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ENERGY PARTITIONING OF PREGNANT AND LACTATING RABBIT DOES FED COMBINATIONS OF CONCENTRATE AND LABLAB HAY

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ABSTRACT

Concentrate and lablab hay combinations at different levels were fed to twenty-eight crossbred rabbit does in a completely randomized design to examine the partitioning of energy by breeding rabbit does during pregnancy and lactation. At pregnancy, 150 g/day/doe of concentrate and lablab hay combinations were offered in the ratio of 20:130g, 40:110g, 80:70g and 100:50g, while during lactation, 350 g/day/doe was offered in the ratio of 47:303g, 94:256g, 188:166g and 276:74g. Data were collected at each of the physiological stages (pregnancy and lactation) and reference data were used to calculate some of the parameters. Results obtained showed that pregnant rabbit does fed the various combinations had non-significant (P>0.05) difference in all the parameters although the 80:70 combinations performed favorably. Does in the 4th week of pregnancy had significantly (P<0.05) higher DM intake, digestible energy requirement (DE_{req}), digestible energy for fetal growth (DE_{fg}), digestible energy for maternal accretion (DE_{macc}), balance of digestible energy (DE_{bal}) and digestible energy requirement per metabolic weight per day ($DE_{req}/LW^{0.75}$/day) than does in the 2nd week of pregnancy although digestible energy for maintenance (DE_m) was not significant in the 2nd and 4th weeks of pregnancy (715.16 and 720.23 KJ/day). During the lactation phase, there was no significant (P>0.05) difference in all the parameters. Negative DE_{bal} (-304.67, -220.91 and -116.27 KJ/day) were obtained at the lactating phase on concentrate: forage combinations of 47:303, 94:256 and 276:74 g respectively while the 188:166 concentrate and lablab hay combination had positive energy balance of 78.55 KJ/day. It can be concluded that dietary manipulations in meeting energy needs could be used to advance energy in reproductive breeding rabbit does to improve performance. An, equal quantity of the concentrate and forage of 80:70 g (pregnancy) and 188:166 g (lactation) combination is recommended.

Key words: Combinations, Rabbit does, Energy Partitioning, Concentrate, Lablab hay.

INTRODUCTION

Feed is the greatest and critical single factor in animal production and reproduction. Success in both is also determined by several interactive factors like genetic make-up of the animal, temperature, photoperiod, stress and nutrition. Of these factors, nutrition has a great influence on the ability to achieve both production and reproduction goals (Iyeghe-Erakpotobor and Ashworth, 2003). Energy is the largest proportion of nutrients in a compounded animal diet and also the highest cost of production (Soenke *et al.*, 2005). Feed energy concentration is the main factor responsible for the ingestion of dry matter and apparently other nutrients such as protein, amino acid and vitamins which contributes to the animal production and total well-being (Xiccato and Trocino, 2010). Energy is not a nutrient *par-se* as this has been argued but a quality associated with the nutrient content of feed stuffs and mixed diets (Noblet, 2007). The availability of

energy appears to control reproduction primarily through pathways that permit or block the release of gonadotrophic releasing hormones that acts on the ovary to influence specific growth, estrogen production and circulating progesterone levels (John, 2010). It has been documented that reproduction and growth requires about 300 – 500kcal/kg more than maintenance requirement in rabbit due to high energy demand for pregnancy and lactation which have usually leads to negative energy balance (Xiccato and Trocino, 2010). Furthermore, Iyeghe-Erakpotobor *et al.* (2006) amongst many authors observed that feed partitioning between energy and protein materials is vital in successful rabbit production and that combining concentrates and forage or legume residues pose no negative effect. The partitioning of feed between energy and protein in animal management is of substantial importance as this suggests an improvement in growth performance in growing rabbits (Nwagu and Iyeghe-Erakpotobor, 2012). Similarly, Latu *et al.* (2017) reported a positive effect of partitioning protein in pregnant crossbred rabbit as this assisted pregnant rabbit does. Although, inadequate supply of dietary energy intake and/or poor protein intake whether partitioned or supplied by a particular ingredient as reported on grazing animals leads to some adverse effect such as delayed puberty and prolonged postpartum anoestrus (Smith and Somade 1994). In many other prolific species however, reports from data suggest that the partition of nutrients towards lactation leads to lower body condition and higher infertility in females (Cesare *et al.*, 2010). This therefore necessitated this study with the aim at partitioning energy in concentrate and lablab hay fed to pregnant and lactating rabbit does to ascertain their performance at both physiological stages.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Rabbit Research Unit of the National Animal Production Research Institute, (NAPRI), Ahmadu Bello University, Shika, Zaria, Nigeria. Shika is located in the Northern Guinea Savannah between latitude 11º 12' 42" N and longitude 7º 33'14" E at an altitude of 691m above sea level (Ovimaps, 2014). The temperature of Shika ranges between 14.5 – 39.5ºC with a humidity range of 21 - 72% occurring during the early dry and wet season respectively.

Experimental Animals and Management

A total of 28 crossbred rabbit does (New Zealand White X California and California X Chinchilla) of about eight months of age were used. The rabbit does were randomly allotted to four dietary treatments. The treatments consist of concentrate and lablab hay combinations in varying ratios which were fed to pregnant and lactating rabbit does. Pregnant does were offered a total of 150 g/day/doe concentrate and lablab hay combinations (20:130g, 40:110g, 80:70g and 100:50g) while lactating does were offered 350 g/day/doe of the treatments (47:303g, 94:256g, 188:166g and 276:74g) respectively. The lablab hay used was obtained after harvesting the seed, room dried and chopped before feeding to the does. The concentrate diet was formulated to contain crude protein of 22% and metabolizable energy of 2600 ME/Kg (Table 1). The rabbit does were housed individually in metal cages which were housed in a building with large open windows. After mating, pregnancy was confirmed by palpation. Feed and water were offered in flat bottom earthen feeders and drinkers in the morning at 8 am daily. The experiment lasted for four months.

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

Ingredients	Composition (%)
Maize	39.24
Ground-nut cake	42.26
Maize offal	15.00
Bone meal	3.00
Vitamin/mineral premix	0.25
Total	**100.00**

Data collection

Data was collected for dry matter intake, digestible energy required, digestible energy for maintenance, fetal growth and maternal accretion, balance of digestible energy, and digestible energy requirement per metabolic weight per day during pregnancy. During lactation, live weight, dry matter intake, total and daily milk produced, total digestible energy for requirement, digestible energy for maintenance, energy in milk, digestible energy balance, digestible energy requirement per metabolic weight, litter weight at 3 weeks, energy in milk from feed, energy in milk from body energy, body energy retained and total body loss were monitored. Estimations of parameter were done using reference data according to Parigi Bini and Xiccato (1998) during pregnancy and lactation.

Statistical analysis

All data obtained were subjected to analysis of variance using the general linear method while significant means were separated using the pair wise difference method (SAS, 1987). Interaction effects between treatment combinations and stage of pregnancy were not significant and were therefore dropped. The mathematical models used for the study is shown below:

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,

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

Table 2 shows the energy partitioning of pregnant rabbit does offered levels of concentrate and lablab hay combinations. All the parameters considered showed no significant ($P>0.05$) difference between the treatment combinations in energy partitioning by pregnant does. The voluntary DE intake, digestible energy requirement (DE_{req}), digestible energy for maintenance ($DE_{m)}$, digestible energy for foetal growth (DE_{fg}), digestible energy for maternal accretion (DE_{macc}), balance of digestible energy (DE_{bal}) and digestible energy requirement per metabolic weight per day ($DE_{req}/LW^{0.75}$/day) were similar for the high concentrate and low concentrate combinations probably because lablab hay a very digestible forage was used in the combination. This indicates that all the combinations were adequate to meet the requirements for pregnancy in rabbits. This is likely pointing to

the fact that there was high availability of nutrients from the lablab forage in conjunction with the concentrate ensuring the adequacy of energy releasing potential for pregnant rabbit does. This agrees with the report of Ojewole *et al.* (1999) that rabbits perform better when fed mixture of forage and concentrate in equal quantity. Lades (1989) and Xiccato *et al.* (1999) demonstrated that voluntary dry matter intake of reproductive rabbit does is unaffected by dietary energy concentration in the feed consumed when above the critical level of 210 to 310 kcal/d/kg $BW^{0.75}$. Indeed, reports from literature and field practical suggests that, lack of sufficient dry matter intake for energy production causes impediment not only to growth but also to reproductive performance (Smith and Somade 1994). However, it was not the case with this study as the combinations were all adequate to meet energy requirement of the does during pregnancy and therefore supported foetal growth and development and also aid in the kindling of healthy kits.

Table 2: Energy Partitioning of Pregnant Rabbit Does offered levels of concentrate and lablab hay combinations

	Concentrate:Lablab hay combination (g)					
Parameter	**20:130**	**40:110**	**80:70**	**100:50**	**SEM**	**P-value**
DE intake (KJ/day)	2076.62	1972.96	2205.77	1921.18	69.53	0.162
DE_{req} (KJ/day)	1358.86	1316.42	1411.42	1318.78	16.47	0.178
DE_m (KJ/day)	715.11	704.81	727.66	723.22	8.27	0.783
DE_{fg} (KJ/day)	643.75	611.62	683.79	595.57	14.04	0.162
DE_{macc} (KJ/day)	1017.54	966.75	1080.83	941.38	22.20	0.162
DE_{bal} (KJ/day)	717.76	656.54	794.32	602.39	32.14	0.215
DE_{req} (KJ/$LW^{0.75}$/day)	670.61	657.23	686.46	641.11	8.01	0.264

Means within rows with different superscripts are significant ($p<0.05$) different. DM intake = dry matter intake, DE_{req} = Digestible energy required, DE_m = Digestible energy for maintenance, DE_{fg} = Digestible energy for fetal growth, DE_{macc} = Digestible energy for maternal accretion, DE_{bal}= Balance of digestible energy, DEreq/$LW^{0.75}$/day = digestible energy requirement per metabolic weight per day.

Table 3 shows the effect of stage of pregnancy on energy partitioning of rabbit does offered levels of concentrates and lablab hay combinations. Rabbit does in the 4th week of pregnancy had significantly ($P<0.05$) higher DE intake, DE requirement, DE for fetal growth, DE for maternal accretion, balance of DE and DE requirement per metabolic weight than does in the 2nd week of pregnancy although DE for maintenance was similar for does in the 2nd and 4th weeks of pregnancy. The increase in the dry matter and digestible energy intake at the fourth week of pregnancy can be attributed to a need to meet the high energy requirements for proper fetal growth and development and for maternal needs. This is due to the fact that in the second week of pregnancy (early pregnancy period), energy need is more for cell and organ differentiation which is not energy demanding as compared to the last period of pregnancy that involves growth of the fetus, maternal tissue accretion and maintenance. This elaborates and agrees with the earlier report of Iyeghe-Erakpotobor *et al.* (2009) that nutrient requirement increases thereby leading to high nutrient requirement in the fourth week of pregnancy. The digestible energy balance observed in both stages of pregnancy also, indicates the possibilities of maintaining pregnant rabbits on combinations of

concentrates and lablab without adverse effect on reproduction (Iyeghe-Erakpotobor *et al.,* 2009)

Table 3: Effect of Stage of Pregnancy on Energy partitioning of Pregnant Rabbit Does offered levels of concentrates and lablab hay combinations

	Stage of Pregnancy (Weeks)			
Parameter	**2**	**4**	**SEM**	**P-value**
DE intake (KJ/day)	1826.18^{b}	2262.09^{a}	69.53	0.0001
DE_{req} (KJ/day)	1281.28^{b}	1421.48^{a}	16.47	0.0003
DE_{m} (KJ/day)	715.16	720.23	8.27	0.765
DE_{fg} (KJ/day)	566.12^{b}	701.25^{a}	14.04	0.0001
DE_{macc} (KJ/day)	894.83^{b}	1108.42^{a}	22.20	0.0001
DE_{bal} (KJ/day)	544.90^{b}	840.61^{a}	32.14	0.0001
DE_{req} (kJ/$LW^{0.75}$/day)	631.63^{b}	696.08^{a}	8.01	0.0006

Means within rows with different superscripts are significant ($p<0.05$) different. DM intake = dry matter intake, DE_{req} = Digestible energy requirement, DE_{m} = Digestible energy for maintenance, DE_{fg} = Digestible energy for fetal growth, DE_{macc} = Digestible energy for maternal accretion, DE_{bal} = balance of digestible energy, DEreq/$LW^{0.75}$/day = digestible energy requirement per metabolic weight per day.

Table 4 shows the energy partitioning of lactating rabbit does offered concentrate and lablab hay combinations. There was no significant ($P>0.05$) difference in all the parameters considered. Negative digestible energy balance was obtained at 47:303, 94:256 and 276:74 concentrate and lablab combinations with only the 188:166 combination having a positive digestible energy balance (78.55 KJ/day) during lactation. This result agrees with the report of Ojewole *et al.* (1999) that rabbits perform better when fed equal proportions of forage and concentrate. Lactation is an energy demanding process that requires the recruitment of nutrients from feed and body reserves to meet the supply of nutrients lost from the body in milk. The fact that rabbit does on the 188:166 g combination (equivalent of 80:70 g combination during pregnancy) had positive balance of energy indicates the fact that this was a better combination for lactation compared with the other treatments.

Table 4: Energy partitioning by lactating Does fed different combinations of concentrate and Lablab

	Concentrate:Lablab hay combination (g)					
Parameter	**47:303**	**94:256**	**188:166**	**276:74**	**SEM**	**P-value**
Live weight (g)	2380	2330	2570	2400	15.0	0.701
DE intake (KJ/day)	2671.76	2641.18	3024.48	2074.25	157.17	0.779
LWT3 (g)	1166.67	1050.00	1075.00	717.26	189.01	0.425
TMP (Kg/day)	3.39	3.23	3.27	3.27	1.03	0.380
Daily MP (g/day)	161.51	153.79	155.44	104.56	21.72	0.380
TDE_{req} (KJ/day)	2976.46	2862.09	2945.93	2272.26	152.47	0.418
DE_m (KJ/day)	823.02	811.61	873.39	948.77	26.77	0.374
DE_{milk} (KJ/day)	2153.44	2050.47	2072.54	2066.85	40.16	0.835
E_{milk} (KJ/day)	1356.67	1291.80	1305.70	1180.72	37.20	0.496
DE_{bal} (KJ/day)	-304.67	-220.91	78.55	-116.27	53.66	0.135
Doe metabolic weight ($LW^{0.75}$)	1.92	1.89	2.03	2.03	0.08	0.379
DE_{req} (KJ/ $LW^{0.75}$/day)	1567.11	1516.65	1456.03	1233.57	57.18	0.299
E_{milk} FE (KJ/day)	1046.64	953.01	864.21	711.78	47.21	0.159
E_{milk} BE (KJ/day)	310.03	338.79	441.49	329.83	19.31	0.136
BE_{retain} (KJ/day)	397.47	434.35	566.02	422.85	24.80	0.136
Fat loss (KJ/day)	10.89	11.90	15.51	11.59	0.68	0.136
TB loss (KJ/day)	228.68	249.90	325.65	243.29	14.25	0.136

DM intact = Dry matter intake, TMP =Total milk produced, MP =Milk produced, TDE_{req} = Total digestible energy for requirement, DE_m= Digestible energy for maintenance, E_{milk} = Energy in milk, DE_{bal} = Digestible energy balance, $DEreqLW^{0.75}$/day = Digestible energy requirement per metabolic weight, LWT3 = Litter weight at 3 weeks, E_{milk} FE = Energy in milk from feed, E_{milk} BE = Energy in milk from body energy, BE_{retain} = Body energy retain, TB loss = Total body loss.

CONCLUSION

The study reveals that the concentrate and lablab hay combinations were sufficient to provide the necessary digestible energy to meet the physiological needs of rabbit does during pregnancy and lactation phases. However, in the lactation phase, the digestible energy balance was not adequate to cater for the requirements of lactating does on the 47:303, 94:256 and 276:74g combination treatments but was adequate on 188:166 combination treatment. Therefore, dietary manipulations between concentrate and forage with regards to meeting energy needs could be used to advance energy in breeding rabbit does to improve performance.

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