1 2 3	Crop-residue supplementation of pregnant does influences birth weight and weight gains of kids, daily milk yield but not the progesterone profile of Red Sokoto goats
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19 20 21 22	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 littersize 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 1. INTRODUCTION

2 The success of any livestock production enterprise depends largely, on adequate and qualitative 3 nutrition. The majority of small ruminant farmers in Nigeria practice the extensive system of 4 management which does not make provision for adequate feeding. In the northern region of 5 Nigeria where most of the nation's livestock are concentrated, there is a long and pronounced dry 6 season lasting for six to nine months, often causing serious feed shortages for anim als. The 7 prolonged dry season and high temperatures are also accompanied by rapid deterioration in the 8 nutrient guality of available pasture hence, the basic nutritional requirements of the animals during 9 pregnancy or lactation are not met [1]. The majority of Nigerian smallholder goat farmers resort to 10 the easily available, cheap and abundant crop-residues from post-harvest farm operations to feed 11 their animals instead of using the expensive, conventional concentrate ration. These crop residues 12 are also limiting in nutrients necessary for maintenance and production. Therefore, supplementary 13 feeding to boost the nutritional status of the animals has been advocated [2]. However, feed 14 supplementation packages for improving reproductive and lactation performance of small 15 ruminants during the long dry periods of the year are currently not available in Nigeria. 16 Progesterone is the most important reproductive hormone necessary for the initiation and 17 maintenance of pregnancy in female animals. Not much is known about the progesterone profiles 18 of Red Sokoto does during late pregnancy, at parturition and during the early lactation period when 19 the animals are supplemented with crop-residue rations, thus justifying the need for this study and 20 its potential benefit to goat production in Nigeria. Therefore, this study was undertaken to 21 investigate the effect of crop residue supplementation on the birth weight, 0-90 days gain and 22 average daily gains in kids as well as daily milk yield and progesterone profile from late gestation 23 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 Resear ch 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).

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13 2.2. Crop residue selection and preparation

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

20 2.3. Animals, experimental rations and management

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

1 factorial design. Thus, a total of 7 treatments of 4 goats each were utilized after balancing the 2 animals for weight. All treatment groups had a basal diet of Digitaria smutsii hay and natural 3 pasture ad libitum. Ration A the conventional concentrate ration, was used as the positive control, 4 Rations B and C were the two crop residue based test rations, while Ration D the unsupplemented 5 treatment, was used as the negative control. Does in treatment 1A had conventional concentrate 6 at 1% of their body weight, those in treatment 2A also had conventional concentrate but at 2% of 7 their body weight. Animals in treatments 1B, 2B, 1C and 2C were those fed the two crop-residue 8 test rations B and C at 1% and 2% of body weight respectively. In terms of management, all 9 animals were routinely dewormed with anthelmintic drugs (lyomec and thiabendazole) and dipped 10 in an acaricide (Asuntol) solution against ectoparasites. The animals were fed for two hours each 11 day between 0800-1000 hrs with the appropriate ration. Feed was weighed before offering it to 12 individual animals. The left-over was again weighed at the end and the difference between what 13 was offered and the residual was taken as feed intake. Thereafter, they were released into a 14 specified paddock to graze natural pastures and Digitaria smutsii hay ad libitum under the 15 supervision of a herdsman until 1800 hrs. The animals were housed in well-ventilated pens during 16 the night. The rations in all the groups were subjected to digestibility trials prior to being fed to the 17 experimental animals as described below.

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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

were weighed at the beginning and end of the study. F aeces were collected each morning just
before feeding. 10% of each daily faecal output was collected from which sub-samples were
bulked for chemical analyses. Samples of the different rations fed were taken daily and bulked,
from which sub-samples were taken for laboratory analysis. Also, samples of the individual feed
ingredients were analysed in the laboratory. Water was made available to the animals ad libitum.
The inventory, abundance and palatability of the plant species in the grazed paddock has been
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.

2.6 Blood sampling: Blood samples (10 ml) for progesterone assay were collected from each doe
by jugular venipuncture twice a week during the last trimester of pregnancy. The blood samples
were allowed to clot within two hours of collection and the sera decanted into plastic tubes and
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 Kjedahl 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].

7 2.8 Hormonal assay of sera and milk samples: Progesterone concentration in the sera and milk
8 samples was determined by the radio-immunoassay procedure using the solid phase coated tube
9 system employing ¹²⁵I as tracer supplied in kit form by the Joint FAO/IAEA Division, Agriculture
10 Laboratory, Siebersdof. The assay procedure was as follows:

11 To antibody coated tubes, 100 µl of standard (0.1 to 40 ng/ml) of sample and 1ml buffered [125] 12 labelled progesterone solution was added. The mixture was incubated for 3 hours at room 13 temperature, the liquid phase discarded (centrifugation is not required) and the radioactivity bound 14 to the antibody-coated tube counted. The immunogen used to raise the antibody and 15 radioiodinated progesterone (tyrosine methyl ester) are both 11 α -linked conjugates. The cross -16 reactivity, 3.8%, was with 11 α -hydroxy progesterone [6]. The sensitivity of the assay defined as 17 twice the standard deviations away from the zero standard was 0.08ng/ml. The within and between 18 assay coefficients of variation were 8.5% and 9.5% respectively. The potencies of the samples 19 were estimated using a linear logit log dose response curve.

20 2.9 Calculations and Statistical analysis: Dry matter intake (DMI) was determined using the21 following equation:

22 DMI (g/day) = %DM/100 x feed intake.

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

1 100 x [DM intake (g) – DM output (g)] /DM intake (g)]. The other digestibilities were calculated as 2 above. Data on kid birth weight and weight gains, dam's daily milk yield and peripheral 3 progesterone concentrations were statistically analysed using the general linear models procedure 4 (PROC GLM) of SAS [7] in a 3 x 2 factorial (3 rations and 2 feeding levels) analysis to test for 5 significant differences between means. The model below was utilised:

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7 $Y_{ijk} = \mu + R_i + F_j + (RF)_{ij} + b_1(w_{ijk} - w^-) + e_{ijk}$

8 where Y_{ijk} = dependent variable of the kth doe on the ith ration and the jth feeding level,

9 μ = the overall mean,

10
$$R_i$$
 = fixed effect of the ith ration (i=1, 3),

11 $F_j = fixed effect of the jth feeding level (j=1, 2),$

12 (RF)_{ij} = interaction between the ith ration and jth feeding level,

13 b_1 = partial regression coefficient of initial body weight with mean w⁻,

14 w = initial body weight fitted as a covariate,

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

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3. RESULTS

23 3.1. Feed intake and digestibility

1 Tables 1, 2, 3 and 4 show the component of ingredients, chemical composition of the major feed 2 ingredients, chemical composition of the experimental diets and their digestibilities respectively. 3 Ration A had the highest crude protein (CP) of 17.19%, rations B and C had 9.54 and 10.38% 4 respectively, while ration D had the least with Digitaria smutsii hay and natural grazed pastures 5 having 4.75 and 2.76% respectively (Table 3). There were differences (P<0.05) in nutri ent intake, 6 digestibility and cost of feeds between the different treatment groups (Table 4). The Table shows 7 that generally, the supplemented groups had significantly higher (P<0.05) DM and CP intakes and 8 digestibilities than the unsupplemented group except animals on Ration B that had similar values 9 to the unsupplemented group. It was also evident that increasing the level of supplementation also 10 resulted in increased DM and CP intakes of all the experimental rations, with these increases 11 being significant (P<0.05) and similar for Rations A and C. It was also observed that 12 supplementation increased the digestibility of all the nutrients. However, animals on Ration B 13 recorded very poor digestibility values and their counterparts in the unsupplemented group had the 14 least. Ration 1A (the conventional concentrate at 1% of body weight) gave the highest digestibility 15 values; a comparison of the unsupplemented animals with all the other treatment groups reveals 16 that DM digestibility improved by a range of 4.1 to 27.9% and CP digestibility by 17.1 to 42.2%, the 17 highest being in animals on ration 1A. Similar improvements trends were also noticeable for 18 neutral detergent fibre (NDF) and acid detergent fibre (ADF). A simple economic analysis (Table 4) 19 revealed that the conventional concentrate feed was the most expensive for supplementation 20 particularly, at the 2% level (4.42 naira per animal per day). Of the two tested crop -residue rations, 21 Ration 1B was significantly cheaper (P<0.05) than Rations 2B and 2C, but similar to Ration 1C. 22

23 3.2 Influence of supplementation on kid birth weight and weight gains, littersize and milk yield

1 Portrayed in Table 5 was evidence that there was a highly significant (P<0.01) effect of feed 2 supplementation during gestation on the birth weight of kids whereas litter size was unaffected 3 (P>0.05). Does on ration 2A had the heaviest kids (1.4 Kg) at birth, followed by kids whose dams 4 were fed on ration 2C (1.34 Kg). Does on ration 2B had the lightest kids at birth (1.07 Kg) but this 5 was not significantly different from the birth weights of kids whose dams fed on rations 1B, 1C and 6 D. It was also evident that supplementation significantly (P<0.001) increased dam 's daily milk yield 7 in that does on ration 2A gave 0.62 Kg of milk per day (not signi ficantly different from the 0.60 8 Kg/day from does on ration 1C), compared to the lowest milk yield of 0.25 Kg per day from the 9 unsupplemented does (ration D). There were significant differences in the liveweights and gains of 10 kids as they advanced in age. At 30 days of age (WT30), kids of does fed ration 2A were 11 significantly (P<0.01) heavier than all the others. This weight advantage was consistently 12 maintained through 60 (WT60) to 90 (WT90) days of age with kids weighing 4.70 and 6.25 Kg 13 respectively. This superiority over the other treatment groups was also reflected in the average 14 daily gain (ADG) of 53.88g. However, kids from does fed crop -residue test rations 1C ranked next 15 with WT30, WT60, WT90 and ADG values of 2.55, 3.85, 5.88 Kg and 53.00 g/day res pectively. It 16 was also consistently evident that kids from dams that were unsupplemented (ration D) and those 17 fed crop-residue test rations 1B and 2B recorded the least weights and average daily gains.

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19 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 (P₄) 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 P₄

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.

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5 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 inspite 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 volu ntary intake, and poor digestibility of Ration B.

11 The observed higher digestibilities of DM, CP, NDF and ADF at 1% level in comparison to 12 2% level can be attributed to the higher feed intake at the 2% level of inclusion. It has been 13 established that higher feed intake results in a faster rate of passage of digesta from the reticulo -14 rumen [8]. This does not allow for effective degradation, hence lowering the digestibility of feed. 15 Increasing the level of crop residue inclusion in the diet also increases the amount of lignin, which 16 depresses the digestibility of the ration [9], because the rate of microbial colonisation of a feed with 17 high fibre content is comparatively lower [10]. The poor intake and digestibility values obtained for 18 the unsupplemented animals is due to the fact that Ration D was of low quality as a result of its 19 high NDF and lignin contents. This shows that there is the need for dry season supplementation in 20 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

1 quality roughages than Digitaria smutsii hay and contain adequate protein to maintain ruminants 2 without any form of supplementation during the periods of feed scarcity [11]. The groundnut shells 3 fed to the animals were also crushed before inclusion into the ration as earlier stated. This must 4 have aided their consumption and digestibility. Even though Ration B contained groundnut haulms, 5 the combination of Guinea corn bran and cowpea husk which had low crude protein percentages, 6 must have reduced the intake and digestibility of the ration. Alhassan et al. [12] observed lower 7 digestibility values in sheep and goats (48.8 and 56.3% respectively) compared with cattle (73.6%) 8 when they fed them cowpea vines. This might imply that cattle do better on cowpea residues than 9 small ruminants. Generally speaking, digestibility of feeds in cattle is lower than that in sheep or 10 goats under similar conditions because of the higher rate of passage from the rumen in cattle than 11 sheep or goats. From the economic analysis, the high cost of the conventional concentrate ration 12 shows that it is beyond the reach of a typical smallholder goat farmer; whereas the crop-residue 13 based rations seem guite affordable. Even though Ration B had the least cost, it was gl aring that it 14 had lower intake and digestibility compared to Ration C, indicating in essence, that Ration C had a 15 better efficiency of utilisation.

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19 4.2 Birth weight and weight gains of kids

The importance of supplementation during the last lap of pregn ancy 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 the 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.

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

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

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1 4.2 Daily milk yield of dams

2 This study also confirms that the milk yield of does can be improved by supplementing their 3 pasture diets with some concentrates [21]. The observed values of daily milk yield in does fed 4 rations 2A and 1C were higher than those reported by Adu et al. [1], Akinsoyinu et al. [22] and 5 Ehoche and Buvanendran [16]. This increase in milk yield may be due to improvement as a result 6 of selection over the years within the Red Sokoto breed. The inference that can be drawn from this 7 observation is that feeding lactating does on ration 1C irrespective of the fact that it is a mainly 8 crop residue ration, gives just as good a result in terms of daily milk yields, as full concentrate 9 rations. This holds hope for smallholders interested in improving the milk yield of their Red Sokoto 10 dams without necessarily embarking on an expensive concentrate ration. It was expected that 11 ration 2C with a higher dry matter intake in comparison with ration 1C (Table 4) would give a 12 higher milk yield, but the reverse was the case (Table 5). The reason was be cause the fat content 13 of the milk from does on ration 2C was higher than that of does on ration 1C [23, 24]. There is an 14 inverse relationship between total milk yield and fat content in lactating animals [25] which explains 15 why this trend was observed. This suggests that if Nigerian goat producers in the subhumid zone 16 intend to place more emphasis on total milk yield rather than fat content of the milk, then going by 17 our results in this study, ration C fed at 1% level of inclusion is better than at 2% level.

18 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

8 concentration and profile during late gestation through to early lactation.

9

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1 Table 1. Component of ingredients in the experimental rations

2				
	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	ad libitum	
	, , , , , , , , , , , , , , , , , , ,	natural grazed pasture		
3	Ration A = Conventiona	al concentrate (positive co	ntrol).	
4	Ration B = Crop-residu	e test Ration 1.		
5	Ration C = Crop-residu	ue test Ration 2.		
6	D = Unsuppleme	ented group (negative con	trol) that was the basal die	t common to all treatments
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1 Table 2. Chemical composition of the major feed ingredients (DM basis) (%)2

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	Feedstuff	DM	СР	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 pro	tein, CF=C	rude fibre,	EE=Ether ext	rac t, NFE=	Nitrogen-f	ree extracts
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1	Table 3.	Chemical com	position of the	experimental	diets (dr	y matter	basis) (%)
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	Ration	DM	СР	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 e	xperiment	al ra tions					
	Ra	ation A		Ration	В	R	ation C	
	CP (%) 17	.05		9.82		1	0.85	
	ME (MJ /Kg DM) 11	.17		10.29		10	0.17	
3 4 5 6	The ME values of the exper ME (MJ/kg DM) = where CP = Crud DM = Dry matter, ADF=Acid	imental ra 11.78 + 0 e Protein, I detergen	tions were .00654CP EE = Ethe t fibre, ND	calculated + (0.0006 r Extract, (F=Neutral	d as per A 65EE) ² – CF = Crud detergen	lderman [: CF(0.0041 le Fibre, A t fibre	27] as follo 14EE) – 0.(= Ash	ws: 0118A
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	Treatment	1A	2A	1B	2B	1C	2C	D	SEM
	Nutrient inta	ke (Kg/day)	<u></u>						
	DM	0.24 ^b	0.47ª	0.21 ^{bc}	0.30 ^{ab}	0.23 ^b	0.42ª	0.15 ^c	± 0.02
	СР	0.044 ^a	0.087 ^a	0.012 ^b	0.017 ^b	0.032 ^a	0.072 ^a	0.009 ^b	± 0.01
	Apparent dig	estibility of	nutrients (%	<u>6)</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
	СР	90.6 ^a	89.2ª	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	51.7ª	49 .8ª	43.9 ^{bc}	42.8 ^c	46.1 ^b	44.4 ^{bc}	42.3 ^{bc}	± 5.0
	Economic ar	nalysis of th	e feeds (Na	<u>iira) *</u>					
	Cost of feed	2.19 ^b	4.42 ^a	0.50 ^e	1.06 ^d	0.83 ^{de}	1.55 ^c	-	± 0.15
	per day								
2 3	a,b,c,d,e,f m (P<0.05)	neans with	in the sam	e row bea	ring differe	nt superscr	ipt letters	differ signif	icantly
4	Naira = Nige	rian curren	cy (100 kob	o make 1 na	aira and cur	rent exchar	nge rate is 1	US\$ = 140	Naira)
5 6	Trea	atment 1A =	Ration A (Convention	al concentra	ate) offered	at 1% of bo	ody weight.	
7		2A =	Ration A (Convention	al concentra	ite) offered	at 2% of bo	ody weight.	
8 9		тв = 2В =	Crop-resid	ue test ratio ue test ratio	n B offered	at 1% of bo	ody weight. ody weight.		
10		1C =	Crop-resid	ue test ratio	on C offered	at 1% of bo	ody weig ht.		
11 12		2C =	Crop-resid	ue test ratio	on C offered	at 2% of bo	ody weight.		
13		D =	Unsupplem	ienteu grou	þ				
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15 16									
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1	Table 4. Mean	nutrient intake,	apparent	digestibility	and cost	of the expe	erimental (diets

2 3 Table 5. Effect of ration supplementation of Red Sokoto does on daily milk yield, littersize, b irth weight,

0-90 days weight gain an	d average daily gains of their kids $(+s)$	(m د
0-70 days weight gain an	μ average uaity gains of their kius (\pm 3.6	5.IIIJ.

Ration	Dam's milk	Littersize	BWT	WT30	WT60	WT90	ADG
	yield		(Kg)	(Kg)	(Kg)	(Kg)	(g/day)
	(Kg/day)						
1A	0.48 ^b	1.34	1.3ª	2.33 ^b	3.50 ^b	5.54 ^{ab}	47.11 ^b
2A	0.62ª	1.32	1.4 ^a	3.30 ^a	4.70 ^a	6.25 ^a	53.88ª
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	1.34ª	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.	± 0.02	± 0.09	± 0.16	± 0.21	± 0.30	± 0.27	± 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,

5 6 7 ADG = average daily gain Ration symbols as described in Table 4

Table 6. Progesterone concentration (ng/ml) during late gestation, pre -partum, at parturition and post-partum (\pm SEM) in Red Sokoto does supplemented with crop residue rations. 2 3

Ration	Late gestation (day 120 - day140)	Pre-partum (day 6 – day 2)	Parturition	Post-partum (day 1 – day 15)
	(uuy 120 uuy 140)	(uuyo uuyz)	(uay o)	
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	± 0.45	± 0.22	± 0.05	± 0.11