

Protein partitioning of pregnant and lactating rabbit does fed combination of concentrates and *Stylosanthes hamata* hay

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Target Audience: Rabbit Farmers, Animal Scientist

Abstract

The study evaluate protein partitioning of pregnant and lactating rabbit does offered levels of concentrate and *Stylosanthes hamata* hay to ascertain whether it meets their high reproductive and nutritional requirements. Forty-eight nulliparous crossbred does (New Zealand White x California and California x Chinchilla breeds) of eight months of age were allocated to four dietary treatments in a completely randomised design. During pregnancy, 150 g/doe/day concentrate and *Stylosanthes hamata* hay combinations (30:120g, 60:90g, 90:60g and 120:30g) of feed was offered while 350 g/doe/day concentrate and *Stylosanthes hamata* hay combinations (70:280g, 140:210g, 210:140g and 280:70g) was offered during lactation. Data collected for live weight (LW), digestible crude protein DCP_{intake} and litter weight were used to estimate metabolic weight, protein requirement for maintenance, foetal growth and lactation of rabbit does. Results showed that pregnant rabbit does fed the combinations had significant ($P < 0.05$) differences in the parameters considered. The 4th week had significant ($P < 0.05$) difference over the 2nd week in most parameters except LW (2570 to 2640) and $DCP_{maintenance}$ (7.50 to 7.64g/day) that had no significant ($P > 0.05$) differences. During lactation, all parameters showed no significant ($P > 0.05$) difference. Therefore, the diet combinations were adequate to satisfy protein requirement of pregnant does but inadequate for lactating does.

Key words: Rabbit doe; Pregnancy; Lactation; Protein Partitioning; Concentrate; *Stylosanthes hamata* hay.

Description of Problem

Best known for being prolific, rabbits are also herbivores, which 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 (1). 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 soya bean 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 (1). 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 soybeans cheese waste which is in less competition with man (2). Despite this merit, rabbit feeding still pose a great challenge in any type of rearing system adopted (3) and in conditions where there is great intensification of breeding on does; the reproductive rhythm becomes widespread alongside pregnancy and lactation. This therefore lead 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 utilize 50g of concentrates partitioned with forage or legume residues combinations without adverse effect on growth (2) and consequently, rabbits performs better when fed mixture of forage and concentrates (4). Therefore, this study focuses at protein partitioning of pregnant and lactating breeding rabbit does offered levels of concentrate and *Stylosanthes hamata* hay to ascertain whether it meets their high reproductive and nutritional requirement.

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 (5). 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 (6).

Experimental Animals and Management

Forty-eight nulliparous crossbred does (New Zealand White x California and California x Chinchilla breeds) of about eight months of age were allotted to four dietary treatments in a completely randomised design. After allotting the does to each dietary treatments, 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 back to their cages. Mating was carried out between 8:00 – 9:00am. The diets containing concentrate and *Stylosanthes hamata* hay combinations of 30:120g, 60:90g, 90:60g, 120:30g and 70:280g, 140:210g, 210:140g, 280:70g was fed to pregnant and lactating does respectively. The *Stylosanthes hamata* hay was harvested, dried at room temperature and chopped before feeding while the concentrate diet was formulated and contained crude protein of 22% and metabolisable energy of 2600ME/Kg (Table 1). Estimations of digestible crude protein during pregnancy and lactation was carried out and reference data were used in the calculation of digestible crude protein requirement (DCP_{req}) and digestible crude protein required for foetal (DCP_{fg}) and digestible crude protein required for maintenance (DCP_m) according to (7). Does were housed individually in metal cages housed in a well-ventilated building with large open windows. Pregnant does were offered a total of 150g feed/doe/day while lactating does were offered 350g feed/doe/day. Water was

given *ad libitum*. Flat bottom earthen feeders with rims were used for feeding the rabbits to avoid wastage. The experiment lasted for four months.

Table 1: Composition of concentrate diets fed to pregnant and lactating rabbit does

Ingredients	Composition (%)
Maize	39.24
Groundnut	42.26
Maize offal	15.00
Bone	3.00
Salt	0.25
Vitamin/minerals premix	0.25
Total	100.00

*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 statistical analysis

Data were collected and analyzed for live weight, 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 (8). Orthogonal pair wise difference method was used to separate significant means. Interaction effects between level of dietary treatment and stage of pregnancy were dropped because it was not significant. Below is the mathematical models used for the study:

Pregnancy:

$Y_{ijk} = \mu + T_i + S_j + (T_i * S_j) + \epsilon_{ijk}$
 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 ($i= 2^{nd}$ week and $ii= 4^{th}$ week),

$(T_i * S_j)$ = interaction between treatment and stage of pregnancy
 ϵ_{ijk} = random error

Lactation:

$Y_{ij} = \mu + T_i + \epsilon_{ij}$
 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,
 ϵ_{ij} = random error

Results and Discussion

The protein partitioning of rabbit does fed levels of concentrate and *Stylosanthes hamata* hay combinations as shown in Table 2. Digestible crude protein (DCP) intake, digestible crude protein requirement (DCP_{req}), digestible crude protein required for foetal growth (DCP_{fg}) and balance of digestible crude protein (Balance DCP), live weight and metabolic live weight by pregnant rabbit does fed 120:30 and 90:60 concentrate and *Stylosanthes hamata* statistically similar

($P > 0.05$) and higher than does fed 60:90 and 30:120 concentrate and *Stylosanthes hamata* combinations.

Protein partitioning of pregnant does shows significant increases in digestible crude protein intake as the level of concentrate fed increased. (9) reported an increase of 16% in total feed intake of rabbits fed 60:90 concentrate and *Stylosanthes hamata* over those fed 30:120 concentrate and *Stylosanthes hamata* and 16% higher on 90:60 than 60:90 and only 6% higher on 120:30 than 90:60 dietary levels. Total digestible crude protein requirement, digestible crude protein requirement for maintenance and foetal growth were significantly affected with increase

concentrate and decrease in *Stylosanthes hamata*. Though widely used, its palatability has been reported by (10) to be relatively low.

Digestible crude protein (DCP) balance obtained showed that the rabbits fed 30:120 and *Stylosanthes hamata* were on a negative DCP balance. This may be attributed to the lowest DCP intake recorded due to the high level of *Stylosanthes hamata* which has been reported by (10) to have relatively low palatability. Dietary combinations of 90:60 and 120:30 concentrate and *Stylosanthes hamata* had better performance in terms of digestible crude protein balance (5.25 and 5.63) than 30:120 and 60:90 concentrate and *Stylosanthes hamata* combinations (-1.46 and 0.95).

Table 2: Protein Partitioning of Pregnant Rabbit Does Offered levels of concentrate and *Stylosanthes* hay combinations

Parameters	Concentrates and <i>Stylosanthes hamata</i> hay combinations (g)				SEM	P-value
	30:120	60:90	90:60	120:30		
Live weight (g)	2500 ^c	2580 ^b	2500 ^c	2830 ^a	0.38	0.0307
DCP _{intake} (g/d)	10.16 ^c	14.61 ^b	21.74 ^a	23.60 ^a	9.46	0.0001
DCP _{req} (g/d)	11.62 ^c	13.67 ^b	16.49 ^a	17.97 ^a	0.20	0.0001
DCP _m (g/d)	7.35 ^c	7.53 ^b	7.36 ^c	8.06 ^a	0.08	0.0319
DCP _{fg} (g/d)	4.27 ^c	6.14 ^b	9.13 ^a	9.91 ^a	0.19	0.0001
BalanceDCP (g/d)	-1.46 ^b	0.95 ^b	5.25 ^a	5.63 ^a	0.29	0.0001
DCP _{req} /LW ^{0.75} (d)	5.84 ^c	6.77 ^b	8.32 ^a	8.26 ^a	0.29	0.0001

abc= 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 = digestible crude protein balance, DCP_{req}/LW^{0.75}/d = digestible crude protein requirement per metabolic weight per day.

The protein partitioning of concentrate and *Stylosanthes hamata* hay combinations fed to pregnant rabbit does in the second and fourth week of pregnancy is shown in Table 3. Digestible crude protein (DCP_{intake}), digestible crude protein required (DCP_{req}), digestible crude protein for foetal growth (DCP_{fg}) and digestible crude protein balance were significantly ($P < 0.05$) higher in the 4th week than 2nd week of pregnancy while digestible

crude protein required (DCP_m) was similar both at 2nd and 4th week stage of pregnancy. Even though there was slight increase in DCP_{fg} in the 4th week of pregnancy, both stages were in positive DCP balance and this could be attributed to the increase in DCP intake compared to what was observed in pregnant rabbit does fed 30:120 concentrate and *Stylosanthes hamata* hay combinations. (9) also reported high feed intake concentrate and

Stylosanthes hamata during pregnancy as compared to lactation. During the first pregnancy, rabbit does retain protein in their body in the early gestation (0–21 days), while they transfer some protein from their body to the rapidly growing foetuses in the late period of pregnancy (21–30 days), (7). This is due to the exponentially increasing protein

requirements of the foetuses and the intense foetal protein turnover, which has been shown to be five times higher than that of maternal tissue, as observed in sheep by (11). Although, no significant ($P>0.05$) difference was obtained in live weight, digestible crude protein requirement for maintenance between the 2nd and 4th weeks of pregnancy.

Table 3: Effect of Stage of Pregnancy on Protein partitioning of Pregnant Rabbit Does offered levels of concentrates and *Stylosanthes* hay combinations

Parameters	Stage of Pregnancy (weeks)			
	2	4	SEM	P-Value
Live weight (g)	2570	2640	0.38	0.3877
DCP _{intake} (g/d)	15.98 ^b	19.08 ^a	0.46	0.0023
DCP _{req} (g/d)	14.21 ^b	15.66 ^a	0.20	0.0010
DCP _m (g/d)	7.50	7.64	0.08	0.4017
DCP _{fg} (g/d)	6.71 ^b	8.01 ^a	0.19	0.123
BalanceDCP	1.77 ^b	3.42 ^a	0.29	0.0092

ab= 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.

Table 4: Protein Partitioning of Lactating Does offered different combinations of concentrate and *Stylosanthes* hay combinations

Parameters	Concentrates and <i>Stylosanthes hamata</i> hay combinations (g)					
	70:280	140:210	210:140	280:70	SEM	P-value
DCP _{intake} (g/d)	15.60	15.83	16.64	16.02	0.49	0.8931
DCP _{req} (g/d)	19.43	20.54	20.25	19.74	0.52	0.8660
DCP _m (g/d)	7.58	8.55	7.61	7.56	0.43	0.7795
DCP _{milk} (g/d)	11.85	12.03	12.64	12.18	0.37	0.8933
Balance DCP (g/d)	-3.84	-4.75	-3.61	-3.71	0.46	0.7745
LSB	4.00	5.00	5.00	4.80	0.37	0.7117
LSA	4.00	4.44	4.86	4.20	0.36	0.8667
DCP _{req} /LW ^{0.75} /d	9.50	9.45	9.92	9.77	0.30	0.9208

DCP intake = Digestible crude protein intake, DCP_{req} = Digestible crude protein required, DCP_m = Digestible crude protein for maintenance, DCP_{milk} = Digestible crude protein for milk, BalanceDCP = Balance digestible crude protein, LSB = litter size at birth, LSA = litter size at parity, DCP_{req}/LW^{0.75}/d = digestible crude protein requirement per metabolic weight per day.

Table 4 shows the protein partitioning of lactating rabbit does offered concentrate and *Stylosanthes hamata* combinations. There was no significant ($P<0.05$) difference in DCP intake, DCP requirement, DCP maintenance, DCP milk, DCP balance, metabolic weight and other parameters between the combinations.

During lactation, all parameters were not affected by treatment levels. However, the digestible crude protein balance showed that rabbits on all the treatments were on negative protein balance. This result agrees with (2) and (13) who observed that lactating does mobilised body tissues to support lactogenesis especially during early and mid-lactation. The observation by these authors appears to explain the findings of this study as there was mobilisation of nutrients from the body tissues which led to a negative balance in digestible crude protein in the body of the does with the 140:210 combinations having a higher negative result (-4.7.5) which may adversely affect the performance and health status of the lactating does. This result on lactation is opposed to what was observed during the pregnancy stages where the balanced of digestible crude protein was positive implying that the rabbit does have enough and can store excess for lactation requirements. The negative balance DCP at all the different combinations of concentrate and *Stylosanthes hamata* agree with the fact that lactating does need the richest, most concentrated feed (1). 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 (1). This also agrees with the report of (3) that feed energy concentration is the main factor responsible for ingestion of dry matter and ostensibly other nutrients such as protein, amino acid and vitamins which contributes to the animal production and total well-being, that is to say animals will eat to meet their energy needs and consequently other nutrients alongside energy.

Conclusion and Applications

The study shows that:

1. Dietary combinations of 90:60 and 120:30 concentrate and *Stylosanthes hamata* had better performance in terms of DCP balance (5.25 and 5.63g/day)

and were adequate to satisfy the protein requirement of pregnant rabbit.

2. The diet combinations of concentrate and *Stylosanthes hamata* were inadequate for lactating does as observed in the negative DCP balance in each treatment diet (-3.84, -4.75, -3.61 and -3.71g/day).
3. There is a need for further studies on the quantity of feed offered and amino acids balance of diets for lactating rabbit does to prevent any adverse effect on health and reproductive performance of breeding rabbit does.

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