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PROTEIN PARTITIONING OF PREGNANT AND LACTATING RABBITS DOES FED SOYABEAN CHEESE WASTE AND CONGO GRASS (*Brachiaria ruziziensis)* HAY DIETS

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ABSTRACT

The study evaluated protein partitioning of breeding rabbit does offered levels of soyabean cheese waste (SCW) diets and *Brachiaria ruziziensis* hay to ascertain whether it meets their nutritional requirement for reproduction. Fifty-four nulliparous crossbred does about eight months of age were allotted to six dietary treatments in a completely randomised design. Concentrate diets containing 0, 10, 20, 30, 40, and 100% SCW were fed to breeding rabbit does as a replacement for groundnut cake. After mating, the does were fed 100 g/doe/day concentrate up to the third week of pregnancy and 200 g/doe/day from the middle of the third week of pregnancy to first week of lactation and 350 g/doe/day in the second week of lactation. Estimations of digestible crude protein during pregnancy and lactation were carried out and reference data were used to calculate for $DCP_{req,}$ $DCP_{m,}$ $DCP_{fg,}$ $DCP_{macc,}$ BalanceDCP and $DCP_{req}/LW^{0.75}$. Results showed that pregnant rabbit does fed SCW diets and *Brachiaria ruziziensis* hay had no significant difference in all the parameters considered except BalanceDCP which was negative. All parameters measured were significantly ($P>0.05$) higher in the 4^{th} week of pregnancy as compared to the 2^{nd} week of pregnancy except for DCP_m which was similar. During lactation, all parameters considered showed no significant difference. Therefore, the SCW diets and *Brachiaria ruziziensis* hay were adequate to satisfy protein requirement of pregnancy but inadequate for lactation.

Key Words: Rabbit doe; Pregnancy; Lactation; Protein Partitioning; Concentrate; *Brachiaria ruziziensis* hay.

INTRODUCTION

The need to improve rabbit production for increased supply of animal protein requirements of Nigerian populace (Iyeghe-Erakpotobor *et al*., 2002; Mohammed *et al.*, 2018)) is no longer in doubt due to the high cost of chicken, pork and beef (Mohammed *et al.*, 2018). Increased production of fryers can be ensured through proper nutrition and feeding of breeding rabbits. Recently, there has been increased awareness in rabbit production in Nigeria. The advantages of rabbit include, short generation interval, high productive potential, high prolificacy, high carcass yield and ability to efficiently convert fodder to food. The whole point of meat production is to convert plant proteins of little or no use to people as food into high value animal protein. In efficient production systems, rabbits can turn 20% of the proteins they eat into edible meat. Comparable figures for other species are 22 to 23% for broiler chickens, 16 to 18% for pigs and 8 to 12% for beef (Lebas *et al.*, 1977). Rabbits can also easily convert the available proteins in cellulose-rich plants, whereas it is not economical to feed these to chickens and turkeys the only animals with higher energy and protein

efficiency. The traditional grain and soyabean cakes fed to these domestic poultry put them in direct competition with humans for food. For countries with no cereal surpluses, rabbit meat production is thus especially interesting (Lebas *et al.,* 1977). Rabbits unlike other animal species like poultry, beef and swine can be produced on a wide range of feedstuff materials like forages, cereal by-products and SCW which is in less competition with man (Iyeghe-Erakpotobor *et al.*, 2006). Despite these advantages, rabbit feeding still pose a serious challenge in any type of rearing system adopted (Xiccato and Trocino, 2010) and in conditions where there is great intensification of breeding on does; the reproductive rhythm becomes widespread alongside pregnancy and lactation. This therefore leads to does needing high nutrient feed balance with increase voluntary intake to meet up the physiological needs of milk production and foetal development. Feed partitioning between energy and protein feedstuff materials in rabbit is important as it showed that rabbits can utilise 50g of concentrates partitioned with forage or legume residues combinations without adverse effect on growth (Iyeghe-Erakpotobor *et al.,* 2006) and consequently, rabbits performs better when fed mixture of forage and concentrates (Ojewole *et al.,* 1999; Latu *et al.,* 2018). Therefore, this study focuses at protein partitioning of pregnant and lactating rabbit does offered levels of SCW diets and *Brachiaria ruziziensis* hay to ascertain whether it meets their nutritional requirement for reproduction.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Rabbit Research Unit of Swine and Rabbit Research Programme of the National Animal Production Research Institute (NAPRI), Shika, Nigeria, located in the northern Guinea savannah ecological zone. The area lies between latitude 10°11' N and longitude 7°8' E, and 650 meters above sea level (Ovimaps, 2014). The area receives an annual rainfall of 1100 mm, which is spread from April to October. The mean minimum and maximum temperatures range from 12 –28° C during the cold season and 20 - 36° C in the hot season. Relative humidity during the rainy season is about 75% and 21% during the dry season (IARMS, 2014).

Experimental Animals and Management

Fifty-four nulliparous crossbred does (New Zealand White x California and California x Chinchilla breeds) of about eight months of age were allotted to six dietary treatments in a completely randomised design. After allotting the does to each dietary treatment, does were then introduced to bucks in their cages in a mating ratio of 1 buck: 6 does. After a successful mating was confirmed, by the buck thrusting forward and falling by its side, the does were then returned to their cages. Mating was carried out between 8:00 – 9:00am. Concentrate diets containing 0, 10, 20, 30, 40, and 100% SCW respectively, was fed to pregnant and lactating does as a replacement for maize and groundnut cake. The *Brachiaria ruziziensis* hay was harvested, dried at room temperature, chopped and fed to all the groups at 60 g/doe/day while the concentrate diet was formulated and contained crude protein of 22.50% and metabolisable energy of 2600 ME/Kg (Table 1). Estimations of digestible crude protein during pregnancy and lactation were carried out and reference data were used in the calculation of digestible crude protein requirement (DCP_{req}), digestible crude protein required for foetal (DCP_{fg}) and digestible crude protein for maintenance (DCP_{m}) according to Parigi Bini and Xiccato (1998) and Fraga (1998). The rabbits were fed with the diet for one-week period of adjustment and then mated to intake bucks. After mating, the does were fed 100g concentrate up to the third week of pregnancy and subsequently fed 200 g/doe/day from the middle of the third week of pregnancy to the first week of lactation. Feed supply was increased to 350 g/doe/day in the second week of lactation. Feeding of the soyabean based diets was terminated at the third week of lactation

following observed contamination of the concentrate diets possibly due to poor drying of the SCW. Does were housed individually in metal cages in a well-ventilated building with large open windows. Water was given *ad libitum*. Concentrates and forages were weighed and fed separately in flat bottom earthen feeders with rims to avoid wastage and leftovers were collected weighed and recorded daily. The does were weighed at the onset of the study and at weekly intervals during pregnancy and lactation. The parameters measured were: feed intake (concentrate, forage and total feed intake), doe weight, litter size and weight of litter at 21 days. The study lasted for 11 weeks.

Table 1: Composition of Experimental Diets fed Rabbits during Pregnancy and Lactation

	Levels of soyabean cheese waste (%)					
Ingredients	**0**	**10**	**20**	**30**	**40**	**100**
Maize	42.46	34.86	27.26	19.66	15.66	-
GNC	39.04	36.64	34.24	31.84	25.84	-
SCW	-	10.00	20.00	30.00	40.00	81.50
Maize offal	15.00	15.00	15.00	15.00	15.00	15.00
Bone ash meal	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vitamins/minerals Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

GNC = Ground nut cake; SCW = Soyabean cheese waste; *Vitamin/mineral premix content per kilogram ration: vit. A 1251 IU, vit. D3 2750 IU, vit. E 151 IU, vit. K 0.002 g, vit. B2 0.006 g, nicotinic acid 0.035 g, calcium D-pantothenate 0.01 mg, vit. B6 0.0035 g, vit. B12 0.02 g, folic acid 0.001 g, biotin 0.0005 g, vit. C 0.025 g, cholin chloride 0.39g, zinc bacitracin 0.02 g, methionine 0.2 g, avatec (lasolocid) 0.09 g, manganese 0.1 g, iron 0.05 g, zinc 0.04 g, copper 0.002 g, iodine 0.00153 g, cobalt 0.000225 g, selenium 0.0001 g.

Data Collection and Evaluation

Data were collected and analysed for digestible crude proteins (intake, requirement, maintenance, foetal growth, balance and metabolic weight) on pregnancy and lactation and interactions with the dietary treatments using the General Linear Model Procedure of (SAS, 1987). Orthogonal pair wise difference method was used to separate significant means. Interaction effects between level of dietary treatment and stage of pregnancy were dropped due to lack of interaction effect. Below are the mathematical models used for the study:

Pregnancy:

$$Y_{ijk} = \mu + T_i + S_j + (T_i * S_j) + e_{ijk}$$

Where;

Y_{ijk} = observation on the i^{th} treatment in the j^{th} stage of pregnancy in the k^{th} random error,

μ = overall mean,

T_i = fixed effect of treatment

S_j =fixed effect of stage of pregnancy (i= 2nd week and ii= 4th week),

(T_i * S_j) = interaction between treatment and stages of pregnancy,

e_{ijk} = random error.

Lactation:

$Y_{ij} = \mu + T_i + e_{ij}$

Where;

Y_{ij}= observation on the i^{th} treatment of the j^{th} random error,

μ = overall mean,

T_i = fixed effect of dietary treatment,

e_{ij} = random error

RESULTS AND DISCUSSION

The protein partitioning of pregnant rabbit does fed levels of SCW diets and *Brachiaria ruziziensis* hay combinations are as shown in Table 2. There was no significant (P>0.05) difference between the control and the treatments in all the parameters considered. Digestible crude protein intake (DCP_{intake}), DCP_{req}, DCP_m, DCP_{fg}, live weight and metabolic live weight of pregnant does were not significantly (P>0.05) different across treatments except that a negative balance of digestible crude protein (BalanceDCP) was observed in the diet with 20% SCW.

Table 2: Protein Partitioning of Pregnant Does Offered levels of Soyabean Cheese Waste diets and *Brachiaria ruziziensis* hay combinations

	Levels of soyabean cheese waste (%)							
Parameters	**0**	**10**	**20**	**30**	**40**	**100**	**SEM**	**P-value**
DCP_{intake} (g/d)	16.19	14.14	12.43	14.88	14.46	14.51	0.29	0.1172
DCP_{req} (g/d)	13.99	13.29	12.60	12.94	12.62	12.69	0.19	0.4156
DCP_m (g/d)	7.19	7.35	7.38	6.69	6.54	6.60	0.14	0.3266
DCP_{fg} (g/d)	6.80	5.94	5.22	6.25	6.08	6.09	0.12	0.1177
BalanceDCPg/d	2.20	0.85	-0.17	1.94	1.85	1.82	0.22	0.0872
$DCP_{req}/LW^{0.75}$/d	7.14	6.78	6.24	6.91	7.00	6.94	0.11	0.4545

DCP_{req} = Digestible crude protein required; (DCP_m) = Digestible crude protein for maintenance; DCP_{fg} = Digestible crude protein for foetal growth; Balance DCP = digestible crude protein balance; DCP_{req}/LW0.75/d = digestible crude protein requirement per metabolic weight per day.

The protein partitioning of SCW diets and *Brachiaria ruziziensis* hay combinations fed to pregnant does in the 2nd and 4th week of pregnancy is shown in Table 3. DCP_{intake}, DCP_{req}, DCP_{fg}, balanceDCP and $DCP_{req}/LW^{0.75}$ were significantly (P<0.05) higher in the 4th week compared to the 2nd week of pregnancy while DCP_m was similar at 2nd and 4th week stage of pregnancy.

Table 3: Protein Partitioning of Pregnant Does Offered levels of Soyabean Cheese Waste diets and *Brachiaria ruziziensis* hay combinations

	Stage of Pregnancy (weeks)			
Parameters	**2**	**4**	**SEM**	**P-Value**
DCP_{intake} (g/d)	5.96[b]	22.91[a]	0.29	0.0001
DCP_{req} (g/d)	9.22[b]	16.82[a]	0.19	0.0001
DCP_{m} (g/d)	6.72	7.20	0.14	0.122
DCP_{fg} (g/d)	2.50[b]	9.62[a]	0.12	0.0001
BalanceDCPg/d	-3.27[b]	6.09[a]	0.22	0.0001
$DCP_{req}/LW^{0.75}$/d	4.96[b]	8.71[a]	0.11	0.0001

[a,b] Means within rows with different superscripts are significant ($p<0.05$) different; DCP_{intake} = Digestible crude protein intake; DCP_{req} = Digestible crude protein required; DCP_{m} = Digestible crude protein for maintenance; DCP_{fg} = Digestible crude protein for foetal growth; Balance DCP = Balance digestible crude protein.

However, low DCP_{intake} was observed during the 2nd week of pregnancy resulting in a negative balance DCP which could be attributed to the inability of the does to quickly adjust and increase DCP_{intake} to accommodate the high demand for DCP_{req} to meet bodily needs for the initiation of pregnancy in which case there was mobilisation of nutrients from body tissues (Latu *et al.*, 2018*)* to compensate for DCP_{fg}. This result also agrees with the report of Iyeghe-Erakpotobor (2009) that the ability of does to meet DCP_{m} and DCP_{fg} depends on the DCP_{intake}. DCP_{intake} however, varied significantly ($P<0.05$) with stages of pregnancy. At the 4th week of pregnancy, does had higher DCP_{intake} which was reflected in total DCP_{req}, DCP_{m}, DCP_{fg}, balanceDCP and $DCP_{req}/LW^{0.75}$ as compared to the 2nd week of pregnancy. This was in consonance with the report of Iyeghe-Erakpotobor *et al.* (2006) that the first two weeks of pregnancy, foetal development is concentrated on organ development which does not require high nutrients input as increase in body size that was noted in the 4th week of pregnancy.

Protein partitioning of lactating does offered levels of SCW diets and *Brachiaria ruziziensis* hay combinations is shown in Table 4. During lactation there was no significant ($P>0.05$) difference in DCP_{intake}, DCP_{req}, DCP_{m}, digestible crude protein requirement for milk (DCP_{milk}), $DCP_{req}/LW^{0.75}$, digestible crude protein, does live weight, litter size at parity (LSP) and litter size at birth (LSB) between the control and the treatments. During lactation, all parameters were not affected by dietary treatment levels. However, the balance DCP showed that rabbits on the control and all the treatments were on negative protein balance.

This indicates that there was mobilisation of nutrients from the body tissues. This result agrees with Toschi *et al.* (2005), Iyeghe-Erakpotobor *et al.* (2006), Latu *et al.* (2017) and Latu *et al.* (2018) who observed that lactating does mobilised body tissues to support lactogenesis especially during early and mid-lactation. The observations by these authors explain the findings of this study as there was mobilisation of nutrients from the body tissues which led to a negative balanceDCP in the body of the does, which may adversely affect the reproductive performance and health status of lactating does. The negative balance could also be attributed to the inclusion of *Brachiaria ruziziensis*. *Brachiaria ruziziensis* though well accepted by

rabbits has been reported (Patridge, *et al.,* 1989) to have low crude protein (6%). The negative balanceDCP of the control and all the different levels of SCW diets agrees with the fact that lactating does need the richest, most concentrated feed because they produce milk three times richer than cow's milk, at the rate of 100 to 300g/day, and have few reserves in relation to the demand made on them (Lebas *et al.,* 1977). The 20% SCW diets and the control (0%) were significantly higher (P<0.05) in litter weight at weaning (LWW) at 21 (6.00 and 5.50) days than the rest of the treatments which were similar. The 20% SCW diet was numerically higher than the control but was not statistically significant so it is safe to say that 20% SCW diet compared favourably with the control.

Table 4: Protein Partitioning of Lactating Does Offered levels of Soyabean Cheese Waste diets and *Brachiaria ruziziensis* hay combinations

	Levels of soyabean cheese waste (%)							
Parameters	**0**	**10**	**20**	**30**	**40**	**100**	**SEM**	**P-value**
DCP_{intake} (g/d)	26.60	23.15	22.31	23.31	23.54	19.29	0.47	0.132
DCP_{req} (g/d)	27.24	24.42	24.52	24.38	24.91	21.79	0.37	0.154
DCP_{m} (g/d)	7.02	6.83	7.35	6.67	7.02	7.13	0.21	0.951
DCP_{milk} (g/d)	20.22	17.59	17.67	17.72	17.90	14.66	0.36	0.131
BalanceDCPg/d	- 0.64	- 1.27	- 1.94	- 1.07	- 1.37	- 2.51	1.26	0.626
$DCP_{req}/LW^{0.75}$/d	14.36	13.30	12.35	13.79	13.19	11.30	0.18	0.563
LSP	6.00	4.00	7.00	5.50	4.50	4.00	0.37	0.290
LSB	5.50	3.67	7.00	5.00	4.50	4.00	0.45	0.420
LWW	5.50^{a}	2.68^{b}	6.00^{a}	2.78^{b}	1.90^{b}	1.93^{b}	0.30	0.024

^{a,b} Means within rows with different superscripts are significant (p<0.05) different.; DCP_{req} = Digestible crude protein required; (DCP_{m}) = Digestible crude protein for maintenance; DCP_{milk} = Digestible crude protein for milk; Balance DCP = digestible crude protein balance; DCP_{req}/LW0.75/d = digestible crude protein requirement per metabolic weight per day; LSP = Litter size at parity; LSB = Litter size at birth; LWW = Litter weight at weaning (21 days).

CONCLUSION

The study concluded that the SCW diets and *Brachiaria ruziziensis* hay were adequate to meet protein requirement of pregnant does and can replace maize and groundnut cake during pregnancy but inadequate for lactating does as observed in the negative balance DCP. Therefore, to avoid any adverse effect on reproductive performance and health status of breeding does, there is need for further investigation for suitable combinations of diets for lactating does.

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