

1 Crop-residue supplementation of pregnant does influences birth weight and weight
2 gains of kids, daily milk yield but not the progesterone profile of Red Sokoto goats
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20 SHORT TITLE: Liveweight, lactation and reproduction in goats
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1 Abstract

2 Parameters investigated in this study with the objective of evaluating growth, lactation and
3 reproductive performances, included birth weight, litter size, 0-90 days gain and average daily gain
4 of kids as well as milk yield and progesterone profile of Red Sokoto does supplemented with crop -
5 residue based rations during the long-dry period of the subhumid zone in Nigeria . A total of 7
6 treatments of 4 goats each was utilized. All treatment groups had a basal diet of *Digitaria smutsii*
7 hay and natural pasture ad libitum. Ration A, the conventional concentrate was used as the
8 positive control; rations B and C were crop residue-based supplements; and ration D without
9 supplement was used as the negative control. Supplementation with concentrate and crop
10 residues significantly increased ($P<0.05$) the birth weight and liveweight gains of kids, but litter size
11 was unaffected. The heaviest kids at birth (1.3-1.4 Kg) were from does in treatments 1A, 2A and
12 2C, while does in treatments 1B, 2B, 1C and D had the lightest kids (1.07-1.18 Kg). The highest
13 daily gains of 53.9g/day were recorded in kids in treatment 2A and the least (32.4g/day) in
14 treatment 1B. Supplementation also significantly influenced ($P<0.01$) the daily milk yield of dams
15 over the 90-day period of the dry season . All the does had similar progesterone profiles from late
16 gestation through parturition to early lactation irrespective of their treatment group. It was
17 concluded that ration C fed at 2% level is a good and affordable supplementary feed package for
18 increased birth weight and preweaning gains in kids for meat production.

19 KEYWORDS: Red Sokoto goats, supplementation, weight gains, milk, progesterone

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1. INTRODUCTION

The success of any livestock production enterprise depends largely, on adequate and qualitative nutrition. The majority of small ruminant farmers in Nigeria practice the extensive system of management which does not make provision for adequate feeding. In the northern region of Nigeria where most of the nation's livestock are concentrated, there is a long and pronounced dry season lasting for six to nine months, often causing serious feed shortages for animals. The prolonged dry season and high temperatures are also accompanied by rapid deterioration in the nutrient quality of available pasture hence, the basic nutritional requirements of the animals during pregnancy or lactation are not met [1]. The majority of Nigerian smallholder goat farmers resort to the easily available, cheap and abundant crop-residues from post-harvest farm operations to feed their animals instead of using the expensive, conventional concentrate ration. These crop residues are also limiting in nutrients necessary for maintenance and production. Therefore, supplementary feeding to boost the nutritional status of the animals has been advocated [2]. However, feed supplementation packages for improving reproductive and lactation performance of small ruminants during the long dry periods of the year are currently not available in Nigeria. Progesterone is the most important reproductive hormone necessary for the initiation and maintenance of pregnancy in female animals. Not much is known about the progesterone profiles of Red Sokoto does during late pregnancy, at parturition and during the early lactation period when the animals are supplemented with crop-residue rations, thus justifying the need for this study and its potential benefit to goat production in Nigeria. Therefore, this study was undertaken to investigate the effect of crop residue supplementation on the birth weight, 0-90 days gain and average daily gains in kids as well as daily milk yield and progesterone profile from late gestation through parturition to early lactation of the Red Sokoto doe.

1 2. MATERIALS AND METHODS

2 2.1. Experimental location

3 The experiments were conducted in the Experimental Unit of the Small Ruminant Research
4 Programme of the National Animal Production Research Institute, Shika, Zaria, Nigeria. Shika falls
5 between latitudes 11 and 12°N and between longitudes 7 and 8°E, with an altitude of 640m above
6 sea level. Shika is located within the Northern Guinea Savannah Zone with an average annual
7 rainfall and temperature of 1,107 mm and 24.4°C respectively. The seasonal distribution of the
8 annual rainfall is approximately 0.1% (11.0 mm) in the late-dry season (January-March), 25.8%
9 (285.6 mm) in the early-wet season (April-June), 69.6% (770.4 mm) in the late-wet season (July-
10 September) and 4.5 % (49.8 mm) in the early dry season (October -December). The experiments
11 were conducted during the dry seasons (between October and March).

12

13 2.2. Crop residue selection and preparation

14 The crop residues used in this study were guinea-corn bran, maize offal, cowpea husks, groundnut
15 shells and groundnut haulms as depicted in Table 1. They were selected because they were easily
16 available, abundant, cheap and easy to process. These residues were bought in bulk from an
17 open market. To aid consumption and digestibility, the groundnut shells were crushed before
18 inclusion into the ration. All the crop residues were stored in a well-ventilated barn and required
19 amounts compounded every fortnight to maintain freshness.

20 2.3. Animals, experimental rations and management

21 Twenty-eight adult Red Sokoto does with an average liveweight of $28 \pm 3.5\text{kg}$ were used for this
22 study. Besides the negative control, the other 6 treatments consisting of three experimental rations
23 (A, B, C) and 2 feeding levels (1 and 2% of body weight) for each ration were arranged as a 3 x 2

factorial design. Thus, a total of 7 treatments of 4 goats each were utilized after balancing the animals for weight. All treatment groups had a basal diet of *Digitaria smutsii* hay and natural pasture ad libitum. Ration A the conventional concentrate ration, was used as the positive control, Rations B and C were the two crop residue based test rations, while Ration D the unsupplemented treatment, was used as the negative control. Does in treatment 1A had conventional concentrate at 1% of their body weight, those in treatment 2A also had conventional concentrate but at 2% of their body weight. Animals in treatments 1B, 2B, 1C and 2C were those fed the two crop-residue test rations B and C at 1% and 2% of body weight respectively. In terms of management, all animals were routinely dewormed with anthelmintic drugs (Ivomec and thiabendazole) and dipped in an acaricide (Asuntol) solution against ectoparasites. The animals were fed for two hours each day between 0800-1000 hrs with the appropriate ration. Feed was weighed before offering it to individual animals. The left-over was again weighed at the end and the difference between what was offered and the residual was taken as feed intake. Thereafter, they were released into a specified paddock to graze natural pastures and *Digitaria smutsii* hay ad libitum under the supervision of a herdsman until 1800 hrs. The animals were housed in well-ventilated pens during the night. The rations in all the groups were subjected to digestibility trials prior to being fed to the experimental animals as described below.

2.4. Digestibility measurement: Red Sokoto does (n=28) ranging between 24.6 and 26.4 kg were used for the digestibility trial. Each doe was individually offered its appropriate corresponding ration to evaluate the digestibility of the diets. The study comprised a two-week preliminary period of realimentation and adjustment, and one week of sample collection. The animals were housed in individual metabolism cages with facilities for separate collection of faeces and urine. The animals

1 were weighed at the beginning and end of the study. Faeces were collected each morning just
2 before feeding. 10% of each daily faecal output was collected from which sub-samples were
3 bulked for chemical analyses. Samples of the different rations fed were taken daily and bulked,
4 from which sub-samples were taken for laboratory analysis. Also, samples of the individual feed
5 ingredients were analysed in the laboratory. Water was made available to the animals ad libitum.
6 The inventory, abundance and palatability of the plant species in the grazed paddock has been
7 described by Lakpini et al. [3].

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9 2.5 Kid weight and milk sampling: The animals were fed from the last trimester of pregnancy to
10 parturition. At parturition, the doe and its kid(s) were separated into an individual pen. The kids
11 were weighed within 8 hours after birth and subsequently once every week until they were weaned.
12 Dams were also weighed weekly starting from 20 days postpartum, until the end of the study.
13 Measurements for milk yield commenced from day 7 postpartum to allow kids have access to all
14 their dams' colostrum. The two halves of the udder of each lactating doe were hand-milked early in
15 the morning. The quantity of milk collected at each milking was recorded and does were monitored
16 from a week after delivery to the last day of milk let-down when the total lactation length was
17 recorded. Milk samples were collected twice daily (morning and evening) from 7 days postpartum
18 to 90 days after parturition.

19 2.6 Blood sampling: Blood samples (10 ml) for progesterone assay were collected from each doe
20 by jugular venipuncture twice a week during the last trimester of pregnancy. The blood samples
21 were allowed to clot within two hours of collection and the sera decanted into plastic tubes and
22 stored at -20°C until assayed.

2.7 Chemical analyses: Proximate analyses of feed and faecal samples were carried out by the AOAC methods [4]. Dry matter of samples was determined in an oven at 105°C for 48 hours. Nitrogen determination was by the Micro Kjeldahl method, while the Soxhlet extraction procedure was used for ether extraction. Crude fibre was determined by alternate refluxing with weak solutions of H₂SO₄ and KOH. The detergent fibre fractions (Neutral detergent fibre, acid detergent fibre and lignin) were determined according to Goering and Van Soest [5].

2.8 Hormonal assay of sera and milk samples: Progesterone concentration in the sera and milk samples was determined by the radio-immunoassay procedure using the solid phase coated tube system employing ¹²⁵I as tracer supplied in kit form by the Joint FAO/IAEA Division, Agriculture Laboratory, Siebersdorf. The assay procedure was as follows:

To antibody coated tubes, 100 µl of standard (0.1 to 40 ng/ml) of sample and 1ml buffered [¹²⁵I] labelled progesterone solution was added. The mixture was incubated for 3 hours at room temperature, the liquid phase discarded (centrifugation is not required) and the radioactivity bound to the antibody-coated tube counted. The immunogen used to raise the antibody and radioiodinated progesterone (tyrosine methyl ester) are both α-linked conjugates. The cross-reactivity, 3.8%, was with α-hydroxy progesterone [6]. The sensitivity of the assay defined as twice the standard deviations away from the zero standard was 0.08ng/ml. The within and between assay coefficients of variation were 8.5% and 9.5% respectively. The potencies of the samples were estimated using a linear logit-log dose response curve.

2.9 Calculations and Statistical analysis: Dry matter intake (DMI) was determined using the following equation:

$$\text{DMI (g/day)} = \% \text{DM}/100 \times \text{feed intake.}$$

Dry matter digestibility (DMD (%)) was calculated as:

100 x [DM intake (g) – DM output (g)] /DM intake (g)]. The other digestibilities were calculated as above. Data on kid birth weight and weight gains, dam's daily milk yield and peripheral progesterone concentrations were statistically analysed using the general linear models procedure (PROC GLM) of SAS [7] in a 3 x 2 factorial (3 rations and 2 feeding levels) analysis to test for significant differences between means. The model below was utilised:

$$Y_{ijk} = \mu + R_i + F_j + (RF)_{ij} + b_1(w_{ijk} - \bar{w}) + e_{ijk}$$

where Y_{ijk} = dependent variable of the k^{th} doe on the i^{th} ration and the j^{th} feeding level,

μ = the overall mean,

R_i = fixed effect of the i^{th} ration ($i=1, 3$),

F_j = fixed effect of the j^{th} feeding level ($j=1, 2$),

$(RF)_{ij}$ = interaction between the i^{th} ration and j^{th} feeding level,

b_1 = partial regression coefficient of initial body weight with mean \bar{w} ,

\bar{w} = initial body weight fitted as a covariate,

e_{ijk} = random error associated with each record with a mean of 0 and variance σ_e^2 .

Primary and secondary interactions of fixed effects with initial body weight were also tested but later dropped from the model as all the interactions were not significant, mainly because all the animals were as much as possible, balanced for initial weight and age at the start of the experiment. The contrast option of Tukey test was used for mean separation where significant differences ($P<0.05$) were established between treatments.

3. RESULTS

3.1. Feed intake and digestibility

Tables 1, 2, 3 and 4 show the component of ingredients, chemical composition of the major feed ingredients, chemical composition of the experimental diets and their digestibilities respectively. Ration A had the highest crude protein (CP) of 17.19%, rations B and C had 9.54 and 10.38% respectively, while ration D had the least with *Digitaria smutsii* hay and natural grazed pastures having 4.75 and 2.76% respectively (Table 3). There were differences ($P<0.05$) in nutrient intake, digestibility and cost of feeds between the different treatment groups (Table 4). The Table shows that generally, the supplemented groups had significantly higher ($P<0.05$) DM and CP intakes and digestibilities than the unsupplemented group except animals on Ration B that had similar values to the unsupplemented group. It was also evident that increasing the level of supplementation also resulted in increased DM and CP intakes of all the experimental rations, with these increases being significant ($P<0.05$) and similar for Rations A and C. It was also observed that supplementation increased the digestibility of all the nutrients. However, animals on Ration B recorded very poor digestibility values and their counterparts in the unsupplemented group had the least. Ration 1A (the conventional concentrate at 1% of body weight) gave the highest digestibility values; a comparison of the unsupplemented animals with all the other treatment groups reveals that DM digestibility improved by a range of 4.1 to 27.9% and CP digestibility by 17.1 to 42.2%, the highest being in animals on ration 1A. Similar improvements trends were also noticeable for neutral detergent fibre (NDF) and acid detergent fibre (ADF). A simple economic analysis (Table 4) revealed that the conventional concentrate feed was the most expensive for supplementation particularly, at the 2% level (4.42 naira per animal per day). Of the two tested crop-residue rations, Ration 1B was significantly cheaper ($P<0.05$) than Rations 2B and 2C, but similar to Ration 1C.

3.2 Influence of supplementation on kid birth weight and weight gains, litter size and milk yield

Portrayed in Table 5 was evidence that there was a highly significant ($P<0.01$) effect of feed supplementation during gestation on the birth weight of kids whereas litter size was unaffected ($P>0.05$). Does on ration 2A had the heaviest kids (1.4 Kg) at birth, followed by kids whose dams were fed on ration 2C (1.34 Kg). Does on ration 2B had the lightest kids at birth (1.07 Kg) but this was not significantly different from the birth weights of kids whose dams fed on rations 1B, 1C and D. It was also evident that supplementation significantly ($P<0.001$) increased dam's daily milk yield in that does on ration 2A gave 0.62 Kg of milk per day (not significantly different from the 0.60 Kg/day from does on ration 1C), compared to the lowest milk yield of 0.25 Kg per day from the unsupplemented does (ration D). There were significant differences in the liveweights and gains of kids as they advanced in age. At 30 days of age (WT30), kids of does fed ration 2A were significantly ($P<0.01$) heavier than all the others. This weight advantage was consistently maintained through 60 (WT60) to 90 (WT90) days of age with kids weighing 4.70 and 6.25 Kg respectively. This superiority over the other treatment groups was also reflected in the average daily gain (ADG) of 53.88g. However, kids from does fed crop-residue test rations 1C ranked next with WT30, WT60, WT90 and ADG values of 2.55, 3.85, 5.88 Kg and 53.00 g/day respectively. It was also consistently evident that kids from dams that were unsupplemented (ration D) and those fed crop-residue test rations 1B and 2B recorded the least weights and average daily gains.

3.3 Progesterone profile

Hormonal assay results shown in Table 6 reveal that right from late gestation through parturition to early lactation, progesterone profile was remarkably similar for all does irrespective of treatment groups. The progesterone (P_4) concentrations were quite high in late gestation with an average value of 13 ng/ml (Table 6) and the highest value of 17.08 ng/ml at day 140. At parturition, the P_4

concentration dropped sharply to an average of 0.10 ng/ml, then rose slowly in early lactation to 0.18 ng/ml. However, there were no significant supplementation effects on progesterone profiles of the does.

4. DISCUSSION

4.1. Ration intake and digestibility: The preponderance of crop residues in Rations B and C was responsible for their high crude fibre and lignin levels compared to the conventional concentrate ration A. The current study showed that in spite of Rations B and C being isocaloric and isonitrogenous, animals on Ration C had better intakes and digestibilities than those on Ration B, possibly due to the low palatability, hence low voluntary intake, and poor digestibility of Ration B.

The observed higher digestibilities of DM, CP, NDF and ADF at 1% level in comparison to 2% level can be attributed to the higher feed intake at the 2% level of inclusion. It has been established that higher feed intake results in a faster rate of passage of digesta from the reticulo - rumen [8]. This does not allow for effective degradation, hence lowering the digestibility of feed. Increasing the level of crop residue inclusion in the diet also increases the amount of lignin, which depresses the digestibility of the ration [9], because the rate of microbial colonisation of a feed with high fibre content is comparatively lower [10]. The poor intake and digestibility values obtained for the unsupplemented animals is due to the fact that Ration D was of low quality as a result of its high NDF and lignin contents. This shows that there is the need for dry season supplementation in goats because the available feeds at that time are limiting in crude protein.

Of the two tested rations, Ration C seemed to have produced better intakes and digestibilities in the animals, possibly due to the composition of the rations. It contained maize offal which has very low fibre content [2], groundnut haulms which have been demonstrated to be better

quality roughages than *Digitaria smutsii* hay and contain adequate protein to maintain ruminants without any form of supplementation during the periods of feed scarcity [11]. The groundnut shells fed to the animals were also crushed before inclusion into the ration as earlier stated. This must have aided their consumption and digestibility. Even though Ration B contained groundnut haulms, the combination of Guinea corn bran and cowpea husk which had low crude protein percentages, must have reduced the intake and digestibility of the ration. Alhassan et al. [12] observed lower digestibility values in sheep and goats (48.8 and 56.3% respectively) compared with cattle (73.6%) when they fed them cowpea vines. This might imply that cattle do better on cowpea residues than small ruminants. Generally speaking, digestibility of feeds in cattle is lower than that in sheep or goats under similar conditions because of the higher rate of passage from the rumen in cattle than sheep or goats. From the economic analysis, the high cost of the conventional concentrate ration shows that it is beyond the reach of a typical smallholder goat farmer; whereas the crop-residue based rations seem quite affordable. Even though Ration B had the least cost, it was glaring that it had lower intake and digestibility compared to Ration C, indicating in essence, that Ration C had a better efficiency of utilisation.

4.2 Birth weight and weight gains of kids

The importance of supplementation during the last lap of pregnancy is confirmed in this study with does on ration 2A producing the heaviest kids at parturition compared to the unsupplemented does (ration D) having the lightest kids at birth. However, dams fed ration 1A and 2C also had kids with similar birth weights as ration 2A.

1 The growth rate of kids was influenced by the type of ration offered to their dams during
2 lactation, and the average daily gain was found to be lowest (32.44 g/day) in kids from dams fed
3 ration 1B and highest in ration 2A (53.88 g/day). As t he kids advanced in age from birth to 90 days,
4 the effect of dam supplementation was reflected in their liveweight gains in agreement with the
5 report of Ahmed et al. [13]. The highest ADG value of 53.88 g/day in this study fell within the range
6 of 64g/day reported in West African Dwarf does [14, 15, 16], but much lower than 150g/day in
7 Yankasa lambs [17]. The lower values in this study are justifiable given the fact that it was
8 conducted in the long-dry season of the year when naturally grazed pasture and f eed resources
9 are critically low. The average littersize of 1.3 reported herein is similar to the findings of Adu et al.
10 [1]. The observation that supplementation did not affect littersize agrees with that of Sibanda et al.
11 [18], indicating that littersize may be controlled more by genetic, rather than nutritional, factors.

12 The effects of various crop residues on feed intake, liveweight gains and growth
13 performance of ruminants have been reported by Adu and Lakpini [19, 20] and Ikhatua and Adu
14 [11]. Adu and Lakpini [20] obtained liveweight gains of 90.2 g per day in Yankasa lambs fed sole
15 diet of unchopped groundnut haulms. In the study by Ikhatua and Adu [11], supplementation of
16 groundnut haulms with concentrate further enhanced intake and performance of th e animals.
17 Similar effects of supplementation have been observed in this study.

18 The observation that birth weight in ration 2C was higher than that of 1C but the
19 subsequent growth thereafter was reversed (Table 5) was probably as a result of the incidence of
20 scouring (diarrhea) that occurred in kids on ration 2C. The weight losses observed in does fed
21 rations 1B and D could be attributed to the low palatability, low intake and poor digestibility of the
22 feeds.

4.2 Daily milk yield of dams

This study also confirms that the milk yield of does can be improved by supplementing their pasture diets with some concentrates [21]. The observed values of daily milk yield in does fed rations 2A and 1C were higher than those reported by Adu et al. [1], Akinsoyinu et al. [22] and Ehoche and Buvanendran [16]. This increase in milk yield may be due to improvement as a result of selection over the years within the Red Sokoto breed. The inference that can be drawn from this observation is that feeding lactating does on ration 1C irrespective of the fact that it is a mainly crop residue ration, gives just as good a result in terms of daily milk yields, as full concentrate rations. This holds hope for smallholders interested in improving the milk yield of their Red Sokoto dams without necessarily embarking on an expensive concentrate ration. It was expected that ration 2C with a higher dry matter intake in comparison with ration 1C (Table 4) would give a higher milk yield, but the reverse was the case (Table 5). The reason was because the fat content of the milk from does on ration 2C was higher than that of does on ration 1C [23, 24]. There is an inverse relationship between total milk yield and fat content in lactating animals [25] which explains why this trend was observed. This suggests that if Nigerian goat producers in the subhumid zone intend to place more emphasis on total milk yield rather than fat content of the milk, then going by our results in this study, ration C fed at 1% level of inclusion is better than at 2% level.

4.3 Progesterone profile during late pregnancy, at parturition and early lactation

This study indicated that level of supplementation does not affect progesterone profile and concentration from the last trimester of gestation to early lactation (Table 6). This may mean that the endocrine system is resilient to nutritional stress at this period. Progesterone plays a major role in the development, the luteolytic signal and maintenance of regular ovarian cycles. Therefore, progesterone can probably inhibit the development of the luteolytic mechanism until endometrial

progesterone receptor activity is lost [26]. However, more studies are required to ascertain the effect of undernutrition on the endocrine changes occurring in the Red Sokoto doe through gestation to early lactation.

In conclusion, this study has demonstrated that ration C elicited as much favourable response in the birth weight and liveweight of Red Sokoto kids, the daily milk yield of their dams as the conventional concentrate ration A which may be too expensive for the local farmer to purchase. Furthermore, in this experiment, the ration differences did not affect plasma progesterone concentration and profile during late gestation through to early lactation.

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1 Table 1. Component of ingredients in the experimental rations

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Ration	Ingredients	% inclusion
A + basal diet	Maize	40.0
	Wheat offal	35.0
	Cottonseed cake	20.0
	Bone meal	3.0
	Salt	2.0
B + basal diet	Guinea-corn bran	39.5
	Cowpea husk	30.0
	G/Nut haulms	30.0
	Salt	0.5
C + basal diet	Maize offal	49.5
	Ground nut shells	20.0
	Groundnut haulms	30.0
	Salt	0.5
D (basal diet)	Digitaria hay and natural grazed pasture	ad libitum

3 Ration A = Conventional concentrate (positive control).

4 Ration B = Crop-residue test Ration 1.

5 Ration C = Crop-residue test Ration 2.

6 D = Unsupplemented group (negative control) that was the basal diet common to all treatments

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1 Table 2. Chemical composition of the major feed ingredients (DM basis) (%)

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Feedstuff	DM	CP	CF	Ash	EE	NFE
(n=7 samples/ingredient each)						
Maize	90.73	9.56	2.20	9.67	4.05	74.52
Wheat offal	87.60	16.90	11.30	6.40	3.80	61.60
Cottonseed cake	93.60	29.94	23.50	5.16	5.76	35.64
Bone meal	75.00	36.00	3.00	49.00	4.00	8.00
Guinea corn bran	93.33	7.60	24.80	6.95	3.01	59.90
Cowpea husks	91.41	7.10	33.40	7.14	0.65	58.91
Groundnut haulms	93.65	15.63	23.26	8.00	2.43	51.00
Maize offal	89.07	10.08	1.50	0.80	1.70	60.30
Groundnut shells	96.05	5.90	31.80	8.50	1.31	50.30

3 DM = Dry matter, CP=Crude protein, CF=Crude fibre, EE=Ether extract, NFE=Nitrogen-free extracts

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1 Table 3. Chemical composition of the experimental diets (dry matter basis) (%)

Ration	DM	CP	Ash	EE	ADF	NDF	LIGNIN
(n=7 samples/ration each)							
Ration A	93.87	17.19	13.85	14.08	20.00	40.01	4.64
Ration B	94.97	9.54	10.55	10.43	38.10	68.42	8.94
Ration C	95.94	10.38	11.97	12.45	36.65	54.74	8.23
Ration D (Hay)	94.78	4.75	8.47	2.40	49.14	74.73	9.49
Ration D (Natural pastures)	96.26	2.76	7.02	0.78	50.29	80.27	11.50

2 Calculated analysis of the experimental rations

	Ration A	Ration B	Ration C
CP (%)	17.05	9.82	10.85
ME (MJ /Kg DM)	11.17	10.29	10.17

3 The ME values of the experimental rations were calculated as per Alderman [27] as follows:

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$$ME (MJ/kg DM) = 11.78 + 0.00654CP + (0.000665EE)^2 - CF(0.00414EE) - 0.0118A$$

5 where CP = Crude Protein, EE = Ether Extract, CF = Crude Fibre, A = Ash

6 DM = Dry matter, ADF=Acid detergent fibre, NDF=Neutral detergent fibre

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1 Table 4. Mean nutrient intake, apparent digestibility and cost of the experimental diets

Treatment	1A	2A	1B	2B	1C	2C	D	SEM
<u>Nutrient intake (Kg/day)</u>								
DM	0.24 ^b	0.47 ^a	0.21 ^{bc}	0.30 ^{ab}	0.23 ^b	0.42 ^a	0.15 ^c	± 0.02
CP	0.044 ^a	0.087 ^a	0.012 ^b	0.017 ^b	0.032 ^a	0.072 ^a	0.009 ^b	± 0.01
<u>Apparent digestibility of nutrients (%)</u>								
DM	84.3 ^a	83.0 ^a	62.5 ^d	60.5 ^e	75.8 ^b	67.8 ^c	56.4 ^f	± 2.8
CP	90.6 ^a	89.2 ^a	69.5 ^d	65.5 ^e	82.7 ^b	78.1 ^c	48.4 ^f	± 3.1
NDF	69.5 ^a	66.6 ^b	62.1 ^{cd}	61.9 ^d	65.9 ^b	63.7 ^c	60.1 ^e	± 3.2
ADF	51.7 ^a	49.8 ^a	43.9 ^{bc}	42.8 ^c	46.1 ^b	44.4 ^{bc}	42.3 ^{bc}	± 5.0
<u>Economic analysis of the feeds (Naira) *</u>								
Cost of feed consumed per day	2.19 ^b	4.42 ^a	0.50 ^e	1.06 ^d	0.83 ^{de}	1.55 ^c	-	± 0.15

2 a,b,c,d,e,f means within the same row bearing different superscript letters differ significantly
3 (P<0.05)

4 Naira = Nigerian currency (100 kobo make 1 naira and current exchange rate is 1US\$ = 140 Naira)

5 DM = Dry matter, CP=Crude protein, NDF=Neutral detergent fibre, ADF=Acid detergent fibre

6 Treatment 1A = Ration A (Conventional concentrate) offered at 1% of body weight.

7 2A = Ration A (Conventional concentrate) offered at 2% of body weight.

8 1B = Crop-residue test ration B offered at 1% of body weight.

9 2B = Crop-residue test ration B offered at 2% of body weight.

10 1C = Crop-residue test ration C offered at 1% of body weight.

11 2C = Crop-residue test ration C offered at 2% of body weight.

12 D = Unsupplemented group

Table 5. Effect of ration supplementation of Red Sokoto does on daily milk yield, litter size, birth weight, 0-90 days weight gain and average daily gains of their kids (\pm s.e.m).

Ration	Dam's milk yield (Kg/day)	Littersize	BWT (Kg)	WT30 (Kg)	WT60 (Kg)	WT90 (Kg)	ADG (g/day)
1A	0.48 ^b	1.34	1.3 ^a	2.33 ^b	3.50 ^b	5.54 ^{ab}	47.11 ^b
2A	0.62 ^a	1.32	1.4 ^a	3.30 ^a	4.70 ^a	6.25 ^a	53.88 ^a
1B	0.27 ^d	1.34	1.09 ^b	1.95 ^b	3.09 ^b	4.01 ^c	32.44 ^d
2B	0.36 ^c	1.30	1.07 ^b	2.04 ^b	3.05 ^b	4.33 ^c	36.11 ^c
1C	0.60 ^a	1.31	1.11 ^b	2.55 ^b	3.85 ^{ab}	5.88 ^{ab}	53.00 ^a
2C	0.45 ^b	1.32	1.34 ^a	2.20 ^b	3.45 ^b	5.33 ^b	44.33 ^b
D	0.25 ^d	1.31	1.18 ^b	1.88 ^b	2.98 ^c	4.16 ^c	33.11 ^d
s.e.m.	\pm 0.02	\pm 0.09	\pm 0.16	\pm 0.21	\pm 0.30	\pm 0.27	\pm 0.17

Column means bearing different superscripts differ from each other significantly ($P < 0.01$)

BWT = birth weight, WT30, WT60, WT90 are liveweights at 30, 60 and 90 days,

ADG = average daily gain

Ration symbols as described in Table 4

1 Table 6. Progesterone concentration (ng/ml) during late gestation, pre -partum, at parturition and post -
2 partum (\pm SEM) in Red Sokoto does supplemented with crop residue rations.
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Ration	Late gestation (day 120 - day140)	Pre-partum (day 6 – day 2)	Parturition (day 0)	Post-partum (day 1 – day 15)
1A	13.03	8.90	0.09	0.17
2A	12.98	9.06	0.09	0.16
1B	13.04	9.05	0.11	0.20
2B	12.98	8.92	0.09	0.18
1C	12.92	8.94	0.09	0.19
2C	12.88	9.04	0.10	0.17
D	13.05	8.98	0.10	0.18
SEM	\pm 0.45	\pm 0.22	\pm 0.05	\pm 0.11

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