC: scrotum circumference.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).
* (P≤0.05) ** (P≤0.01) and *** (P≤0.001).
LSM: least square mean; Na: not applicable; Nm: not measured; NS: non significant and SE: standard error.

West African Dwarf (WAD) goat has 12.00 ± 0.34 cm udder widths in semi intensive management system in Nigeria, which was higher than the present rear udder diameter (Abu *et al.* 2013). However, udder circumference (25.44±0.58 cm) and teat length (2.40±0.11 cm) of greater than two years WAD goat in Nigeria were lower than the present dairy type goats (Abu *et al.* 2013). Scrotum length, scrotum width and scrotum circumference were 13.75 ± 1.09, 9.37 ± 0.89 and 23.75 ± 1.74 cm in dairy type male goats, 12.85 ± 0.69, 9.20 ± 0.56 and 24.26 ± 1.10 cm in dual male goats and 12.21 ± 0.63, 8.44 ± 0.52 and 22.92 ± 1.00 cm in meat type male goats, respectively.

CONCLUSION

From this study, it was possible to see that goats' milk provides more nutritional and therapeutic value than dairy cows, which can satisfy the nutritional requirement with small amount. Goats' milk is easy to drink and is a richer food because it has more calcium, phosphorous and chlorine than cow's milk. But the dairy goat industry is not yet started in Ethiopia in general and in Amhara region in particular as the goat breeding and reproduction was not identified as dairy, meat and dual purpose types. There were significant differences among indigenous dairy type goats from dual and meat type goats in almost all morphological quantitative traits but there is no specialized production and system in the area to enhance production and productivity. The results of dairy specific trait morphological characterization such as the mean rear udder length, udder circumference and teat length and rear udder diameter for dairy goat types were comparable with other internationally known dairy goat breeds. However, there is no specialized dairy goat breeding, reproduction and corresponding production system in the region. Therefore, morphological traits identification, breeding and multiplication of superior dairy type goats with specialized and intensive production system are crucial to increase the milk productivity of their goats and thereby improving the livelihood of the farmers.

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