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Phenotypic Correlations and Relationship Estimations between Litter Size, Kidding Interval, Parity and Body Size Characteristics in Red Sokoto Goat.

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Abstract: *Data from 1330 Red Sokoto goats were used to study the phenotypic correlation and relationship estimations between litter size, kidding interval, parity and body size characteristics in Red Sokoto goat. The data were collected from two areas; Saunawa and Amarzakawa villages, all in Kano State, Nigeria. The traits recorded were litter size, kidding interval, body weight and body measurements viz height-at-withers, body length and chest girth. These were taken at mating, during pregnancy, at kidding and 60 days post kidding. The data were analysed using General Linear Model of SAS. The average litter size, kidding interval, height-at-withers, body length and chest girth recorded were 1.45, 6.9 month, 67.0, 73.0, 79.0cms receptively. Litter size had positive correlation ($p < 0.01$) with KI, Mwt, PKwt, Kwt, 60d PKwt, HAW, BL, and CG; and KI had positive correlations ($p < 0.01$) with Mwt, Kwt, 60d PKwt, HAW, BL and CG. There was significant effect ($p < 0.01$) of parity of the doe on LS, KI, Mwt, Kwt, 60d PKwt, HAW, BL and CG. Correlations between LS, KI, Mwt, HAW, BL and CG were significant ($p < 0.01$) and ranged between ($r = 0.30$) and ($r = 0.93$). This study indicated that body weight and measurements showed significant and positive correlations and the tendency to show some progress with progressing age and parity; these characters could be improved by conditioning the environment.*

Key words: *Litter size, kidding interval, body weight, body measurement, Red Sokoto goats.*

I. Introduction

Small holder production systems comprise sedentary farmers, each with small parcel of land in which they practice mixed (crop and livestock) farming. (Kosgey et al., 2006). Approximately, 64% of the world's small ruminants are kept in small holdings (De Haan et al., 1996) and the number of animals under this system is increasing (FAO, 2004). Nigeria has over 38 million goats, representing 4% of the world population (FAO, 2006). Small scale goat production is of significant benefits to families all over the world living in wide variety of climates and conditions (James, 2008). Among the poor, livestock accounts for up to 60% of their incomes (Devendra, 2006). Despite the large numbers and importance of small ruminants in developing countries, information on sustainable genetic improvement programme is scarce, especially for the adapted indigenous breeds (Kosgey et al, 2006).

The knowledge of body weight of goats is important for a number of reasons; it is related to breeding (selection), feeding and health care (Thiruvenkadan, 2005). Body measurements have been used to predict body weight by several authors in many breeds of goats; Indian goats (Singh and Mishra, 2004). Sahel goat of Nigeria (Mohamed and Amin, 1996), Red Sokoto goats (Akpa et al., 1998), West African Dwarf goat (Mayaka et al, 1995) and Nguni goats (Slipper et al ., 2000). Litter size was related to doe age and parity (Amoah and Geleye, 1990). Litter size increases with parity with fifth parity recording the highest litter size (Akpa et al. 2004; Awemu et al., 1999; Olayemi et al., 1993). Interval between kidding is an important predictor of lifetime productivity (Awemu et al., 1999). Parity and year significantly affected interval between kidding, which generally decrease with parity (Awemu et al., 1999; Sodiq, 2004).

Thiruvenkadan (2005) reported that correlations between body weight and body measurements were positive and strong. Hamayun et al., (2006) observed high and significant correlations coefficient between height-at-withers and heart girth and body weight in Beetal goats. In the study of Red Sokoto goats, body weight was significantly and positively correlated with body length, height-at-withers, and heart girth (Akpa et al., 1998, Akpa et al., 2009).

This study is therefore aimed at evaluating the phenotypic correlations and relationship estimation between body weight and some reproductive traits in Red Sokoto goats under small holder production system.

II. Materials and Methods

Experimental Site

This on-farm research under small holder production system was conducted at Saunawa and Amarzakawa villages in Kano State. These places are on latitude $11^0$59'N and longitude $8^0$34' E, altitude 486.5m above sea level. The annual rainfall is 1239mm with minimum temperature (14^0C) recorded between December and January, and maximum (41^0C) recorded in April (IAR, ABU, 2005).

Animals and their Management

The number of animals that were used in this research was one thousand, three hundred and thirty (1330) Red Sokoto goats. The study commenced with primary visit to identify herds, herd owners, and individual female goats and bucks. The animals were identified using necklace tags. At each location, details of individual female goats were recorded; such as age, kidding interval (interval between previous and current one), month of mating, month of kidding, and parity of the does, were all recorded.

Management Practice

The period of grazing in these areas were 7 am and 8 am in Saunawa and Amarzakawa villages, respectively. There was no distinct separation of herds based on functions or sex. Animals were kraaled at night. Majority of the house made using corn stalk for fencing and thatched roof for protection against heat and rainfall. These houses were open-sided for adequate ventilation. There was no organized health care provision in terms of vaccination and deworming. However, veterinary officers were called to treat the animals when cases of ill-health occurred. Supplementary feeding was done using crop residues such as groundnut haulm, bean pods, and maize/millet offals. Mineral blocks and water were also provided. The breeding animals were grouped in the ratio of 1 male to 10 females.

Data Collection

The body weight and body measurement traits were measured at each location. These records were taken at mating, during pregnancy, at kidding (day 1) and 60 days post kidding. The age of the animals were provided by the farmers and by the use of dentition formula as per Wilson and Durkin (1984). The body weight of these animals were measured every two weeks using potable scale, and their weights recorded in (Kg) to the nearest decimals. The body measurements recorded were height-at-withers (HAW), body length (BL), and chest girth (CG). These traits were measured using measuring tape and figures recorded in centimeters (cm). Height-at-withers was measured as the distance from the surface of a platform to the withers, while body length was measured as the distance from external occipital protuberance to the base of the tail and chest girth represented the circumference of the chest. Other measured characteristics were litter size (Ls), kidding interval (KI), mating weight (Mwt), Pre-kidding weight change (PkwtΔ), 60 days post kidding weight (60d Pkwt), kidding weight (Kwt) and pre-kidding rate of gain (PKRG).

Statistical Analysis

The population average and standard deviations were calculated based on the means of SAS (2001). The variance analysis and multiple comparison were analysed by the General Linear Model (GLM) of SAS (2001). Significant differences were separated using Duncan Multiple Range Test SAS (2001). Correlation and regression were computed using SAS (2001). The data were analysed using the following model:-

$Y_{ijkl} = \mu + A_i + P_j + M_k + W_l + E_{ijkl}$

Y_{ijkl} = any observation

μ= the overall mean

A_i = effect of age of dam

P_j = effect of parity of dam

M_k = effect of month of mating

W_l = effect of weight of dam and

E_{ijkl} = the random error term.

III. Results

The summary statistics; mean $\pm$ se, minimum and maximum values for litter size, kidding interval an body size characteristics are presented in Table 1. The overall litter size recorded was 1.45 $\pm$ 0.04, with 1.0 and 2.0 minimum and maximum values respectively. Mean kidding interval was 6.9 months, approximately 7.0 months. Height-at-withers, body length and chest girth were 55.4 $\pm$ 0.40, 50.0 $\pm$ 0.43 and 65.8 $\pm$ 0.52 cm, respectively.

Coefficient of phenotypic correlations amongst litter size, kidding interval and body size characteristics of Red Sokoto goats are presented in Table 2. This study showed that there was a positive correlation ($p < 0.01$)

of litter size with kidding interval, mating weight, pre-kidding weight gain, kidding weight, 60d PKwt, HAW, BL and CG. However, non-significant correlation ($p > 0.05$) of litter size with PKRG and PKwt Δ was observed. Kidding interval had positive correlation ($p < 0.01$) with Mwt, Kwt, 60d PKwt, HAW, BL and CG. Mating weight had the highest positive correlation ($p < 0.01$) with kidding weight ($r = 0.93$), followed by 60d PKWT ($r = 0.84$). Positive correlation ($p < 0.01$) were also observed between mating weight and HAW, BL and CG. Non-significant correlations ($p > 0.05$) of mating weight with PKWT, PKRG, and PKwtΔ respectively, were observed. Pre-kidding weight gain, pre-kidding rate of gain, kidding weight, 60d post kidding, height-at-withers and body length had positive correlation with PKRG, Kwt, 60d PKwt, PKwtΔ, HAW, BL and CG respectively. There were non-significant correlations ($p> 0.05$) of PkwtG with pre-kidding rate of gain (PKRG), with Kwt, 60d PKwtΔ, PKwt, HAW, BL and CG and kidding weight with PKwtΔ

The effect of parity of the doe on litter size, kidding interval and body size characteristics are presented in Table 3. Parity significantly affected ($p < 0.01$) litter size, with an increase in parity of the doe, leading to increase in litter size. There was significant difference ($p < 0.01$) of kidding interval with parity. Kidding interval appeared to decrease as the parity of the does increased. Doe mating weight was significantly affected ($p < 0.01$) by parity; mating weight increased as parity increased. There were non-significant effect ($p > 0.05$) of parity on pre-kidding weight gain, pre-kidding rate of gain, and post kidding weight changes, but there was significant effect ($p < 0.01$) of parity on kidding weight, height-at-withers, body length, and chest girth. These values appeared to increase with increase in parity.

IV. Discussion

The average litter size in this study was 1.45. This value was within the range reported by Osinowo and Abubakar (1989) that obtained the value of 1.12 – 1.45 litter size in Red Sokoto goats. The value recorded in this study was lower than 1.8 ± 0.05 obtained by Akpa et al., (2004) for the same breed. Litter size increases with parity with the highest litter size at fifth parity. This is in agreement wit report of Awemu et al., (1999) and Akpa et al., (2004).

Mean kidding interval recorded in this study was 6.9 months, which is slightly lower than the value obtained by Awemu et al., (1999) that was 215 days for the same breed and lower that the value obtained by Adu and Lakpini (1989), which was 240 days for Red Sokoto goats under intensive management. This lower value obtained in this study might be partly due to extensive management as kidding interval was reported to be higher under intensive management(confinement) and controlled mating; (Wilson et al., 1989). The value of kidding interval in this study is also within the range reported in other breeds such as Kecang goats of Indonesia that have 205 days kidding interval (Sodiq, 2004). The young does were observed to have longer kidding interval than old does. This is in agreement with the report of Wilson and Light (1986), Das (1993) and Awemu et al., (1999). The average mean mating weight, kidding weight and 60 days post kidding weight obtained in this study were 20.4kg, 24.7 kg and 23.0kg, respectively. These values were within the range of weights recorded in Red Sokoto goats of 1–2 years, 3 –4 years and 5 years (Hassan and Ciroma, 1992). The significant effect of these weights with regards to other traits measured in this study may be partly due to relatively adequate feed obtained by the animals during the mating period, which took place during the early dry season when there was available crop residue on the farmlands, where the animals went for grazing. The height-at-withers, body length and chest girth values obtained in this study were 55.4 ± 0.40cm, 59.0 ± 0.43cm and 65.8 ± 0.52cm respectively. These values are within the range reported in the same breed by Hassan and Ciroma (1992) and Akpa et al., (1998)

There were high and positive phenotypic correlations observed between mating and kidding weight ($r = 0.93$) and between mating weight and 60 days post kidding ($r = 0.81$) (Table 2). The significant and positive correlation observed between live weight and body measurement (height –at-withers, body length and chest girth) were within the range reported by Hassan and Ciroma (1992), Akpa et al., (2009), Thiruvenkadan (2005) and Hamayun et al., (2006). Parity significantly affected litter size in this study, with an increase in parity of the doe, leading to increase in litter size (Table 3). This is in agreement with the report of Awemu et al., (1999) and Akpa et al., (2004). The kidding interval was observed to decrease with increase in the parity of the doe in this study. This is in agreement with the report of Awemu et al., (1999), Choudhury et al., (2002), Hossain et al,, (2004) and Sodiq, (2004).

V. Conclusion

The body weight and body size characteristics showed significant and positive correlations and the tendency to show some progress with progressing parity and weight of dam; these characters could be improve by conditioning the environment for better production.

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Table 1: Summary Statistics of litter size, kidding interval and body size characteristics of Red Sokoto goats

Characteristics	N	Mean ± se	Cv	Min.	Max.
Litter size (LS)	1330	1.45 ± 0.04	24.6	1.0	2.0
Kidding Interval (KI) months	1330	6.9 ± 0.70	14.2	6.0	9.0
Mating Weight (Mwt) (Kg)	1330	20.4 ± 0.42	22.7	12.5	31.0
Pre-kidding Weight Gain (PKwG) (Kg)	1330	10.8 ± 0.20	16.4	7.3	12.2
Pre Kidding Rate of Gain (PKRG) (Kg)	1330	0.09 ± 0.01	13.4	0.05	0.9
Kidding Weight (Kwt) (Kg)	1330	24.7 ± 0.39	17.4	15.5	33.6
60 days Post Kidding Weight (60d PKwt)	1330	23.0 ± 0.42	20.2	14.0	35.0
Post kidding weight (PKwtΔ) (Kg)	1330	1.7 ± 0.23	13.9	- 4.0	3.0
Height-at-withers (HAW)	1330	55.4 ± 0.40	7.7	46.0	67.0
Body Length (BL) (cm)	1330	59.0 ± 0.43	8.3	46.5	73.0
Chest girth (CG) (cm)	1330	68.5 ± 0.52	8.7	53.0	79.0

N = number of animals

Table 2 Phenotypic correlation amongst litter size, kidding interval and body size characteristics of Red Sokoto does.

Traits	KI	Mwt	PKwtG	PkRG	Kwt	60d Pkwt	PKwtΔ	HAW	BL	CG
1. Litter size	0.47**	0.61**	0.35**	0.07	0.54**	0.50**	0.01	0.32*	0.42**	0.48**
2. Kidding Interval (KI) (Kg)		0.57**	0.11	0.11	0.58**	0.52**	0.04	0.26*	0.42**	0.44**
3. Mating Weight (Mwt) (Kg)			0.13	0.05	0.93**	0.81**	0.11	0.49*	0.65**	0.73**
4. Pre-kidding Rate Gain (PKRG) (Kg)				0.22*	0.34**	0.30*	0.13	0.25*	0.31*	0.23*
5. Pre-kidding Rate of gain					0.10	0.01	0.15	- 0.08	0.13*	0.04
6. Kidding Weight (Kwt) (Kg)						0.84**	0.15	0.53**	0.69**	0.72**
7. 60days post kidding weight (60d PKwt)							0.40**	0.64**	0.74**	0.84**
8. Post Kidding weight change (PKwtΔ) (Kg)								0.27*	0.19*	0.30*
9. Height-at-withers (HAW) (cm)									0.70**	0.66**
10. Body length										0.80**

* = p <0.05 ** = p < 0.01

LS: litter size; KI: Kidding interval; Mwt: Mating weight; PKwtG: Post kidding weight gain; PKRG: Post kidding Rate of Gain

Kwt: Kidding weight; 60d Pkwt: 60 days post kidding weight; PKwt Δ: Post kidding weight change; HAW: Height-at-withers

BL: Body length; CG: Chest girth.

Table 3: Effect of parity of doe on litter size, kidding interval and body size characteristics

Parity	LS	KI	Mwt	PKwtG	PKRG	Kwt	60d Pkwt	PKwtΔ	HAW	BL	CG
	**	**	**	ns	ns	**	**	ns	**	**	**
1	1.00^{a}	8.0^{a}	15.24^{f}	10.13	0.07	19.92^{f}	18.35^{g}	1.57	52.87	54.98^{f}	60.27^{g}
2	1.30^{d}	6.8^{abc}	17.48^{e}	11.1	0.11	23.11^{e}	20.91^{f}	2.20	54.09d	56.38^{e}	62.41^{f}
3	1.63^{c}	6.2^{bc}	22.56^{d}	10.90	0.13	26.02^{d}	24.26^{e}	1.76	55.58e	59.24^{d}	67.34^{e}
4	1.78^{b}	7.3^{abc}	24.44^{c}	10.72	0.11	28.16^{c}	26.16^{bc}	2.08	57.64b	61.64^{c}	69.18^{d}
5	1.81^{b}	7.6^{ab}	25.73^{b}	10.04	0.07	28.89^{bc}	28.00^{c}	0.89	58.31b	63.00^{b}	70.38^{e}
6	1.80^{b}	6.8^{abc}	26.98^{a}	11.58	0.08	30.90^{a}	28.86^{b}	2.04	58.40b	65.10^{a}	73.50^{b}
7	2.00^{a}	6.0^{c}	27.00^{a}	9.00	0.06	29.00^{b}	32.00^{a}	3.00	62.00a	60.00^{d}	75.00^{a}
SEM	**0.40**	**0.70**	**0.42**	**0.20**	**0.01**	**0.39**	**0.42**	**0.23**	**0.40**	**0.43**	**0.52**

** = p <0.01 * = p < 0.05, a,b,c, … means within column with different superscripts differ significantly (p < 0.05)

LS: litter size; KI: Kidding interval; Mwt: Mating weight; PKwtG: Post kidding weight gain; PKRG: Post kidding Rate of Gain

Kwt: Kidding weight; 60d Pkwt: 60 days post kidding weight; PKwt Δ: Post kidding weight change; HAW: Height-at-withers

BL: Body length; CG: Chest girth.