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# Factors Influencing Udder and Milk Yield Characteristics of Indigenous Goats in North - West Nigeria

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***Authors' contributions***

*This work was carried out in collaboration between all the authors. Author IMS designed the study, wrote the protocol and wrote the first draft of the manuscript. Author GNA managed the literature searches. Author CA performed the statistical analysis. All authors read and approved the final manuscript.*

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## ABSTRACT

The udder conformation and milk yield characteristics of agropastoral goats were evaluated using records obtained from a total of 250 does at two locations (Jigawa and Katsina States) over a period of one year. The udder conformation characteristics measured were udder circumference(UC), udder height (UH), distance between teats (DT), teat length (TL), and teat circumference (TC).While the milk yield characteristics were initial yield (IY), average daily yield (ADY), total yield (TY), peak yield (PY), peak day (PD), lactation length (LL) and last day yield (LDY). The effect of age, parity, breed and coat colour on udder conformation and milk yield characteristics were determined using GLM procedures of SAS; the phenotypic relationship between the udder conformation and milk production characteristics were equally determined. The phenotypic correlation amongst the milk production traits were significantly positive ($P<0.05$; $r = 0.261-0.926$), similarly phenotypic correlation between udder conformation characteristics and milk yield characteristics were positive except the correlation between PD and udder conformation

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characteristics which were negatively weak (r = 0.007 to -0.007). It was concluded that age, parity,breed and coat colour were factors constituting variations in udder conformation and milk yield characteristics in goats; and morphological characteristics of udder had strong relationship with milk yield, and can be use as selection criteria for improvement of milk yield in goats.

*Keywords: Udder conformation; milk yield characteristics; factors; indigenous goats.*

## 1. INTRODUCTION

In Nigeria, the indigenous cattle have been the major source of domestic meat and milk supply. Milk supply from other animals such as sheep, goats and camels is negligible [1,2]. The dairy industry still remains rural and traditional with Fulani pastoralists controlling more than 95 per cent of the national herds [3].

Nigeria is blessed with large numbers of small ruminants which are yet to be fully investigated for milk production. Goats are the greatest in number among ruminant livestock, totaling about 53.8 million [4]. Goats are predominantly owned by the rural households and ownership is spread across all human age groups and sexes [3]. Goats in different countries are kept mainly for meat production; their milk is rarely used for human consumption [5,6,7]. However, there is a growing awareness of the importance of goats as a source of milk for man [8].

The udder of any dairy animal is the most important physical asset. A large, strongly attached, well carried and quality udder is very important for high milk production and long period of usefulness [9,10]. The most important udder traits that determine the health and productivity of the dairy animal are udder size and shape, udder and teats placement,and udder attachment [11]. Farm hygiene is an important factor which also influences milk yield and udder characteristics, [12] indicated that poor hygiene is an important risk factor for reduce udder health and milk yield. Reports from literature indicate that udder traits are highly variable and it correlation with milk yield, moderate to high [13,14,10]. It has been observed that udder size increased with age and parity in Red Sokoto goats; and may be more of a limiting factor to yield in first lactation than in later ones [15,14]. The knowledge of the relationships between individual characteristics of udder morphology is important for their inclusion into total selection indexes or construction of partial selection indexes for udder morphology and it will enable the farmer to predict future correlated responses in milk-oriented selection programmes [16]. Udder traits have been widely reported in cattle [17], Red Sokoto goats [14] and sheep [16].

A number of studies have been carried out on milk yield and composition of indigenous breeds of goats [18,19,5,2,20]. These reports emanated from Universities and Research Institute, except for the work of [11]. Information on milk yield and udder characteristics of Nigerian indigenous goats particularly under the rural agropastoral management system is limited. Therefore the objective of this study was to determine the effect of some factors on udder and milk yield characteristics of agropastorally managed goats.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The Study was carried out in Jigawa and Katsina States, both within the Sudan savannah zone of North-West Nigeria. Katsina lies between latitude 13°01' North of the equator and longitude 07°41' East of Greenwich meridian. It is situated at an altitude of 464 m (1525 ft) above sea level. Mean annual rainfall is about 780 mm. Katsina State is hot for most parts of the year, even during the wet season. Mean annual temperatures range between 19° in the cold dry season to 38°, [21]. Jigawa State falls within latitude 11°-13°N and Longitude 8°-10°E; the State has an altitude of between 400 – 600m above sea level. The mean annual rainfall varies from 500 mm to 1000 mm. The mean daily maximum and minimum temperatures are 35°c and 19°c respectively, [20,22].

### 2.2 The Animals and Management

A total of 250 does (whose parities were between 1-6 and average body weight of 28.84 kg) were used for this study. The does were managed under the rural agropastoral system. They were taken out to graze every morning from 8.00 am to 5.00 pm by children and were penned at night; the animals were penned in small open sided shades by tethering. New born kids were left to suckle their dams freely for the first 6 days postpartum to enable the kids take advantage of

colostrum. Before setting out for grazing every morning, the goats were given water and concentrates which included groundnut haulms, bean haulms, bean pods and dry grasses, containing 53.7% and 10.5% TDN and CP respectively. Each animal was tagged with a number for individual identification. The breeds were identified by peculiar characteristics as described by [23]. Coat colour was identified by visual appraisal; while parity was obtained through interaction with the farmers.

## 2.3 Udder Measurements

The udder characteristics of each doe were measured on day 7 postpartum. The date of kidding, age and parity of does were recorded. The breed, coat colour and the location of the does were also recorded. The Udder characteristics were measured using flexible tape as described by [11] as follows:

**Udder Circumference (UC):** Measured at the widest point of the Udder round it.
**Udder height (UH):** Measured from the rear attachment of the Udder to the front of it where it blends with the body.
**Distance between Teats (DT): -**Measured between the bases of the two teats.
**Teat length (TL):** was measured as the distance from the upper part of the teat, where it hangs perpendicularly from the Udder to the tip of the teat.
**Teat circumference (TC):** was measured at the widest point around the teat.

## 2.4 Milking and Milk Yield Characteristics

All milk measurements commenced from day 7 postpartum and were taken till the milk yield per goat per day was less than 100ml. During milking, lactating does were kept calm by providing supplements in a feeder for them. The quantity of milk available per doe per test day was measured using graduated plastic beakers. Milk yield was determined twice a week. Kids were separated from their dams at 18.00hours on the evening proceeding the day of milking. On the test day, the two halves of the udder of each lactating doe were hand-milked for all herds from 06.00 to 08.00hours and the milk yield was recorded to the nearest gram. Milking was done once in the morning on each test day. The average of the total volume of milk collected for the two test days was taken as the average daily yield of the doe for that week. Milk recording was terminated at the point where a doe was unable to produce 100 ml and above.

Milk yield characteristics were measured as follows:

**Average Daily Yield (ADY): -** As average of all test day yields within the period milked.
**Initial Yield (IY): -** As milk yield at day 7 postpartum
**Total Yield (TY): -** As milk production of the doe during the lactation period to the point when the production dropped below 100ml.
**Peak Yield (PY): -** As the yield with the highest test day yield during the lactation period studied.
**Peak day (PD): -** As the day with the highest test day yield during the lactation period under study.
**Lactation Length (LL): -** As the period during which the doe was milked.
**Last Test Day Yield (LDY): -** Measured as the last test day yield before production dropped below 100 ml.

## 2.5 Statistical Analysis

General Linear Model (GLM) procedure of [24] was used to determined the effect of age, parity, breed, coat colour on each udder conformation and milk production characteristics. The linear model is as shown below;

$$Y_{ijkmn} = \mu + A_i + P_j + B_k + C_m + E_{ijkmn}$$

Where ;

$Y_{ijkmn}$= The value of the trait of interest
$\mu$ = The overall mean for trait of interest
$A_i$ = The fixed effect of $i^{th}$ age group (i=1-7)
$P_j$= The fixed effect of $j^{th}$parity(j=1-6)
$B_k$ = The fixed effect of $K^{th}$ breed (k = 1-4)
$C_l$ =The fixed effect of $l^{th}$ coat colour (l=1-5)
$E_{ijkl}$ = Random error effect

The correlation coefficients of the relationship of udder conformation traits and milk yield characteristics were computed using Pearson correlation procedure of [24].

## 3. RESULTS AND DISCUSSION

## 3.1 Udder Traits

The mean values and coefficient of variation for udder characteristics of goats are presented in Fig. 1. The traits showed low to moderate variability (10.67-22.58%) The Lowest variability was recorded for UH while the highest was TL. The udder dimensions measured in this study had higher values than the previous measurements on the Red Sokoto goats [25]. This is probably because the present results

involve goats of different breeds and only lactating does, while the previous report by [25] encompassed lactating and dry does. Udder is the main body part of a dairy animal that is related to its milk producing capacity. The variability of udder dimensions in this study suggested that the udder characteristics have adequate genetic variation to allow selection response [14]. The measured udder characteristics of the does were comparable to reports of other authors [15,19] and other tropical breeds like Beetal goats [26].

The effect of age and parity on udder conformation traits are presented in Table 1. The observed influence of age and parity on udder characteristics in this study is in agreement with the reports of [14,24,27] who all reported that udder circumference and udder length increased with age in goats. However [16] observed that age did not affect udder measurement in Awassi sheep. [15] also observed that age had no significant effect on udder characteristics. The observed increase in udder characteristics with age and parity could be due to proportion of mammary alveoli that developed in previous lactations which did not regress completely but was added to those which developed in the subsequent lactations, thus increasing the size of the udder [28].

The effect of coat colour and breed on udder traits is shown in Table 2. The influence of coat colour and breed on udder characteristics of goats in this study could be due to genetic makeup of the different breeds. The Red sokoto goats have been reported to have better milk production potentials than other breeds in Nigeria [29,11]. The effect of heterosis could have aided milk production in the crosses. [26] explained that increase in milk production increase udder size; therefore this could have led to increase in the sizes of udder in the Red Sokoto goats and the crosses. The dark brown coat colour does were predominantly the Red Sokoto goats, this breed had been reported to be more efficient in milk yield than other indigenous breed [11], this could explain the reason for the observed larger udder size.

The correlation between udder conformation traits and milk yield characteristics is shown in Table 3. The correlation between udder conformation traits and milk yield characteristics were positive except the correlation between peak day (PD) and the udder characteristics which were negatively weak (r = 0.007 to -0.007). The negative correlation between udder characteristics and PD in this study is in agreement with observations of [25] in Beetal goats. The positive relationship between the udder conformation traits and milk yield characteristics (IY, ADY, PY,TY and LL) had been reported by [14,16]. The udder size characteristics (UH and UC) had strong significant effects on milk yield characteristics. The UH and UC were strongly and positively correlated (P<0.05-0.01) with IY (r = 0.273-0.489), PY (r = 0.374-0.559), ADY (r = 0.338-0.532) and TY (r= 0.339-0.470). This observation suggests that selection for the increase in udder size would increase milk yield. Thus goats with large udder size may have high potential for milk production. This strong relationship between udder size and milk yield had also been reported in sheep [30].

**Table 1. Mean values (±s.e) for udder characteristics (cm) in goats according to age and parity**

| Factor | | UH | UC | DT | TL | TC |
|---|---|---|---|---|---|---|
| | | * | * | * | * | * |
| **Age** | 2 | 11.081±0.28$^{e}$ | 25.378±0.95$^{e}$ | 7.878±0.34$^{c}$ | 2.111±0.22$^{d}$ | 3.981±0.18$^{d}$ |
| | 3 | 11.851±0.23$^{ed}$ | 29.389±0.78$^{d}$ | 8.269±0.28$^{bc}$ | 2.763±0.18$^{d}$ | 4.546±0.15$^{cd}$ |
| | 4 | 12.439±0.26$^{ed}$ | 34.024±0.89$^{c}$ | 8.927±0.32$^{bc}$ | 3.842±0.21$^{c}$ | 5.171±0.17$^{bc}$ |
| | 5 | 13.081±0.28$^{bcd}$ | 34.649±0.95$^{c}$ | 9.662±0.34$^{abc}$ | 4.257±0.23$^{c}$ | 5.649±0.18$^{ab}$ |
| | 6 | 13.550±0.44$^{abc}$ | 36.000±1.29$^{bc}$ | 8.425±0.46$^{bc}$ | 5.225±0.29$^{ab}$ | 5.895±0.25$^{ab}$ |
| | 7 | 14.700±0.53$^{a}$ | 40.500±1.82$^{a}$ | 11.300±0.65$^{a}$ | 5.350±0.42$^{a}$ | 6.250±0.35$^{a}$ |
| | | * | * | * | * | * |
| **Parity** | 1 | 10.872±0.26$^{e}$ | 25.205±0.92$^{e}$ | 8.089±0.33$^{c}$ | 2.079±0.21$^{e}$ | 3.789±0.18$^{d}$ |
| | 2 | 11.981±0.23$^{d}$ | 29.404±0.79$^{d}$ | 8.163±0.28$^{c}$ | 2.792±0.18$^{d}$ | 4.625±0.15$^{c}$ |
| | 3 | 12.659±0.24$^{cd}$ | 33.872±0.84$^{c}$ | 8.680±0.29$^{bc}$ | 3.904±0.19$^{c}$ | 5.276±0.16$^{b}$ |
| | 4 | 13.026±0.27$^{bc}$ | 34.868±0.93$^{c}$ | 9.579±0.33$^{b}$ | 4.447±0.21$^{b}$ | 5.737±0.18$^{a}$ |
| | 5 | 13.714±0.44$^{b}$ | 37.857±1.54$^{b}$ | 8.964±0.55$^{bc}$ | 5.214±0.35$^{a}$ | 5.957±0.29$^{a}$ |
| | 6 | 14.636±0.50$^{a}$ | 40.546±1.74$^{a}$ | 11.272±0.63$^{a}$ | 5.227±0.39$^{a}$ | 6.136±0.33$^{a}$ |

**P < 0.05; a, b, c, d, e = column means under the same factor with different superscripts differ significantly. UH = Udder Height, UC = Udder Circumference, DT = Distance between Teat, TL =Teat Length, TC = Teat Circumference*

**Table 2. Mean values (±s.e) for udder characteristics (cm) in goats according to coat colour and breed**

| Factor | | UH | UC | DT | TL | TC |
|---|---|---|---|---|---|---|
| | | * | * | * | * | * |
| **CC** | BB | 13.333±0.56$^{a}$ | 31.667±1.92$^{a}$ | 7.111±0.69$^{b}$ | 3.566±0.44$^{a}$ | 5.556±0.37$^{a}$ |
| | DB | 12.247±0.17$^{ab}$ | 32.090±0.61$^{a}$ | 8.966±0.22$^{a}$ | 3.496±0.14$^{ab}$ | 5.028±0.12$^{a}$ |
| | White | 11.833±0.68$^{b}$ | 28.000±2.35$^{b}$ | 8.166±0.84$^{ab}$ | 3.916±0.54$^{a}$ | 5.500±0.45$^{a}$ |
| | BW | 12.521±0.17$^{ab}$ | 32.109±0.60$^{a}$ | 8.824±0.21$^{a}$ | 3.570±0.14$^{a}$ | 4.953±0.12$^{a}$ |
| | LB | 11.400±0.75$^{a}$ | 28.400±2.57$^{b}$ | 7.400±0.92$^{ab}$ | 2.800±0.59$^{b}$ | 3.800±0.49$^{b}$ |
| | | * | * | * | * | * |
| **Breed** | Crosses | 12.596±0.16 | 32.069±0.57$^{a}$ | 8.688±0.20 | 3.570±0.11$^{a}$ | 5.007±0.11$^{a}$ |
| | Sahel | 11.833±0.68 | 28.000±2.35$^{b}$ | 8.166±0.84 | 3.916±0.57$^{a}$ | 5.500±0.45$^{a}$ |
| | Red sokoto | 12.247±0.18 | 32.090±0.61$^{a}$ | 8.966±0.22 | 3.496±0.14$^{a}$ | 5.028±0.12$^{a}$ |
| | Kano brown | 11.400±0.75 | 28.400±2.57$^{b}$ | 7.400±0.92 | 2.800±0.59$^{b}$ | 3.800±0.49$^{b}$ |

**P < 0.05; a, b, c, d, e = column means under the same factor with different superscripts differ significantly. UH = Udder Height, UC = Udder Circumference, DT = Distance between Teat, TL =Teat Length, TC = Teat Circumference , CC = coat colour, BB = brown/black,DB = Dark brown, BW = brown/white, LB = light brown, KB = kano brown*

**Table 3. Phenotypic correlation between milk yield and udder characteristics of goats**

| Characteristics | ADY | TY | IY | PD | PY | LL | LDY |
|---|---|---|---|---|---|---|---|
| UH | 0.338* | 0.339$^{*}$ | 0.273$^{**}$ | 0.007 | 0.374 | 0.333$^{*}$ | 0.072 |
| UC | 0.532$^{**}$ | 0.470$^{**}$ | 0.489$^{**}$ | -0.101 | 0.559$^{**}$ | 0.214 | 0.111 |
| DT | 0.244 | 0.179 | 0.299$^{*}$ | -0.007 | 0.249 | -0.069 | 0.094 |
| TL | 0.331$^{*}$ | 0.328$^{*}$ | 0.215 | -0.063 | 0.317* | 0.219 | 0.408 |
| TC | 0.310$^{*}$ | 0.316$^{*}$ | 0.296$^{*}$ | -0.020 | 0.279$^{*}$ | 0.269* | 0.056 |

***P < 0.01, *P < 0.05, ADY = Average Daily Yield, TY = Total Yield, IY = Initial Yield, PD = Peak Day, PY =Peak Yield, LL = Lactation Length, LDY = Last Day Yield*

**Table 4. Mean values of milk yield (g) characteristics of goats in Jigawa and Katsina State**

| Characteristics | No | Means(±s.e) | CV % | Min | Maxi |
|---|---|---|---|---|---|
| ADY | 250 | 248.22 ± 1.85 | 11.51 | 177.50 | 339.00 |
| TY(kg) | 250 | 29.56 ± 0.39 | 21.05 | 15.66 | 45.24 |
| IY | 250 | 243.57 ± 3.12 | 20.35 | 100.00 | 390.00 |
| PD | 250 | 33.04 ± 0.44 | 21.14 | 21.000 | 67.00 |
| PY | 250 | 358.73 ± 3.73 | 16.17 | 220.00 | 550.00 |
| LL | 250 | 118.26 ± 1.04 | 13.84 | 77.00 | 150.00 |
| LDY | 250 | 106.69± 0.42 | 5.97 | 100.00 | 130.00 |

*ADY = Average Daily Yield, TY = Total Yield, IY = Initial Yield, PD = Peak Day, PY =Peak Yield, LL = Lactation Length, LDY = Last Day Yield, CV= Coefficient of variation, MIN = Minimum, MAX = Maximum*

## 3.2 Milk Yield Characteristics

The means and CV of milk yield characteristics of goats are presented in Table 4. The milk yield traits had low to moderate variability (5.97 – 21.14).The observed TY 29.52 kg and LL 118.25 days agrees with existing reports on Nigerian indigenous goat breeds 25-40 kg and 90-120days, respectively [31]. The peak day conformed to the range reported by [3].

Table 5 shows the effect of age and parity on milk yield characteristics, age of does significantly (P<0.05) influenced milk yield characteristics. Milk yield characteristics increased progressively from age two, and peaked at age four. This finding is in agreement with those of [9]. They explained that milk production increases with age, reaching a peak between 30 and 50 months of age and then decrease thereafter. [5] similarly confirmed that milk yield of Sahel and Red Sokoto goats increased significantly for up to 4 years and declined subsequently. The significant effect of parity on milk yield characteristics observed in this study agrees with earlier reports in Nigerian indigenous goats. The present result is in line with reports of [3] on Red Sokoto goats in Zaria, in which milk yield peak at parity 3. [5] similarly reported that milk yield of Sahel and Red Sokoto goats increased significantly up to the third parity and declined subsequently. [2] also reported significant influence of parity on milk yield.

**Table 5. Mean values (±s.e) of milk yield characteristics in goats according to age and parity**

| Factor | | ADY | TY (kg) | IY | PD | PY | LL | LDY |
|---|---|---|---|---|---|---|---|---|
| | | * | * | * | | | * | |
| **Age** | 2 | 209.79±4.79$^{c}$ | 26.93±0.78$^{c}$ | 210.14±7.76$^{b}$ | 30.68±0.84 | 365.00±8.19 | 126.78±1.03$^{b}$ | 103.00±1.09 |
| | 3 | 252.18±3.97$^{ab}$ | 32.99±0.65$^{ab}$ | 259.43±6.42$^{a}$ | 32.07±0.70 | 348.78±6.78 | 131.22±0.85$^{ab}$ | 108.82±0.90 |
| | 4 | 270.05±4.55$^{a}$ | 36.32±0.74$^{a}$ | 275.29±7.37$^{a}$ | 31.98±0.80 | 371.10±7.78 | 133.34±0.98$^{a}$ | 107.76±1.03 |
| | 5 | 250.56±4.79$^{ab}$ | 33.22±0.78$^{ab}$ | 265.51±7.76$^{a}$ | 30.68±0.84 | 355.24±8.19 | 131.92±1.03$^{ab}$ | 107.98±1.09 |
| | 6 | 243.00±6.52$^{b}$ | 31.94±1.06$^{b}$ | 246.05±10.68$^{a}$ | 30.55±1.15 | 342.50±11.14 | 131.05±1.40$^{ab}$ | 105.55±1.48 |
| | | * | * | * | * | * | * | |
| **Parity** | 1 | 208.15±4.67$^{c}$ | 26.70±0.77$^{c}$ | 202.18±7.57$^{b}$ | 30.49±0.82 | 285.64±7.98$^{b}$ | 126.85±1.01$^{c}$ | 103.18±1.06 |
| | 2 | 253.83±4.04$^{b}$ | 33.06±0.66$^{b}$ | 265.08±6.55$^{a}$ | 32.67±0.72 | 352.10±6.91$^{a}$ | 130.73±0.87$^{ab}$ | 109.14±0.92 |
| | 3 | 268.76±4.26$^{a}$ | 36.37±0.69$^{a}$ | 272.02±6.89$^{a}$ | 31.81±0.75 | 367.34±7.27$^{a}$ | 134.32±0.92$^{a}$ | 108.00±0.97 |
| | 4 | 248.93±4.73$^{b}$ | 32.86±0.78$^{b}$ | 263.53±7.66$^{a}$ | 30.42±0.84 | 353.79±8.09$^{a}$ | 131.32±1.02$^{ab}$ | 106.95±1.08 |
| | 5 | 264.36±7.79$^{b}$ | 32.24±1.28$^{b}$ | 257.71±12.63$^{a}$ | 29.50±1.38 | 355.36±13.32$^{a}$ | 130.50±1.69$^{b}$ | 105.71±1.78 |
| | 6 | 255.00±8.79$^{b}$ | 33.35±1.44$^{b}$ | 272.09±14.25$^{a}$ | 30.36±1.56 | 351.64±15.03$^{a}$ | 131.18±1.90$^{ab}$ | 108.00±2.01 |

*a, b, c = column means under the same factor with different letters differ significantly.ADY = Average Daily Yield, TY = Total Yield, IY = Initial Yield, PD = Peak Day, PY =Peak Yield, LL = Lactation Length, LDY = Last Day Yield*

**Table 6. Mean values (±s.e) of milk yield characteristics in goats according to coat colour and breed**

| Factor | | ADY | TY (kg) | IY | PD | PY | LL |
|---|---|---|---|---|---|---|---|
| **CC** | BB | 258.49±9.73 | 32.04±1.59 | 232.11±15.75 | 34.111±1.72 | 325.56±16.62 | 131.67±2.10 |
| | DB | 246.79±3.09 | 32.03±0.51 | 251.21±5.01 | 31.281±0.55 | 345.49±5.28 | 129.94±0.69 |
| | White | 236.00±11.91 | 30.86±1.95 | 235.00±19.29 | 30.167±2.11 | 309.17±20.42 | 130.50±2.57 |
| | BW | 249.76±3.04 | 33.29±0.49 | 260.46±4.93 | 30.978±0.54 | 345.10±5.19 | 132.04±0.66 |
| | LB | 231.25±13.05 | 29.94±2.14 | 250.00±21.13 | 32.800±2.31 | 343.00±22.29 | 127.40±2.82 |
| | | | | | | * | |
| **Breed** | Crosses | 248.76±2.90 | 33.18±0.48 | 257.93±4.72 | 31.26±0.51 | 343.36±4.96$^{a}$ | 132.01±0.63 |
| | Sahel | 236.03±11.91 | 30.86±1.95 | 235.00±19.29 | 30.17±2.11 | 309.17±20.35$^{b}$ | 130.50±2.57 |
| | Red sokoto | 246.79±3.09 | 32.03±0.51 | 251.21±5.00 | 31.28±0.55 | 345.49±5.28$^{a}$ | 129.94±0.67 |
| | KB | 231.25±13.05 | 29.94±2.14 | 250.00±21.13 | 32.80±2.31 | 343.00±22.29$^{a}$ | 127.40±2.82 |

**P < 0.05 a, b, c = column means under the same factor with different letters differ significantly. ADY = Average Daily Yield, TY = Total Yield, IY = Initial Yield, PD = Peak Day, PY =Peak Yield, LL = Lactation Length, CC= Coat colour, BB = brown/black,DB = Dark brown, BW = brown/white, LB = light brown, KB = kano brown*

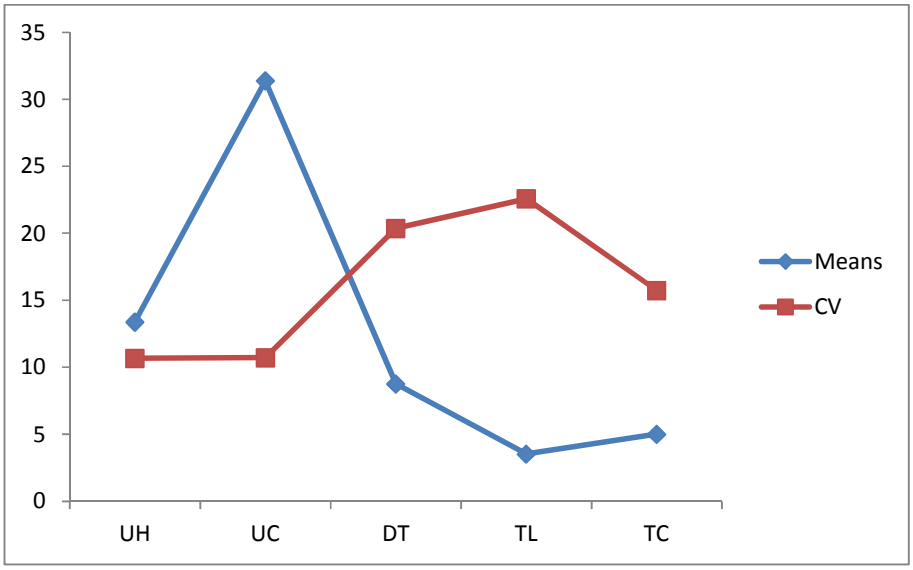


**Fig. 1. Mean values (cm) and coefficient of variation for udder characteristics in goats**

The influence of breed and coat colours on milk production traits are shown in Table 6. The results indicate that coat colour had non-significant (P>0.05) influence on milk production traits while breed of doe only influenced PY. The observed insignificant influence of coat colour (CC) on milk yield characteristics in this study is in agreement with previous reports on goats [32] and cow [33], who reported that coat colours did not affect milk yield characteristics. However, this was contrary to the reports of [34] who observed increase milk yield in white Holstein cow than in black. The result from this study indicates that the level of climatic stress caused by coat colour had no effect on these milk yield characteristics in the studied population.

The effect of breeds in this study only significantly influence peak yield (PY). The crosses, Red Sokoto, and Kano Brown does were better than the Sahel does. The Kano Brown has been reported to be a strain of Red Sokoto, and Red Sokoto has been reported to have better milk production potentials than all other breeds in Nigeria [28,11], hence the observed high milk production of the crosses. Also the high performance of the crosses could be attributed to the combining ability (heterosis) of these crosses.

## 4. CONCLUSION

The findings in this study suggest that age, parity and breed are important sources of variation in udder and milk yield performance, and therefore should be taken into consideration in selection programmes aim at improving milk yield characteristics in goats. The strong relationship between morphological characteristics of udder with milk yield indicate that udder traits can be use as selection criteria for improvement of milk yield in goats.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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