

A review of phenotypic characteristics, production traits and water utilisation of indigenous Tswana goats in Botswana

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ABSTRACT

Indigenous Tswana goats are a valuable genetic resource, which has to be conserved and utilised in a sustainable way to ensure accrued benefits to fanners in Botswana. A pre-requisite to this is that the breed has to be well studied and traits, which make it unique, should be used in value adding marketing. The aim of this paper was to review current knowledge on phenotypic characteristics, production traits and water utilisation of indigenous Tswana goats in Botswana. A countrywide study has characterised incidences of various categorical traits in Tswana goats. A few studies have also indicated that the indigenous Tswana goat is a medium sized breed, highly resistant and/or tolerant to diseases and parasites. Despite lack of selection for higher productivity, the Tswana goat has been shown to have higher productivity if given good management than the Boer goat due to its higher survival rate at all ages of comparison in Botswana. The breed can withstand water deprivation up to 72 hours without severe dehydration and still show medium growth rate (65.6 vs. 85.5 g/day; least significant difference 1.41g/day) with moderate feed conversion efficiency (12.1 vs. 9.3 g feed/g gain; least significant difference 3.43 g feed/g gain) compared to control Tswana goats given *ad libitum* water. Castration has been shown to significantly improve the meat quantity and quality of Tswana goats. Put together findings from the few studies carried out on Tswana goats indicate that more extensive research should be carried out on the breed to popularise unique traits, which can be used for value adding marketing hence the breed being utilised sustainably to ensure its conservation

Keywords: Botswana, goats, phenotypic characteristics, production traits, water utilisation

INTRODUCTION

The population of goats in Botswana is slightly over 1.6 million, with 99% of these raised under the traditional sector and the balance in the commercial sector (Botswana Government, 2004). The traditional sector is practiced on communal land or tribal areas where fencing is generally non-existent; hence there is no controlled breeding (Nsoso and Morake, 1999). The traditional sector is characterised by low level of inputs, poor veterinary care, no formal management and non-existent housing (Adogla-Bessa and Aganga, 2000). The majority of goats kept in Botswana are indigenous to the country (Podisi, 2001). These are a valuable genetic resource adapted to the harsh climatic conditions of Botswana, resistant and/or tolerant to parasites and diseases found in their habitats and they have the ability to

efficiently utilise limited feed resources (Nsoso *et al.*, 2004a). Tswana goats can be watered once in 72 hours without severe dehydration and still show moderate feed conversion efficiency and growth rate (Adogla-Bessa and Aganga, 2000). These traits of economic importance make the indigenous Tswana goat an important breed for semi-arid countries where feed and diseases limit production. The aim of this paper was to review current knowledge on phenotypic characteristics, production traits and water utilisation of indigenous Tswana goats in Botswana.

PHENOTYPIC CHARACTERISTICS

A few studies on phenotypic characteristics of indigenous Tswana goats have been carried out over a period of 25 years, starting with breed evaluation by Animal Production and

Range Research Unit (APRU) (1970-1990) and morphological measurements of Owen *et al.* (1977), Katongole *et al.* (1996) and Nsoso *et al.* (2006).

Table 1. Incidences of horns, shape of horns, orientation of horns, wattles, ear type, ear orientation, beard, face profile, back profile, rump profile and tail type in indigenous Tswana goats in Botswana[‡]

| Trait | Combined sexes | Females | Males |
|---------------------------------|----------------|--------------|--------------|
| Horns (%) | | | |
| Present | 83.0 | 83.02 | 80.91 |
| Absent | 17.0 | 16.98 | 19.09 |
| Shape of horns (%) | | | |
| Straight | 24.55 | 23.02 | 24.92 |
| Curved | 42.73 | 44.27 | 37.79 |
| Spiral | 13.70 | 14.29 | 11.87 |
| Others | 19.02 | 18.42 | 25.42 |
| Orientation of horns (%) | | | |
| Down and in or out | 26.37 | 25.34 | 29.34 |
| Back and in or out | 10.07 | 10.66 | 8.53 |
| Others | 63.56 | 64.00 | 62.13 |
| Wattles (%) | | | |
| Present | 6.84 | 7.09 | 6.15 |
| Absent | 93.16 | 92.91 | 93.85 |
| Ear type (%) | | | |
| Reduced | 1.94 | 2.05 | 1.62 |
| Normal | 98.06 | 97.95 | 98.38 |
| Ear orientation (%) | | | |
| Erect | 0.58 | 0.51 | 0.81 |
| Lateral | 7.45 | 8.41 | 4.53 |
| Droop/looping | 91.30 | 90.25 | 94.50 |
| & Others | 0.67 | 0.83 | 0.16 |
| Beard (%) | | | |
| Present | 56.03 | 59.46 | 45.45 |
| Absent | 43.97 | 40.54 | 54.55 |
| Face profile (%) | | | |
| Flat/straight | 89.14 | 90.16 | 85.76 |
| Concave | 9.77 | 8.81 | 12.78 |
| Convex | 1.09 | 1.03 | 1.46 |
| Back profile (%) | | | |
| Flat/straight | 95.93 | 95.90 | 95.95 |
| Hollow | 2.99 | 3.02 | 2.91 |
| Ridge-backed | 1.09 | 1.08 | 1.13 |
| Rump profile (%) | | | |
| Sloping | 99.73 | 99.74 | 99.68 |
| Flat | 0.27 | 0.26 | 0.32 |

[‡] Adapted from Nsoso *et al.* (2006).

Most of these studies were limited in their scope i.e. based on few animals compared to the whole population or sampling was done in a small part of the country and also covered a few categorical traits such as colour and horn shape. Due to their limited scope, it is possible that they did not capture all the inherent variation within this breed hence failing to indicate the existence of either useful ecotypes or strains within this breed for future exploitation to increase production in Botswana (Nsoso *et al.*, 2006).

As shown in Tables 1 and 2, the comprehensive countrywide survey study (n=2783) of Nsoso *et al.* (2006) on indigenous Tswana goats concluded that:

- Horns were predominantly a feature of both male and female animals
- The shape of horns varied in both sexes, with the commonest type being curved, followed by straight and least common being spiral with various combinations being intermediate.
- The major orientation of horns were combinations of down and in or out and back in and out, and the least being back and in or out, with down and in or out being intermediate for both sexes
- The incidence of beardness was high, with the percentage being higher in females than males.
- The incidence of wattles was less than 8% in both sexes
- Both sexes had normal ears with the incidence of reduced ears being generally less than 2% The dominant ear orientation was drooping/looping, with erect, lateral and other types being less than 10% in both sexes
- The major type of face and back profiles were fiat straight, with other r.-being low in both sexes
- The slopping rump profile was predominantly the common type, with

flat profile being less than 2% in both sexes

- The commonest colour was mixed combinations, followed by white, then roan and piebald with the rest being low in both sexes. It is worth noting that colour is an important physical characteristic since farmers use it to define a breed (Willis, 1998). Therefore, there is need to select Tswana goats so that there are known for either a certain colour or a few related colours that can be used in their marketing.
- The predominant coat type was straight hairs, with incidences of curly and mixed hairs being low and of approximately 10% magnitude in both sexes.
- The coat texture was predominantly coarse hairs, followed closely by fine hairs and the least being mixture of coarse and fine hairs in both sexes

The incidence of cashmere was less than 11% in both sexes

PRODUCTION TRAITS

In Botswana goats provide meat and milk home consumption and cash income from sale of slaughter or breeding stock (APRU, 1994), therefore traits of economic importance include reproduction rate, survival rate/mortality rate, growth rate, carcass characteristics and feed conversion efficiency. As indicated in Table 3, the countrywide study (n=2783) of Nsoso *et al.* (2004a) reached the following conclusions on continuous traits of indigenous Tswana goats:

- The body measurements of castrates were generally significantly higher than both females and entire males of similar ages
- The body measurements of younger animals were significantly less than those of older age groups since the former were still growing compared to the latter

Table 2. Incidences of coat colour, coat type, coat texture, hair/wool distribution, hair length of shoulders, thigh and rump, cashmere, colour of pigmentation under the tail, eye skin pigmentation and colour of hoof in indigenous Tswana goats in Botswana¹

| Trait | Combined sexes | Females | Males |
|--|----------------|---------|-------|
| Coat colour (%) | | | |
| White | 18.89 | 18.57 | 20.03 |
| Black | 8.28 | 8.57 | 7.33 |
| Grey | 0.08 | 0.05 | 0.16 |
| Fawn | 6.49 | 6.05 | 7.82 |
| Brown | 0.23 | 0.26 | 0.16 |
| Red | 5.68 | 5.49 | 6.35 |
| Piebald | 11.16 | 10.93 | 11.73 |
| Roan | 12.40 | 12.21 | 13.03 |
| Mixed | 36.79 | 37.87 | 33.39 |
| Coat type (%) | | | |
| Curly | 9.86 | 9.99 | 9.42 |
| Straight | 80.28 | 80.52 | 79.55 |
| Mixture | 9.86 | 9.49 | 11.03 |
| Coat texture (%) | | | |
| Fine | 44.32 | 41.54 | 53.13 |
| Coarse | 51.32 | 54.05 | 42.76 |
| Mixture | 4.36 | 4.41 | 4.11 |
| Hair/wool distribution (%) | | | |
| Uniform | 68.77 | 67.58 | 72.56 |
| Long on britches | 10.36 | 10.34 | 10.55 |
| Uniform but long on britches | 20.87 | 22.08 | 16.89 |
| Hair length of shoulders (%) | | | |
| Less than 0-2cm | 35.42 | 37.96 | 27.24 |
| Between 2-4cm | 53.33 | 51.52 | 59.22 |
| More than 4cm | 11.25 | 10.52 | 13.54 |
| Hair length of rump (%) | | | |
| Less than 0-2cm | 31.77 | 34.14 | 24.55 |
| Between 2-4cm | 57.96 | 56.33 | 62.85 |
| More than 4cm | 10.27 | 9.53 | 12.60 |
| Hair length of thigh (%) | | | |
| Less than 0-2cm | 36.85 | 39.52 | 28.43 |
| Between 2-4cm | 40.71 | 39.05 | 46.08 |
| More than 4cm | 22.44 | 21.43 | 25.49 |
| Cashmere (%) | | | |
| Present | 9.03 | 8.69 | 10.23 |
| Absent | 90.97 | 91.31 | 89.77 |
| Colour of pigmentation under tail (%) | | | |
| Dark | 60.34 | 61.32 | 57.00 |
| Brown | 7.57 | 7.01 | 9.45 |
| Pale | 11.24 | 10.31 | 14.17 |
| Spots on pale | 20.84 | 21.35 | 19.38 |
| Colour of hoof (%) | | | |
| Dark | 68.72 | 69.14 | 67.42 |
| Light | 14.71 | 14.97 | 13.94 |
| Mixture | 16.57 | 15.89 | 18.64 |

* Adapted from Nsoso *et al.* (2006).

- Different vegetation types resulted in different body measurements, which should be expected due to differences in nutrient supply from different vegetation types

- Efforts should be undertaken to characterise Tswana goats genetically to indicate presence or absence of useful ecotypes or strains
- Productivity should be increased through within breed selection and crossbreeding where infrastructure allows.

Reproduction rate

The only study on reproduction performance of Tswana goats is by APRU (1994) under improved management i.e. adequate feed and regular veterinary care (APRU, 1983-84) (Table 4). The findings from this study were that:

- The kidding rate per doe ranged from 0.77 to 1.20
- Doe fertility was 61.4 to 81.6%
- Kid mortality from birth to 12 months of age was 34.5%. The major causes of death were sudden deaths (42.8%), typical of heart water and predators (27.3%) (APRU, 1994).

Performance in these traits indicates that there is room for improvement through better management and within breed selection since this breed has not been artificially selected for increased reproductive rate.

Growth rate

According to APRU (1994), the birth, weaning and 12 months weight of Tswana goats were 2.8-3.2, 10.5-13.1 and 20.8- 28.3kg, respectively. These are similar to breed evaluation means on Tables 3 and 4. These show that despite lack of selection for increased productivity, this breed has potential for improvement under good management and proper selection regimes.

Milk production

A study of milk production conducted in

Tutume Agricultural District in Botswana indicated that the average milk production per goat was 177-357ml/day (APRU, 1970-1990) under communal farming system. The population was heterogeneous for this trait, therefore, in agreement with APRU (1970-1990), selection and improved management could raise overall production in this breed. Milk is of particular importance for home consumption (APRU, 1970-1990), therefore, improving this trait would improve the livelihood of rural people through better growth rates of kids and adequate availability of milk for domestic use.

Carcass characteristics

The only work on carcass composition of Tswana goats is by Owen *et al.* (1978). The authors drew two conclusions as follows:

- The maximum yields of meat and offals, with moderate carcass fat levels i.e. approximately 15% were obtained when the goats were at least six-tooth stage
- Castration was a useful management technique for increasing the rate of maturity of indigenous male goats and increasing the fat content of carcasses without excess fat.

Similar conclusions were also reached by Nsoso *et al.* (2004b) based on a smaller sample (n=32) of goats. Nsoso *et al.* (2004b) further concluded that castration using burdizzo method generally promoted the development of carcasses with significantly higher dressing percentage, longer carcasses and higher height at withers than entire males at 14 and 22 months of age (Table 5). Further studies should be undertaken on meat quality, especially taste, tenderness, juiciness and meat composition since these traits have been shown elsewhere to influence the marketability of red meat.

Table 3. Mean body measurements of indigenous Tswana goats for different traits at various ages sampled from all over Botswana^{ab†}

| Trait | Age groups (months) | | | | | |
|----------|-----------------------|-------------------------|---------------------|------------------------|-------------------------|---------------------|
| | 0-12 | | 13-24 | | 25-36 | |
| BWT (kg) | Female 18.08±0.51a | Castrate 22.37±0.67b | Buck 14.37±0.76c | Female 33.20±0.32ab | Castrate 34.38±0.55b | Buck 31.22±1.27a |
| HG (cm) | 58.84±0.47a | 63.92±0.62b | 54.55±0.70c | 75.48±0.29a | 76.53±0.50b | 73.05±1.16b |
| HW (cm) | 51.70±0.67a | 56.54±0.88b | 49.15±1.00c | 63.45±0.42a | 63.32±0.72b | 62.27±1.66ab |
| BL (cm) | 46.93±0.46a | 51.83±0.61b | 43.03±0.69c | 58.53±0.29a | 60.20±0.49b | 54.84±1.15c |
| SW (cm) | 11.12±0.27a | 12.46±0.35a | 10.97±0.40b | 13.28±0.17a | 13.24±0.29a | 13.74±0.66a |
| EL (cm) | 15.29±0.20a | 16.21±0.27b | 14.48±0.30c | 17.04±0.13a | 17.29±0.22a | 17.31±0.50a |
| NL (cm) | 20.04±0.31a | 20.87±0.41a | 18.02±0.46b | 23.75±0.19a | 23.78±0.33a | 24.01±0.77a |
| RHT (cm) | 53.92±0.43a | 58.37±0.57b | 50.10±0.65c | 64.50±0.27a | 67.12±0.46b | 63.07±1.07a |
| HIP (cm) | 11.58±0.18a | 12.16±0.24a | 10.25±0.27b | 13.84±0.11a | 13.63±0.20a | 13.72±0.45a |
| HL (cm) | 8.26±0.46a | 11.23±0.59b | 8.17±0.76a | 13.99±0.26a | 15.98±0.46b | 16.32±1.04b |
| TL (cm) | 12.23±0.13a | 13.63±0.17b | 11.97±0.20a | 13.94±0.08a | 15.14±0.14b | 14.64±0.33b |
| | | | | Female 41.74±0.47a | Castrate 48.56±1.09b | Buck 49.97±2.17b |
| | | | | 80.59±0.43a | 85.91±1.01b | 87.83±1.99b |
| | | | | 65.14±0.62ab | 71.26±1.44b | 70.60±2.85ab |
| | | | | 62.09±0.43a | 65.67±0.99b | 65.23±1.96ab |
| | | | | 14.59±0.25a | 16.02±0.57b | 17.07±1.14b |
| | | | | 17.59±0.19a | 18.29±0.43a | 18.80±0.86a |
| | | | | 25.46±0.29a | 26.76±0.67a | 27.93±1.37a |
| | | | | 67.03±0.40a | 73.97±0.93b | 70.60±1.84b |
| | | | | 15.14±0.17a | 15.17±0.10a | 17.70±0.78b |
| | | | | 19.00±0.41a | 26.50±0.99b | 27.70±2.01b |
| | | | | 14.21±0.12a | 16.03±0.28b | 16.43±0.56b |

^a BWT, HG, HW, BL, SW, EL, NL, RHT, HIP, HL and TL are abbreviations for body weight, body length, heart girth, height at withers, shoulder width, ear length, neck length, rump length, hip width, horn length and tail length respectively.

^b Means with no letters in common within a row, age group and trait are significantly different (P<0.05). [†] Adapted from Ncoco *et al.* (2004a).

Table 4. Comparative performance of indigenous Tswana and Boer goat and their crosses in Botswana.

| Trait | Breed of goat | | |
|-----------------------------------|---------------|------|-------------------|
| | Tswana | Boer | Tswana-Boer cross |
| Kidding (%) | 121 | 127 | - |
| Birth weight (kg) | 2.8 | 3.2 | 3.0 |
| Weaning weight (kg) | 13.4 | 14.9 | 14.4 |
| Mortality to weaning (%) | 9 | 25 | 11 |
| 18 months weight (kg) | 34.5 | 36.5 | 36.1 |
| Mortality to 18 months (%) | 30 | 46 | 29 |
| Weight of weaner/doe/year (kg) | 14.7 | 14.2 | - |
| Weight of yearling/doe/year (kg) | 27.3 | 24.6 | - |
| Weight of 18 months/doe/year (kg) | 29.3 | 24.5 | - |

A dash (-) indicates figures, which were not available

[†] Adapted from APRU (1983-84).

Diseases and parasites

There is some information on the negative impact of parasites and diseases on productivity of goats in Botswana compiled by National Veterinary Laboratory (Botswana Government 1990-1996). However, the level is not acceptable, particularly concerning their epidemiology and variations within different populations (Nsoso *et al.*, 2001a). Furthermore, the negative impacts of diseases and parasites have been recorded from dead or sick goats, therefore, there is no formal study to quantify their impact on otherwise normal farm goats. The study of Nsoso *et al.* (2001b), reported that the infection by parasites in kids of Tswana goats is as early as one month of age, the severity of infection was low (less than the critical level of 33) with no impact on production. However, in adults Tswana goats, Nsoso *et al.* (2001a) reported a negative effect of parasites on live weight, with a correlation of -0.95 between faecal egg count and live weight. Despite this, Tswana goats still thrive and produce under traditional management with little or no veterinary care (APRU, 1970-1990 & Nsoso *et al.*, 2001a & b). This means that the breed could be resistant and/or tolerant to parasites and diseases found in its habitat. Further studies are required to elucidate this phenomenon.

Purebreed evaluations

Breed evaluations trials by APRU (1970- 1990) conducted under improved management in Botswana, indicated that the indigenous Tswana goat is more productive than the Boer goat because of its high survival rate at all the ages of comparison despite the lower reproductive rate and growth rate than the latter breed (Table 4). The high survival rate of the Tswana goat shows that it's highly adapted to the harsh environment of Botswana and can withstand most diseases vectored by parasites such as ticks better than the exotic Boer goat. There is concern of indiscriminate crossbreeding of indigenous Tswana goats and exotic breeds such as Boer goats (Podisi, 2001), which are also found in the country. Although,

the productivity of the crossbreds is higher than that of the indigenous Tswana in terms of low mortality and higher growth rate (Table 4), crossbreeding is a complicated mating strategy, which requires fenced grazing lands and breeding skills for the heterosis to be beneficial (Nsoso and Morake, 1999). Such fenced grazing paddocks and breeding skills are not present under traditional fanning, therefore the benefits from crossbreeding would be temporary and as such this mating strategy should be discouraged under this farming system.

There have been little efforts to select Tswana goats for increased production. Such efforts have been hampered by little information on the phenotypic and genetic characteristics of the breed. Katongole *et al.* (1996) and Nsoso *et al.* (2006) showed that there were wide phenotypic variations in both categorical and continuous traits in indigenous Tswana goats. Consistent with these studies, this is indication of lack of purified breeding through within breed selection. Therefore, opportunities still exist to increase production through within breed selection.

Table 5. Mean live weight, dressed percentage and body linear measurements for entire i.e. control and castrated using burdizzo method males of indigenous Tswana goats slaughtered at 14 and 22 months of age in Botswana

| Variable | Control | Burdizzo |
|-----------------------------------|-------------|-------------|
| 14 months live weight (kg) | 27.50±1.61a | 23.33±1.61a |
| 14 months dressed percentage (%) | 42.50±1.37a | 47.86±1.37b |
| 14 months height at withers (cm) | 59.67±1.83a | 57.33±1.83a |
| 14 months diagonal length (cm) | 55.67±2.70a | 55.17±2.70a |
| 22 months live weight (kg) | 22.00±2.47a | 28.33±2.47a |
| 22 months dressed percentage (%) | 36.80±0.88a | 42.70±0.88b |
| 22 months diagonal length (cm) | 47.33±1.59a | 54.50±1.59b |
| 22 months height at weathers (cm) | 53.16±1.26a | 61.00±1.26b |

^aMeans with no letters in common within a row differ significantly ($P < 0.05$).

‡Adapted from Nsoso et al. (2004) b.

WATER UTILISATION

As pointed out by Adogla-Bessa and Aganga (2000), Botswana is a semi-arid country with low and erratic rainfall. In addition, scarcity of surface water limits the use of pasture and determines the availability of drinking water for animals. Adogla-Bessa and Aganga (2000) have shown that indigenous Tswana goats can be deprived of water up to 72 hours without severe water dehydration. In this study, the average daily weight gain and feed intake were significantly reduced but were moderately high compared to *ad libitum* and 24 hours watering interval (Table 6). This means that in periods of feed scarcity, Tswana goats can graze far away from watering holes to enable them to get enough to eat. Such periods are frequent in the drought prone Botswana. All measured parameters did not differ significantly between *ad libitum* and 24 hour watering interval (Table 6). This gives the farmers the flexibility of watering Tswana goats once in 24 hours or even longer periods hence farmers can spend their times on other farm activities and also better use water resources during periods of scarcity.

Table 6. Intake of feed and water and weight gain of indigenous Tswana goats subjected to varying lengths of water deprivation in Botswana^{a‡}.

| Variable | Watering interval (hours) | | | Least significant difference |
|--|---------------------------|------|-------|------------------------------|
| | <i>ad libitum</i> | 24h | 48 | |
| Feed intake (g DM/kg) | 762 | 743 | 742 | 75 15.9 |
| Live weight (kg) | 36.1a | 34.7 | 31.31 | 31 1.02 |
| Feed-water intake (ml/day) | 64.0 | 62.4 | 62.4 | 63 1.34 |
| Free water intake (ml/day) | 1895 a | 1785 | 1259 | 1 48.9 |
| Average daily gain (g/day) | 85.5 a | 81.9 | 64.3 | 65 1.41 |
| Feed conversion efficiency (g feed/g gain) | 9.3 | 9.3 | 12.1 | 12 3.43 |

^aMeans with no letters in common within a row differ significantly (P<0.05).

‡ Adapted from Adogla-Bessa and Aganga (2000).

CONCLUSIONS

Limited research has been done on indigenous Tswana goats. A number of categorical traits have been characterised in Tswana goats. These traits can be used to formulate benchmark breed standards to be used in selection by farmers and control entry and continued membership of a breed society for this breed. Some of the traits describe the Tswana breeds and as such can be used in marketing these breeds e.g. face, back and rump profiles. Traits such as cashmere are of commercial importance and may provide ways of diversifying farm products and income under traditional farming system. The indigenous Tswana goat is a medium sized breed fanned predominantly under traditional system, where inputs are low and there is mediocre management and little veterinary care. Tswana goats are moderately productive despite lack of selection efforts for increased productivity. Tswana goats are able to withstand water deprivation up to 72 hours without severe dehydration and still show moderate growth rate and moderate feed conversion efficiency than their counterparts provided with water *ad libitum*. The indigenous Tswana goat is a breed worth improving to increase its productivity to further add to its other traits, which show that it is well suited to semi-arid areas, where feed and water resources and diseases limit production. Further research should be conducted looking at meat quality aspects such as taste, tenderness, juiciness and composition, since these can be used to add value to this breed.

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