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INFLUENCES OF FEED AND SEASON ON BREED AND REPRODUCTIVE TRAITS IN WEST AFRICAN DWARF AND SAHEL BUCKS IN TARABA STATE

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ABSTRACT

The study evaluated the influence of feed on the reproductive parameters of West African Dwarf and Sahel goats at theTeaching and Research farm of the Federal Polytechnic Bali, Taraba State. A total of 8 bucks from two goats breeds (West African Dwarf and Sahel) were used for the experiment. The 8 bucks were later moved to Vom, for semen collection, using electro-ejaculator. The study lasted for 12 calendar months. They were fed Gmelina and cassava peel meal, Gmelina and cowpea husk, Ficus and cassava peel meal and, Ficus and cowpea husk as experimental treatments (T1-T4), respectively. Goats according to breed were allotted to treatments randomly and treated as factorial experiments. Season had significant ($P<0.01$) influence on buck parameters (scrotal length and semen qualities). The overall samples collected was 192 on both the breeds on the following parameters; scrotal circumference, semen volume, semen pH, sperm concentration, sperm motility and live cells and the results were 11.91cm, 0.47ml, 6.78ph, $414.92x10^6$, 83.02% and 92.33% respectively. The result was significant for breed, season and treatment for all parameters except live and dead cells for breeds and treatment. Feeding Ficus containing diets resulted in higher semen quality values. Also, semen colour using likert scale was analyzed which resulted to three types of colour (creamy, milky and watery). The colour was evaluated under based on breed, seasons and treatment diets (feeds). The overall results show insignificant differences for all the parameters (feeds, seasons, breeds and reproductive traits) observed.

INTRODUCTION

Goats are important domestic farm animals in the world as a source of meat, milk and skin (Onakpa *et al.*, 2010). They are primarily kept for meat and contribute substantially to household income and food security in most rural areas (FAO, 2014). Livestock generally and especially goat production is a traditional activity practiced by 60-87% of the local populations either as the main activity or as a secondary activity (Institut Senegalais de 2003; Ministère de L'Elevage, 2012).

West African area involves a wide range of indigenous goat breeds well adapted to harsh environmental and precarious husbandry conditions but have low genetic potentials. The geographical distribution of the different breeds in West Africa is almost exclusively determined by the presence or absence of the tsetse fly in the region. The vast majority of goats in the areas of high tsetse challenge are the West African dwarf trypanotolerant breeds. In the savannah and the semi-arid zone, the larger sized, long-legged Sahelian breeds thrive well (Timon and Baber, 1989; Opasina and David, 2007) West African Dwarf goat is small size animals with a low meat yield and very low lactogenic productive potential (Gbangboché *et al.*,2002; Monkotan, 2011). The West African Sahelian goat is a long leg breed mainly raised mainly for meat, skin and milk production. The Sahelian is large, long-legged goats mainly found in the semi-arid and arid of the Saharan and sub-Saharan region in distribution. Red Sokoto is also known as Maradi goat is used for the good quality skin production in Nigeria and Niger. These breeds are currently being kept under an acclimatization research program and in some commercial private farm.

Breeding programmes require assurance of the reproductive capacity of breeders, but in areas with low technical and laboratory support for semen evaluation, farmers may need a reference range of testicular sizes, without extraneous mitigating conditions, which may be associated with adequate sperm reserve for reproductive efficiency. While their biometric data help define the reproductive parameters for a species should be performed to certify the reproductive capacity of a male (Ohashi *et al.*, 2007).). In males for instance, there is the need to establish measurable criteria for judging breeding soundness and guiding selection for breeding, this is why it is necessary to determine some reproductive characterization of local buck.

Reproductive efficiency including sperm production is the most limiting constraint to efficient animal production in the tropics (Gbadamosi and Egbunike, 1999). The efficiency of sperm production, tend to remain uniform throughout the reproductive life of an animal, but may be significantly altered by nutrition, environment, age, weight, health status, medication, photoperiod, and chemicals (Togun and Egbunike,2006). Among these factors, nutrition is the

most prominent management factor; improved feeding can optimize spermatozoa cells production (Sallisbury *et al*., 1978; Rekwot *et al*., 1987a, 1988).

Another major contribution to sperm production variation is environment (Curtis, 1983; Chandler *et al.*, 1985; Cupps, 1991; Bearden and Fuquay, 1997). The environment could be defined in terms of temperature, nutrition, season and management of the animal (Bonsma, 1980). A suitable environment would result in higher sperm production (Bearden and Fuquay, 1997). Health is also a factor that affects production. Leboeuf (2000) reported that healthy animals are higher in sperm production due to its ability to ejaculate viable sperm. In addition, body weight and scrotal-testicular biometry has been reported to affect sperm production in bucks (Gemeda and Workalemahu, 2017).

Nutrition is related to hormone production and the growth of reproductive organs. In addition, retarded testicular growth, decreased size of Leydig cells low differentiation of the seminiferous tubules and interstitial tissues delayed appearance of motile sperm in ejaculate are observed in gonads of underfed maturing bull-calves (Almeida *et al.,* 2010). Restricted diets significantly decrease the number of cells of the spermatogenic series at all stages and the number of Sertoli cells. Thus, it is apparent that the cellularity of the tubular epithelium is significantly lowered in low nutrition animals (Almeida *et al*., 2010).

In this study, the testicular biometric parameters; such as scrotal circumference (SC), semen volume (SV) sperm concentration, sperm pH, sperm motility(SM) and normal sperm, and live cells and semen colour of indigenous bucks were evaluated with the aim of identifying bucks with optimal sperm output from testicular and related size variables.

MATERIALS AND METHODS

Experimental site

The study was firstly mounted at the Teaching and Research farm, Federal Polytechnic Bali, Taraba State, Nigeria. But for the purpose of semen collection, using electro-ejaculate, the bucks were moved to National Veterinary Research Institute (NVRI) Vom in second year (2019) of the research.

Bali Local Government Area (LGA) is located between the latitude $7^0$12' and $9^0$00'N of the equator, longitudes $10^0$00 and $12^0$00'E of the Greenwich. The climate is characterized by a well-defined rainy (April-November) and dry (December-march) seasons. The annual rainfall varies from 1, 200 to 3,000mm. The mean annual temperatures range from 20^o to 30^oc.The relative humidity varies from 86 to 90% (MU, FPB, 2019).

On the hand, Vom is located at about 1217m above sea level and between the latitude 9.56N and longitude 8.53E (Ileoje, 2001).Though situated in tropical zone the higher altitude gives the area a near temperate climate with average temperature ranging between 18-22oC and annual rainfall varies from 1800-2200m per annum (Oawuyi *et al.,* 2010).The lowest temperatures are observed between December and February, while the warmest temperature usually occurs between March and April. It has two district seasons namely: rainy, which extends from May to October and dry extend from November to April (Ileoje, 2001). The study was carried out at the livestock investigation department, National Veterinary Research Institute (NVRI) Vom, in plateau state.

Animal management

The animals were managed semi-intensively. In the night, they were kept in a cross ventilated pen within the animal house made up of concrete blocks, cemented floor and wall, and zinc roofing. Mineral licks were provided periodically. Routine health care: vaccination, medication, deworming and regular acaricide application were carried out. Clean fresh water was provided *ad-libitum.* The animals were acclimatized for two weeks before the commencement of the experiment.

Experimental rations were offered in the morning (8-10 am) before release to graze natural pasture under the supervision of an attendant until 5:00pm. The pen (housing) was cleaned on weekly basis, while feeding/ water troughs were usually cleaned before serving the next feed on daily basis.

Treatments/Experimental Diets

The animals were randomly allotted to four treatments, according to breed, such that there were two bucks per treatment, replicated twice. Four experimental diets; A (Gmelina+ Cassava peel meal), B (Gmelina+ Cowpea husk), C (Ficus + cassava peels meal) and D (Ficus+ cowpea husk) were each fed to the animals. The leaves of browse were fed at 1.5kg per animal/day by hanging using rope and allowed to the floor of pen. The supplement (1.5kg) was fed per animal per day. Half of the quantities of browse and supplement were served in the morning before release for grazing and the remaining on return in the evening

Proximate Compositions of Experimental Materials

The proximate composition (Table 1) of experimental materials was determined as follows;

(a) Moisture content

The moisture content was determined using the basic AOAC (2003) oven drying method. A clean crucible was dried in the oven at 105^0C for 30 minutes and allowed to cool and weighed (W_1). Two grammes of the well mixed sample (W_2) was transferred into the clean dried crucible and again placed in the oven at 100-105^0C for 6 hours until a constant weight was obtained. The crucible was then placed in a desiccator for 30min to cool and again weigh (W_3). The percentage moisture was calculated as:

$$\textbf{M.C \%} = \frac{W3-W1}{W2} \textbf{ x 100}$$

(b) Ash content

It was also determined according to AOAC (2003) using the furnace drying method.

A clean crucible was dried in the oven at 105 ^{0}C for 30 minutes, allowed to cool and weighed (W_1). Two grammes of the well mixed sample (W_2) was transferred into the clean dried crucible and incinerated in a muffle furnace at 520 ^{0}C for 4 hours. The appearance of a grey white ash indicates complete oxidation of all organic matter in the sample. The crucible was cooled and weighed (W_3). Percent ash was determined as: $\textbf{Ash \%} = \frac{W3-W1}{W2} \textbf{ x 100}$

(c) Crude protein

Protein content was determined using the micro-Kjeldahl method as described by Pearson. The method involved: digestion, distillation and titration. Crude protein was determined by measuring the nitrogen content of the feed and multiplying by a factor of 6.25. This factor is based on the fact that most protein contains 16 % nitrogen.

A sample (1.5g) of the dried powder of the feed mixture was placed in the digestion flask. Subsequently 20 ml of concentrated H_2SO_4 and 8g of digestion mixture i.e., K_2SO_4: $CuSO_4$ (8:1) were added. The flasks were swirled to ensure thorough mixture and placed on a heater to digestion until it became clear (blue or green in colour) (about 2 hours). The digest was cooled, transferred to 100ml volumetric flask and volume made up to the mark by the addition of distilled water. The digest (50ml) was introduced into the distillation tube and 50 ml of 0.5N NaOH gradually added.

Table 1: Proximate Composition of the Experimental Feeds

Compositions (%)	Gmelina leaves	Ficus leaves	Cassava peels	Cowpea husk
Moisture	10.36	9.71	9.05	4.86
Protein	8.71	15.79	12.95	2.61
Fat	7.57	1.94	0.55	1.16
Fibre	19.0	22.61	9.95	5.36
Ash	6.81	11.03	1.6	10.13
Digestible Carbohydrate	47.34	38.92	60.95	81.23
Nitrogen Free Extract	57.71	48.63	74.95	80.74

Distillation was allowed to continue for at least 10 minutes and the NH_3 produced collected as NH_4OH in a conical flask containing 20ml of 4% boric acid solution with few drops of modified methyl red indicator. During distillation a yellowish colour appeared due to NH_4OH. The distillate was then titrated against standard 0.1N HCl solution till the appearance of a pink colour. A blank was also run through all the steps followed. Percent crude protein content of the sample was calculated by using the following expression:

C.P % = 6.25* × %N (* correction factor)

$$\% \text{ N} = \frac{(S-B)XNX0.014XD}{weightofsampleXV} X100$$

Where:

S= samples titration reading

B= Blank titration reading

N= Normality of HCl

D= Dilution of samples after digestion

V= Volume used for distillation, 0.014 = millilitre, equivalent weight of nitrogen

(d) Crude fibre

Neutralization and dry method of crude fibre determination was used as described AOAC (2003). A moisture free and ether extracted sample of crude fibre cellulose was first digested with dilute H_2SO_4 and subsequently dilute KOH solution. The undigested residue collected thereafter was ignited and loss in weight was registered as crude fibre. The following protocol was followed:

A weighed crucible containing two grammes (W_1) of defatted sample was attached to the extraction unit (Soxhlet apparatus) and into which 150 ml of hot 1.25% H_2SO_4 was added and digested for 30 minutes. The acid was drained and sample washed with hot distilled water. The sample was further digested in a similar way using KOH. It was then dried in an oven at 105 ^{0}C for one hour, allowed to cool in a desiccator and weighed (W_2). The crucible containing the sample was further kept in the muffle furnace at 550 ^{0}C for two hours cooled in the desiccator and re-weighed (W_3). Percentage extracted fibre was calculated as: $\mathbf{C.F\ \%= \frac{W3-W2}{W1} x\ 100}$

(e) Crude lipid/ fat

Dry extraction method of fat determination was applied as described. It consisted of extraction of dry sample with organic solvent. All fat materials e.g., phospholipid, sterols, fatty acid, carotenoids, pigment, chlorophyll etc. are extracted together therefore, the results are frequently referred to as crude fat. The procedure is as follows: -

Two grammes(W_1) of moisture free samples was wrapped in a filter paper, placed in a fat free thimble and introduced into an extraction tube weighed, cleaned and the receiving flask filled with 150 ml petroleum spirit (40–60^{0}CBpt) and fitted into the soxlet apparatus. It was then placed on a heating mantle to start the extraction. After 4-6 hours of siphoning, the apparatus was disconnected and, the extract and solvent in the receiving flask transferred into a pre-weighed beaker (W_2) and placed in a water bath to evaporate the solvent. The extracted fat in the beaker was then allowed to cooled and re-weighed (W_3). The per cent crude fat was determined using the following expression. $\mathbf{C.L\ \%= \frac{W3-W2}{W1} x\ 100}$

(f) Carbohydrate determination

The carbohydrate content was determined by difference as described AOAC (2003), i.e., nitrogen-free extract otherwise known as carbohydrate is: % carbohydrate = 100 – (ash + moisture + protein + lipid + fibre)

Study design and data collection

Eight breeding bucks weighing 28 kg averagely, and within the range of 2- 3years old, were used largely for the study. The study was conducted over a period of 12 calendar months on reproductive parameters of two breeds of goat bucks (WAD and Sahel) at the livestock investigation department (L.I.D) National Veterinary Research Institute (NVRI) Vom, Plateau state. The seasons of the year were grouped into four namely: early rainy (May-July), late rainy (August-October), early dry (November- January), and late dry (February- March).

Data collection and laboratory analysis

Scrotal circumference measurements and semen were collected from the bucks every two weeks into a graduated tube, the volume was read and immersed in a warm water bath at 40^{0}C. The other sample semen characteristics were subsequently evaluated in the laboratory as described by Zemjanis (1977).

- **Semen Volume**: As already stated, it was read from the graduated tube and recorded in milimetres to 0.01ml.
- Semen Colour: This was determined using the universal indicator paper by comparison
- **Hydrogen ion concentration**: **T**he hydrogen ion concentration (pH) was determined using the Chemo craft pH universal indicator paper. The papers are calibrated by colour from 1 to 14. One centimetre of the paper was inserted into the semen for five seconds, removed and air dried. The colour change was compared to the chart on the pH paper. The corresponding colour/number was recorded as the pH of the sample.
- **Sperm motility;** Sperm motility (movement) was scored as outlined by Melrose and Laing (1970).A drop of semen was placed under a cover slip on a microscope slide. The undiluted sample was observed for swirling motion (mass motility) at low power magnification (x100). Subsequently another drop of semen was mixed with a drop of physiological normal saline (0.9% NaCl) under the cover slip (on a slide) and again viewed at x100.The microscope was then switched to x450 for differential count of 10 moving and non-moving sperms. Several fields of view were observed, the differentials count repeated and motility recorded as the average percentage of moving cells.

- **Sperm concentration determination**; The concentration of the spermatozoa was determined using the Accuread photometer, Edition 07/2008. It measures sperm concentration in a suspension at 595nm. The Accuread photometer was first switched on and it was ensured that it was in concentration mode i.e., the point at which the semen image is displayed, viewed and, assessed on the screen of the photometer. Subsequently, 10 µl of raw semen was diluted with 3990 µl of 0.9% NaCl solution in a cuvette using a micropipette. Another cuvette containing only 0.9% NaCl solution was placed in the sample chamber and the equipment set to zero (zero reading). The cuvette was then replaced with the one containing the diluted semen sample which was properly homogenized. The semen concentration was then read.
- **Live and dead sperm ratio:** The live and dead sperm ratio was estimated in accordance with Hancock (1951). A drop of semen was diluted in a ratio of 1:400 with available diluent. A drop of Eosin-Nigrosine stain was placed on a microscope glass slide one centimetre from the end and a drop of the semen added using a pipette. A second slide was placed on top of the first. The slide was circularly and gently turned to ensure uniform mixture of the semen and stain. Excess fluid was blotted from the edge with a tissue and the two slides gradually and carefully drawn apart to produce a thin smear on the first slide. This was quickly dried and labeled. The slide was subsequently mounted on the microscope for counting the live and dead spermatozoa using x400 magnification. Dead sperm were stained and lives ones unstained.
- **Sperm morphology**: The slides prepared for live and dead ratio were used for the morphology studies. Live and abnormal spermatozoa percentages were counted using a tally counter. Some 200 spermatozoa were examined from each sample. The total number of abnormal spermatozoa was counted and recorded. The possible types of abnormality were: detached mid-piece and tail, detached head, mid-piece droplet, coiled and bent tails, and acrosomal abnormality (acrosome membrane detached, acrosome outlines and acrosome cap defect). Acrosomal abnormalities however, were determined using smears stained by Giemsa according to Watson (1975).

Data analysis

The data obtained were subjected to analysis of variance procedure as contained in the statistical package of Statistix 8.0(2009) USA. Significant means were compared, using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSIONS

The average scrotal size and semen quality parameters of bucks fed different feedstuffs are presented in Table 2. The overall scrotal circumference, semen volume, sperm pH, sperm concentration, sperm motility and lives cells were 17.91cm, 0.47ml, 6.78pH, 414.92×10^{6}, 83.02%, 92.33%, and 92.083% respectively. The result-revealed that, there was significant ($P<0.01$) difference among the breeds, seasons, and treatments for all the parameters considered, except for live and dead cells among breeds and treatments.

The WAD had higher values for semen volume (0.500ml), motility (84.33%), normal sperm (93.49%), and sperm concentration ($424x10^{6}$), while Sahel goats were higher for the other parameters. Early rainy season had higher scrotal circumference of 18.30cm while the other seasons had similar values (17.63-17.88cm). Indeed, the early rainy season had higher values for most of the spermatozoa parameters while the other seasons had almost similar values. Generally treatments containing Ficus had the highest values ($501.25x10^{6}$, 7.27, 87.50 and 96.65%) for the parameters considered, while those with Gmelina had almost the lowest ($307.42x10^{6}$, 6.35, 74.71 and 88.96%).

Seasonal variation affected most of the scrotal/semen parameters (18.30cm, 0.522ml, $420x10^{6}$ and 90.13%). This is in consonance with Bitto and Egbunike (2006) in WAD. Daudu (1984) obtained similar results on Red Sokoto bucks. Furthermore, variations in these parameters with season have been reported by Vilar *et al.,* (1993), Moreira *et al.,* (2001) and Campos (2003). Results from this study showed that early rainy season had higher values for the reproductive parameters considered than the other seasons. It has been similarly reported that, goats tended to have better reproductive performance in rainy season than dry seasons. This may be due to availability of feed and cool weather conditions (Daudu, 1984).

It was found in this study that treatment containing Ficus resulted in higher male reproductive parameter values. This is an indication that Ficus may be more suitable for increase in these reproductive parameters in goats than Gmelina. To boost these reproductive parameters in goats in the study area therefore, farmers should incorporate more Ficus browse in the diet of their goats. However, this should be in addition to other supplement especially in the dry season. Toe (2000), Ugwu (2009) and Antonio *et al.,* (2011) have obtained similar results.

Table 2: Mean scrotal size and semen quality of bucks on different feeds

Variables✓ Factors	N	Scrotal circum. (cm)	Semen vol. (ml)	Sperm conc. ($x10^6$)	Sperm pH	Sperm motility (%)	Normal sperm (%)	Live cells (%)
Overall	192	17.91	0.47	414.92	6.78	83.02	92.33	92.083
Breed		**	**	**	**	**	**	Ns
WAD	96	17.70^{b}	0.500^{a}	424.11^{a}	6.65^{b}	84.88^{a}	93.49^{a}	92.013
Sahel	96	18.12^{a}	0.443^{b}	405.73^{b}	6.92^{a}	81.16^{b}	91.18^{b}	92.014
Season		**	**	**	**	**	**	**
Early dry(Nov-Jan)	48	17.63^{b}	0.430^{b}	415.29^{b}	6.58^{b}	81.21^{b}	91.98^{b}	93.438^{a}
Late dry(Feb-Apri)	48	17.88^{b}	0.450^{b}	412.35^{b}	7.04^{a}	85.17^{a}	90.13^{c}	90.583^{b}
Early rainy(May-Jul)	48	18.30^{a}	0.522^{a}	420.54^{a}	6.90^{a}	84.63^{a}	93.92^{a}	92.021^{ab}
Late rainy(Aug-Oct)	48	17.84^{b}	0.477^{ab}	411.50^{b}	6.60^{a}	81.06^{b}	93.31^{a}	92.292^{a}
Treatment		**	**	**	**	**	**	Ns
Gm+ Cpm	48	18.64^{a}	0.508^{a}	372.46^{c}	7.00^{b}	83.31^{b}	88.96^{c}	90.562
Gm+ Cph	48	16.18^{c}	0.422^{c}	307.42^{d}	6.35^{d}	74.71^{c}	91.23^{b}	91.858
Fs+ Cpm	48	18.14^{b}	0.452^{bc}	501.25^{a}	7.27^{a}	87.50^{a}	96.65^{a}	92.875
Fs+ Cph	48	18.69^{a}	0.495^{ab}	478.56^{b}	6.54^{c}	86.54^{a}	92.50^{b}	93.042

**=P<0.01, a, b and c=means within a subset with the same superscript are statistically similar. WAD=West African Dwarf, Gm=*Gmelina arborea*, Fs=*Ficus sycamores*, Cpm=Cassava peel meal, Cph= Cowpea husk, N= sample size, circum. = circumference, conc. =concentration, ns=not significant

Table 3: Breed effect on semen colour

Variable	**Creamy**	**Milky**	**Watery**	**Total Freq**	**Total Likert Sum**	**Likert Mean (3+2+1)/3=2 (accepted minimum standard)**	Remarks
Ratings	**3**	**2**	**1**				
WAD	47	39	10	96	229	2.4	Creamy
Sahel	42	36	18	96	216	2.3	Creamy
Total	**47**	**39**	**10**	**96**	**61**	**2.3**	Creamy

Table 4: Seasonal effect on semen colour for West African Dwarf bucks

Variable	**Creamy**	**Milky**	**Watery**	**Total Freq**	**Total Likert Sum**	**Likert Mean (3+2+1)/3=2 (accepted minimum standard)**	Remarks
Ratings	**3**	**2**	**1**				
Early Dry	13	11	0	24	61	2.5	Creamy
Late Dry	8	10	6	24	50	2.1	Creamy
Early Rain	16	7	1	24	63	2.6	Creamy
Late Rain	10	11	3	24	55	2.3	Creamy
Total	**47**	**39**	**10**	**96**	**61**	**2.3**	Creamy

Table 5: Seasonal effect on semen colour for Sahelian bucks

Variable	**Creamy**	**Milky**	**Watery**	**Total Freq**	**Total Likert Sum**	**Likert Mean (3+2+1)/3=2 (accepted minimum standard)**	Remarks
Ratings	**3**	**2**	**1**				
Early Dry	11	9	4	24	55	2.3	Creamy
Late Dry	4	11	9	24	43	1.8	Milky
Early Rain	14	6	4	24	58	2.4	Creamy
Late Rain	13	10	1	24	60	2.5	Creamy
Total	**47**	**39**	**10**	**96**	**61**	**2.3**	Creamy

Table 6: Treatment effect on semen colour for West African Dwarf bucks

Variable	Creamy	Milky	Watery	Total Freq	Total Likert Sum	Likert Mean (3+2+1)/3=2 (accepted minimum standard)	Remarks
Ratings	**3**	**2**	**1**				
Gm + CPM	13	11	0	24	61	2.5	Creamy
Gm + CPH	1	13	10	24	39	1.6	Milky
FS + CPM	14	10	0	24	62	2.6	Creamy
FS + CPH	19	5	0	24	67	2.8	Creamy
Total	**47**	**39**	**10**	**96**	**61**	**2.3**	Creamy

Table 7: Treatment effect on semen colour for Sahelian bucks

Variable	Creamy	Milky	Watery	Total Freq	Total Likert Sum	Likert Mean (3+2+1)/3=2 (accepted minimum standard)	Remarks
Ratings	**3**	**2**	**1**				
Gm + CPM	13	10	1	24	60	2.5	Creamy
Gm + CPH	0	14	10	24	38	1.6	Milky
FS + CPM	15	9	0	24	63	2.6	Creamy
FS + CPH	14	3	7	24	55	2.3	Creamy
Total	**47**	**39**	**10**	**96**	**61**	**2.3**	Creamy

Breed, season and treatment effects on semen colour using Likert analysis are depicted in Tables 3-7. Breed and season did not affect semen colour. Semen of the two breeds and for the four seasons was generally creamy. For treatment effect however, Gm+Cph resulted in milky semen in both breeds, but remained creamy for the other three treatments.

Although colour is part of semen/sperm quality parameters, it was analyzed separately using Likert procedure. This is because colour is a categorical variable (not amenable to the regular analysis) and unlike the other quality parameters it is not measured on a continuous scale. Semen colour variation however is a measure of differences in quality (Osinowo. 2006); Oyeyemi *et al.*, 2000).

Overall, the colour of semen in this study was creamy. This is consistent with the reports of Bearden and Fuquay (1997) and Oyeyemi *et al.,* (2011). Creamy semen colour i.e., darker than white is an indication of higher spermatozoa concentration unless it is due to contamination/disease (Ax *et al.,* 2004). For both breeds semen colour was also creamy. As already alluded to, this is an indication of good semen quality in them. Creamy coloured semen has also been observed in goats in some previous studies (Setchell *et al.,* 1993; Oyeyemi *et al.,* 2000, 2008). The colour of semen remained the same (creamy) throughout the seasons (except in Sahel in the late dry season). Arthur (1979) had also found consistent goat semen colour throughout the seasons of the year.

The only different semen colour (white) with treatment was observed for the Gm + Cph diet. This indicates that, this treatment might not have been suitable for sperm colour and other qualities associated to it (colour). The generally constant colour despite different treatment is in agreement with Dias *et al.* (2017), but disagrees with (Martin and Walkden-Brown, 1995). Ax *et al.* (2004) on the other hand, reported that, goats generally have yellowish semen.

CONCLUSION

In conclusion therefore the feed component had significant influence on breed differences considering the buck reproductive parameters under study. Similarly seasons influences all the male reproductive parameters by the feeds. The overall results on bases of semen colour was not affected by the feeds, however,

seasons and treatment diets had influence on the semen colour of Sahelian goats

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