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QUALITATIVE TRAITS CHARACTERIZATION OF NIGERIAN WEST AFRICAN DWARF GOAT POPULATION

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Abstract

The study was conducted to identify and characterize West African Dwarf (WAD) goat genetic resources under smallholder production systems. The goats were sampled from smallholder flocks to collect data on certain qualitative traits. These goats were scored for certain qualitative traits on body, udder and teat. The study showed that goats with black and brown (36.7%), pied coat colour pattern, convex head profile (36.3%), erected ear (51.3%), smooth hair type (68%) were predominant. Low frequencies were obtained for presence of wattle (Wa^w), light colouration or roan (Ro^r), beard (Br^b), and extra teat (Et^e) while all goats have horns. More than half of the goats sampled were with a well-developed, symmetric udder (61.3%) with moderate degree of separation and slightly deep udder. The WAD goats have funnel teat shape (44%) and are mostly with intermediate teat placement (61.3%), teat depth (56.7%), teat length (48%) and teat size (50.7%). The study identified considerable diversities in qualitative attributes of the goats

Keywords: Genetic resources, goat, teat, traits, udder

INTRODUCTION

West African Dwarf (WAD) goats have unique features that enable them to adapt to their environment. They contribute significantly to the livelihood of resource-poor households, and in particular those in the rural areas as a source of protein (meat), generation of immediate and extra cash income, and for religious and/or cultural purposes. The WAD goat is widely distributed across the rainforest belt of Southern Nigeria (Oseni *et al*., 2006; Yakubu *et al*., 2010). They are also characterised with short legs, and small-body with an average weight between 22 and 26kg. They are a robust breed and are resistant to diseases. Their short reproduction cycle enhances a high multiplication rate within a year which makes them ideal for poverty alleviation.

Phenotypic and molecular genetic characterization of animal genetic resources is used to measure and describe genetic diversity in these resources. This serves as a basis for understanding and sustainable utilization (FAO, 2012). Qualitative traits are not as directly related to production and service functions of animal genetic resources as quantitative traits. However, they may relate to adaptive attributes. For example, the colour of the skin, wattle, hair coat, size of ears, and horns can be relevant to the dissipation of excess body heat. In such cases, qualitative traits are just as important as quantitative traits, and should therefore be included in phenotypic characterization (FAO, 2012).

West African Dwarf goat is known to display a wide range of qualitative variations in coat colour (Odubote 1994; Ozoje & Mbgere, 2002), presence or absence of wattles and supernumerary (extra) teats in adult females. On

account of these variations, there is a possibility of influence of certain qualitative traits on the genetic potential or adaptability of Nigerian goats (Oseni, 2006). However, in Nigeria, most of the efforts at improving performance have been focused on the quantitative traits to the extent of neglect of qualitative traits. Thus, there is a dearth of knowledge about the inheritance of qualitative traits and their possible influence on the production performance of livestock generally. In this context, the current study sought to assess the phenotypic and genetic diversity of qualitative traits in Nigerian West African Dwarf goat population

MATERIALS AND METHODS

The study was conducted in Oyo and Ogun states, Southwestern Nigeria. The region has a tropical climate with distinct wet and dry seasons. The temperature ranges from 21°C to 34°C, and the annual rainfall varies between 1500 mm and 3000 mm. During the wet season, the Southwest monsoon wind from the Atlantic Ocean brings heavy rainfall, while the dry season is associated with the northeast trade wind from the Sahara Desert. The vegetation in Southwest Nigeria includes freshwater swamps and mangrove forests along the coast, lowland forests stretching inland to Ogun and parts of Ondo state, and secondary forests towards the northern boundary where derived and southern savannah exist.

A longitudinal survey was conducted to describe the qualitative traits of WAD goats in the study areas. The states were purposely selected based on the presence and abundance of WAD goat flocks. A total of 150 adult female goats (does) were randomly sampled for qualitative characterization. All the individual animals sampled were considered as a subpopulation of the WAD goat population.

Data were collected on the qualitative traits of the goats. These data were collected as described by a checklist for phenotypic characterization of sheep and goats by FAO (2012). Traits collected include coat colour, coat colour pattern, ear orientation, hair coat type, wattle, beard and traits related to the udder and teat of the goats.

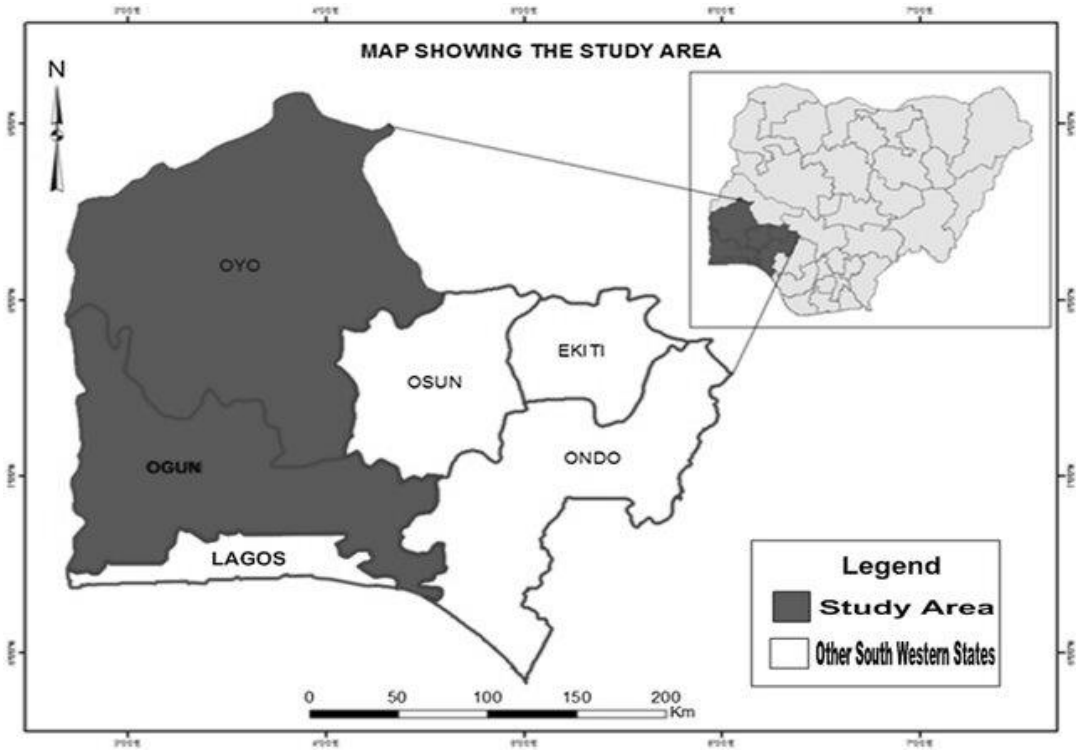

Figure 1. Map of the sampling areas (Oyo and Ogun), Southwest, Nigeria

Traits on coat colour pattern and type, presence or absence of horn, wattles, supernumenary (extra) teat and beard were used as classification variables for genetic differentiation of the WAD goat populations. The genotype of the traits was categorized as reported in related previous studies (Ofori *et al*., 2012; Fajemilehin & Adegun. 2020; Kolo *et al.*, 2015); for wattle, the animals were categorized as presence (Wa^{w}) or absence (Wa^{+}); for beard, absence of beard (Br^{+}) or presence of beard (Br^{b}); for horn, absence of horn/polledness (Ho^{+}) or presence of horn (Ho^{h}) and for coat colour, absence of light coat colouration (Ro^{+}) or presence of light coat colouration (Ro^{r}), teat supernumenary was also categorised as Et^{e} for presence of extra teat (supernumenary) and Et^{+} for absence of extra teat.

Phenotypic frequencies were estimated by direct count, proportions (%) of individuals carrying the traits were determined as:

$$\frac{\text{Number of individuals possessing the specific traits}}{\text{Total number of sampled individual}} \times 100$$

Data were subjected to descriptive statistics using SPSS (v .22).

RESULTS AND DISCUSSION

The frequency distribution of different qualitative traits of WAD goat populations is presented in Table 1. Results show different coat colour types with the dominant coat colour (36.7%) at goats possessing black and brown colour. The dominance of black and brown coat colour as well as proportion of other varied coat colour is an indication of indiscriminate mating among these goat populations which resulted to heterogenous coat colour attributes. Extensive management system of these goats by most of their owners encourage such indiscriminate mating among these goats populations. The dominance of black and brown coat colour reported in this study agrees with the dominance of dark colour in Nigerian WAD goats reported by Oseni &Ajayi, (2014), Idowu & Adelabu, (2018), and in WAD goats of Ghana (Ofori *et al*., 2020). However, Gatew (2014) reported the dominance of brown coat colour in Ethiopian goat populations. Kolo *et al* (2015) also reported dark brown and light brown as the most dominant coat colour in the extensively managed local goat population of Niger State, Nigeria. Goats with pied coat colour were dominant over spotted and plain coat colour goats. In previous studies, plain coat colour (Ahmed *et al*., 2016; Gebreyowhens & Kumar; 2017; Ofori *et al*; 2020); and spotted coat colour (Hassen *et al*; 2012; Yakubu *et al*., 2010) have been reported to be dominant in local goats. The dominance of various coat colour-related traits of these goat populations may also be a result of the preference of owners.

Most of the goats have convex head profile (36.3%), and erect ears (51.3%) with smooth hair type (68%). Yakubu *et al* (2010) also reported the predominance of smooth hair in female WAD goats. The authors asserted that smooth hair provides a medium for heat loss from the surface of animals which could also serve as an adaptive mechanism of animals (Banerji, 1984).

The phenotypic frequency of qualitative traits of WAD goat populations is presented in Table 2. High phenotypic frequencies were observed for dark coat colouration (76.7%) than those with light coat colouration. Coat colour traits have been reported to be associated with adaptation to heat regulation in livestock species including goats. Robertshaw (2006) reported that the black-colored animals have superior adaptation to seasonal cold weather or cold nights as the dark pigment helps them to warm up earlier than those with other coat colours. Expression of various qualitative traits most especially coat colour represents some adaptive mechanism for adaptation and survival of animals (Oseni *et al*., 2006).

Table 1. Frequency of body quality traits of WAD goat populations

Traits	Variables	Frequency	Percent
Coat color	Black	16	10.7
	Brown	19	12.7
	Grey	1	0.7
	Black and white	27	18.0
	Black and brown	55	36.7
	White and brown	32	21.3
Coat coloration	Light coat coloration	35	23.3
	Dark coat coloration	116	76.7
Coat color pattern	Plain	41	27.3
	Pattern	93	62.0
	Spotted	16	10.7
Head profile	Straight	50	33.3
	Concave	45	30.3
	Convex	55	36.7
Ear orientation	Erect	52	24.7
	Semi-pendulum	77	51.3
	Pendulum	21	14.0
Hair coat type	Glossy	16	17.3
	Smooth	102	68.0
	Long straight	22	14.7

Low frequencies were recorded for the presence of wattle in the WAD goat populations. The results of this study agree with the result of Ofoli *et al*., (2020) who reported the absence of wattle in most of the WAD goats of Ghana. However, Yakubu *et al* (2010) and Oseni *et al* (2014) reported that most of the Nigerian indigenous goats have wattle. The absence of wattle in the majority of the goats in this study may not be beneficial for the goats in terms of production indices since the wattle is reported to have a thermoregulatory function as well as reproduction advantage in terms of high prolificacy, litter size, conception rate, milk yield and fertility index (Yakubu *et al*., 2010).

Results of this study revealed the absence of beard in most of the goats (80.7%). In a similar study conducted on WAD goats in Southern Nigeria Fajemilehin & Adegun (2020) also reported that WAD goats with beards outnumbered those without beards, an observation which agrees with reports on indigenous West African goat populations in Ghana, Burkina Faso, and Benin as reported by Hagan *et al*. (2012), Traoré *et al*. (2008), and Dossa *et al*. (2007). The similarities observed between the current study and previous works in other parts of West Africa imply that these African goat breeds share some common genes which control the presence or absence of beard. According to Rodero *et al*. (1996), beard is sex independent. Occurrence of beard is due to a locus which is dominant in males and recessive in females. It is a secondary sexual characteristic under male hormonal action, thus the presence of beard in females could be result from threshold levels of androgenic hormone (Yakubu *et al*. 2010)

Most of the goats do not have extra or supernumenary teats (78.7%), an observation that agrees with report of Kolo *et al*., (2015) about the local goat population in Northern Nigeria. Amao *et al*. (2003) also reported low frequency of goats with supernumerary teats. The author asserted that the presence of supernumerary teat constitutes to a major udder

abnormality in WAD goats. Vasileiou *et al*. (2019) reported that the presence of supernumerary teats, may constitute a minor, but notable, risk factor for acquisition of new intramammary infections. However, Oseni *et al*. (2006) and Adebayo & Chineke (2009) reported the presence of extra teat in most of the goats sampled in the Southwest Nigeria.

All the goats examined in the current study have horns. This observation agrees with previous studies on WAD goats (Yakubu e*t al*., 2010; Kolo *et al*., 2015; Afifo *et al*, 2020). Horns serve as a weapon in self-defence, scratching itches, play or fight with other goats, as well as in sexual selection through intermale competition among goats (Simon *et al*., 2022)

Table 2. Phenotypic frequencies of qualitative traits of WAD goat populations

Traits	**Genotype**	**No of obser-vation**	**PF (%)**
Coat colour	Ro^{r}	35	23.3
	Ro+	115	76.7
Wattle	Wa^{w}	70	46.7
	Wa+	80	53.3
Beard	Br^{b}	29	19.3
	Br+	121	80.7
Supernumerary teat (extra teat)	Et^{e}	32	21.3
	Et+	118	78.7
Horn	Ho^{h}	150	100
	Ho+	0	0.00

Legend: Ro+ =presence of light coloration, Ro^{-} =absence of light coloration; Wa^{w}=presence of wattle, Wa+=absence of wattle; Br^{b}- presence of beard, Br+-absence of beard; Et^{e}=presence of extra teat; Et+=absence of extra teat; Ho^{h}=presence of horn, Ho+=absence of horn. PF (%) = Phenotypic frequency

The results on qualitative udder conformation traits of WAD goat population are presented in Table 3. More than half of the goats sampled were with a well-developed, symmetric udder (61.3%). Their udders displayed a moderate degree of separation (58.7%) and were suspended at an intermediate level (52%) with a slightly deep udder (56.7%). Additionally, the goats had udder with an average size (56%) which were strongly attached (55.3%), had an average udder cleft (58%), and were slightly separated (66.7%) at an angle between 12 and 16 degrees (62.7%). Results further revealed that 48.7% of the goats had pear-shaped udder. A similar result for strong udder attachment was reported for indigenous goats of Ethiopia by Getaneh *et al*., (2022). In a similar study on cattle, Mammo *et al* (2017) reported an intermediate fore udder attachment for most of the dual and meat-type indigenous cattle in Northwest Amhara. The authors concluded that loose or weak fore udder attachment is an indication of poor udder conformation in ruminants. Thus, the well-formed udder for goats should have a firm and wide attachment and should not extend below the height of the hocks of the animal (Holyoke *et al*., 1979).

The teat quality traits of the goats (Table 4) revealed that most of the sampled WAD goats have funnel teat shape (44%) as also observed by Getaneh *et al*., (2022). According to Okano *et al*. (2015), changes in the teat shape are associated with mammary inflammation. This suggests that the animals with undesirable teat shapes had higher incidence of mastitis than those with desirable teat shapes (Getaneh *et al*., 2022). Raby (2011) reported that as teat size becomes large, they may develop undesirable conformation, appearing thicker, less symmetrical, and hanging below the hock.

The goats mostly have intermediate teat placement (61.3%), teat depth (56.7%), teat length (48%) and teat size (50.7%). A similar result was obtained for teat shape and teat placement for Ethiopian indigenous goats (Getaneh *et al*., 2022). The authors noted that teats pointing outside from the rear are not desirable because they tend to pose problems for nursing and machine milking.

Table 3. Frequency of udder quality traits of WAD goat population

Traits	Variables	Frequency	Percent
Udder shape	Funnel	35	23.3
	Cylindrical	42	28.0
	Pear shaped	73	48.7
Udder symmetry	Symmetric	92	61.3
	Moderate	42	28.0
	Asymmetric	16	10.7
Udder degree of Separation	Slight	53	35.3
	Moderate	88	58.7
	Severe	9	6.0
Udder degree of suspension	Extremely	29	19.3
	Intermediate	78	52.0
	Pendulous	36	24.0
	Extremely loose	7	4.7
Udder depth	Shallow	35	23.3
	Slightly shallow	3	2.0
	Moderate	1	7
	Slightly deep	85	56.7
	deep	26	17.3
Udder size	Small	30	20.0
	Average	84	56
	Big	36	24.0
Udder attachment	Weak	31	20.7
	Average	36	24.0
	Wide	83	55.3
Udder cleft	Missing	36	24.0
	Average	87	58.0
	Well-marked	27	18.0
Udder separation	Not separated	34	22.7
	Slightly closed	1	7
	Slightly separated	100	66.7
	Separated	15	10.0
Udder angle	160°-180°	23	15.3
	120°-160°	94	62.7
	90°-120°	32	21.3

The result of the current study further revealed that 78.7% of the goats have two teats while 12.7% and 8.7% have three and four teats respectively. This implies that 21.4% of the sampled goats possess supernumenary (extra) teats. Result revealed also that most of the goats did not have hyperkeratosis while 44% and 9.3% had slight rough ring and rough of hyperkeratosis. Hyperkeratosis is indicated by a smooth or slightly rough ring encircling the orifice. A surface that is smooth or very slightly rough signifies the absence of keratin fronds. In contrast, a rough ring, where a raised and roughened ring has fronds of keratin extending 1-3 mm from the orifice, indicates the presence of keratin fronds (Barkova &Verkhoturov, 2022).

Table 4. Frequency of teat quality traits of WAD goat populations

Traits	Variables	Frequency	Percent
Teat shape	Funnel	66	44.0
	Bottle	50	33.3
	Cylindrical	33	22.7
Teat numbers	2	118	78.6
	3	19	12.7
	4	13	8.7
Teat edema	Present	14	9.3
	Absent	135	90.7
Teat hyperkeratosis	No ring	70	46.7
	Slightly rough ring	66	44.0
	Rough	14	9.3
Teat placement	Vertical	20	13.3
	Average	92	61.3
	Horizontal	38	25.3
Teat depth	Shallow	27	18.0
	Average	85	56.7
	Deep	37	24.7
Teat lenght	Short	47	24.7
	Medium	72	48.0
	Long	41	27.3
Teat sizes	Small	34	22.7
	Medium	76	50.7
	Large	40	26.7
Teat hyperkeratosis	No ring	70	46.7
	Slightly rough ring	66	44.0
	Rough ring	14	9.3

CONCLUSION

The study identified diversities in qualitative attributes within Nigerian WAD goat populations. The product-specific qualitative traits of WAD goat populations revealed that most goats have desirable qualitative body, udder and teat traits for adaptation mechanism and production purposes. These traits suggest opportunities for genetic improvement to strengthen the understanding of diversity within the goat populations and help to conserve their genetic make-up for improvement and sustainable utilization

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