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FEED RESTRICTION DURING PREGNANCY WITH DIETARY VITAMIN E INCLUSION: EFFECT ON WEIGHT OF GESTATING RABBIT DOES IN A TROPICAL ENVIRONMENT

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Abstract
This study evaluated the effect of feed restriction and vitamin E inclusion during pregnancy on weight of does. Sixty rabbits of 20 weeks old ranging from 1.7-2.0 kg were randomly assigned into 12 treatments of 5 replicates during pregnancy. The rabbit does were subjected to two levels of quantitative feed restriction (0%, 15%) at three periods of gestation (15-19 days, 20- 24 days and 25-29 days) with or without vitamin E inclusion (0 and 300mg/kg). Data obtained were arranged in a 2×3×2 factorial arrangement. Interactive effects showed that higher doe weight at kindling was obtained for rabbit does with 15% restriction at 15-19 days of gestation without vitamin E inclusion. Levels and periods of feed restriction applied during pregnancy did not have detrimental effects on the body condition of the does. Furthermore, higher doe weight at weaning obtained for gestating does (15% restriction) with vitamin E inclusion at 15-19 days and 20-24 days of gestation showed that the rabbit does were able to gain more weight after kindling. Hence, it was concluded that feed restriction, and periods of feed restriction, with or without vitamin E inclusion during pregnancy improved body condition of does as there was no abortion or excessive weight loss of the does. Thus, feed restriction can be exploited for gestating rabbit does during the periods of feed scarcity as this will not affect the body conditions of the pregnant female rabbits.

Keywords: Kindling weight, vitamin E, pregnant rabbits, and weaning weight

Introduction

The reproductive performance of rabbit does is influenced by genetic, physiological and environmental factors (Szendro, 2008). The performance of rabbit does during breeding can be affected by nutrition and the environment of the uterus (space and blood supply to fetuses), milk supply to offspring, physiological status of the doe at mating and the rebreeding interval (Szendro, *ibid*). Feeding strategies during rearing in growing rabbits through *ad libitum* feeding can affect the productivity and longevity of rabbit does, as does fed *ad libitum* accumulate excessive body fat leading to inappropriate body condition with age at first insemination, kindling and weaning (Rommers *et al*., 1999; Rommers, 2000). Restrictive feeding of female rabbits combined with delayed in first mating or first insemination to 17.5 weeks of age aids in prevention of excessive fat deposition. (Rommers *et al*., 2001). Excessive feeding of young rabbit does can decrease embryonic survival with subsequent reduction in the number of newborn rabbits, which can also be attributed to excessive fat in does (Fortun-Lamothe and Lebas, 1996). Vitamin E (α-tocopherol) is present in a lipid-soluble antioxidant form responsible for protecting cell membranes from oxidation (Tappel, 1980). Evans and Bishop (1922) indicated that rats failed to maintain fetuses when fed α-tocopherol deficient diet. Inclusion of vitamin E in the diet also helps in embryo viability and development. Hence this study evaluated feed restriction during pregnancy with dietary vitamin E inclusion and its effect on gestating rabbit does in a tropical environment.

Materials and Method

Experimental Site

The experiment was carried out at the Rabbitry Unit of Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State. The site is located in the rain forest vegetation zone of South West Nigeria on latitude 7° 13′ 49.46″ N, longitude 3° 26′ 11.98″E and altitude 76m above sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature and humidity of 34.7°C and 83% respectively (Google Earth, 2018).

Experimental Animals and Management

Sixty (60) five (5) months old does with live weight range of 1.7-2.0 kg were divided into two groups of

thirty (30) rabbits each. The rabbit does were housed in hutches that were disinfected prior to the experiment. Fifteen (15) mature bucks of about 7months old with initial live weight of 2.0-2.5 kg were used for mating the does.

Treatment Description and Experimental Design

Treatments were two (2) levels of quantitative restricted feeding (0 and 15%), three (3) periods (15-19, 20-24, 25-29 days) within the pregnancy duration with or without vitamin E inclusion (0 and 300mg/kg). The does were divided into 12 groups of 5 replicates of 1 rabbit each. Three factors were involved in this study: Quantitative feed restriction, vitamin E, and periods of feed restriction. Rabbit does on 0 % Restriction (control) were fed 100 g/rabbit/day. (*Ad libitum feeding*). Rabbit Does on 15% Restriction were fed 85 g/rabbit/day. Vitamin E inclusion in the diet at 300 mg/kg of feed was chosen based on the recommendation of Virág *et al.* (2008), they reported that rabbits on 300mg/kg performed better than other groups. Rabbits on 0% quantitative restriction were given 100 grams of feed with or without vitamin E inclusion daily throughout the experimental period of 32 days. Rabbits on 15% quantitative feed restriction were given 100 grams of feed daily with or without vitamin E inclusion before and after the restriction periods, while 85 grams of feed were given during the restriction periods. The experiment was laid out in a completely randomized design. The composition of concentrate feed fed to the breeder rabbits is shown on Table 1

Data Collection

Data were collected on the doe weight at kindling and doe weight at weaning.

*Doe weight at kindling***-** This was taken immediately the doe kindled using Avery kitchen scale.

*Doe weight at weaning***-** This was taken after the kits/litters were separated from the does Avery kitchen scale.

Percentage weight loss of doe- This was calculated thus;

$$\text{Percentage weight change} = \frac{\text{weight at kindling} - \text{weight at weaning}}{\text{weight at kindling}} \times 100$$

Statistical Analysis

The experiment was arranged in a 2×3×2 factorial arrangement using a completely randomized design and data collected were subjected to one way analysis of variance using SAS (1999). Significant ($p<0.05$) difference within means were separated using Duncan's Multiple Range Test of the same statistical package.

Table 1: Composition of concentrate breeder diets

	A	**B**
Ingredients (%)		
Maize	47.50	47.50
Fish meal	2.00	2.00
Soybean meal	3.00	3.00
Wheat offal	23.00	23.00
Groundnut cake	12.00	12.00
Rice husk	7.00	7.00
Bone meal	3.00	3.00
Oyster shell	2.00	2.00
Salt	0.25	0.25
*Vitamin and Mineral premix	0.25	0.25
	100	100
Vitamin E	-Vit.E	+ Vit.E
Determined Analysis		
ME (Kcal/kg)	2578.8	2578.8
Ash (%)	5.74	5.74
Crude fibre %	10.65	10.65
Crude protein	16.20	16.20
Nitrogen free extract	42.50	42.50

*** Premix contained: Vit A 8000 iu, Vit D3 2000 iu, Vit E 4000 iu, Vit K 2 mg, Riboflavin 4.20 mg, Vit B12 0.01 mg, Pantothenic acid 5 mg, Nicotinic acid 20 mg, Folic acid 5 mg, Choline 300 g, Mn 56 mg, Fe 20 mg, Cu 10 mg, Zn 50 mg.**

A- Composition of concentrate diet with vitamin E

B- Composition of concentrate diet without vitamin E

Results and Discussion

Effect of levels of feed restriction, periods of feed restriction and vitamin E inclusion during breeding of gestating rabbit does on doe weight at kindling, and doe weight at weaning is shown in Table 2. Doe weight at kindling, and doe weight at weaning were not ($p>0.05$) significantly affected by the levels of feed restriction. This shows that the intensity of feed restriction applied during pregnancy does not have any detrimental effect on the rabbit does. The result obtained in this study is in

contrast to the study of Manal *et al.* (2010), they reported that at kindling, body weight of all restricted does were significantly different compared with the control group. The result obtained on doe weight at weaning was not significantly influenced by levels of feed restriction, following Menchetti *et al.* (2015) and Manal *et al.* (2010), who reported that doe weight at weaning was not significantly affected by feeding levels.

Periods of feed restriction significantly ($p<0.05$) influenced doe weight at kindling. Doe weight at kindling decreased significantly ($p<0.05$) as the periods of restriction increases; this could not be attributed to the treatment effect as the periods of restriction has been completed before the kindling periods. The result obtained on doe weight at kindling in this study is in contrast with the study of Adeyemo (2014), who reported that the periods of feed restriction was not affected by doe weight at kindling. Doe weight at weaning and percentage weight loss was not significantly influenced by the periods of feed restriction; this result corroborates the study of Adeyemo (2014), who reported that doe weight at weaning and percentage weight loss was not significantly influenced by the periods of feed restriction.

Vitamin E dietary inclusion significantly ($p<0.05$) influenced doe weight at weaning. Heavier (2178.33g ± 3.04) doe weight at weaning was obtained in does fed with vitamin E dietary inclusion compared to 2058.33g ± 164.04 obtained for does fed diet without vitamin E inclusion.

Doe weight at weaning was significantly higher in rabbit does fed vitamin E; this result could be attributed to higher weight at kindling that was obtained in this study which corroborates with the findings of Szendro (2008), who reported higher weight at kindling. Vitamin E inclusion did not affect doe weight at kindling. The result is in agreement with the study of Shaibu (2014) who reported that body weight of doe at kindling was not affected with/without vitamin E inclusion.

Table 3 shows the interaction effects between levels and periods of feed restriction of gestating rabbit does during breeding on doe weight at kindling and doe weight at weaning. Doe weight at kindling, weaning and percentage weight loss were not significantly ($p>0.05$) affected by the levels and periods of feed restriction of gestating rabbit does. The result obtained on doe weight at kindling in this study though not significant is in agreement with the study of Menchetti *et al.* (2015), who reported similar weight in doe weight after kindling across the restricted group, which is similar to what was obtained in this study. This shows that the intensity of the restriction was not detrimental to the rabbit does. Doe weight at weaning was not significantly affected by the treatment effect. The result obtained in this study agrees with the study of Breechia *et al.* (2012) that reported similar weight of doe at weaning for rabbit does fasted during pregnancy.

Interaction effects between levels and periods of feed restriction with/without vitamin E inclusion during breeding on doe weight at kindling, and doe weight at weaning, is shown in Table 6. Significant ($p<0.05$) differences were obtained on doe weight at kindling, doe weight at weaning and percentage weight loss. Gestating rabbit does on 15% restriction at 15-19 days of gestation without vitamin E inclusion recorded statistically higher mean (2360.00g ± 151.65) doe weight at kindling, while the least mean values (2070.00 ± 148.32^{b}, 2070.00 ± 160.46^{b}) was obtained for rabbit does on 0 and 15% restriction respectively at 25-29 days of gestation without vitamin E inclusion. Doe weight at weaning was significantly ($p<0.05$) influenced by the dietary treatments with gestating rabbit does on 15% restriction at 15-19 days, and 20-24 days of gestation with vitamin E inclusion recording significant higher mean values respectively (2300.00 ± 209.16^{a}, 2280.00 ± 230.11^{a}), while the least (1940.00 ± 89.44^{b}) was obtained with 15% restriction at 25-29 days of gestation without vitamin E inclusion. The result obtained on doe weight at kindling and doe weight at weaning could be attributed to higher final weight obtained before kindling in this study, which corroborates with the findings of Adeyemo (2014), who reported significant difference on doe weight at kindling, and at weaning in pregnant rabbit does. Percentage weight loss obtained in this study was significantly affected by the dietary treatments; these variations could be attributed to differences obtained on doe weight at kindling and doe weight at weaning.

Table 2: Effect of restriction levels, periods of feed restriction and vitamin E inclusion during breeding on doe weight at kindling and doe weight at weaning

	Levels of feed restriction		Periods of feed restriction			Vitamin E inclusion	
Parameters	**0%**	**15%**	**15-19days**	**20-24days**	**25-29days**	**-Vit.E**	**+Vit. E**
Initial weight (g)	1905.00± 124.81	1936.66 ± 183.32	1957.50 ± 144.43	1917.50 ± 190.75	1887.50 ± 126.57	1916.66 ± 167.29	1925.00± 147.24
Doe weight at kindling (g)	2185.00 ± 152.64	2225.00 ± 214.85	2265.00 ± 182.88[a]	2205.00 ± 199.93[ab]	2145.00 ± 162.14[b]	2161.66 ± 190.59	2248.33 ±173.44
Doe weight at weaning (g)	2095.00 ± 156.11	2141.66 ± 236.74	2140.00 ± 178.88	2147.50 ± 229.11	2067.50 ± 189.37	2058.33 ± 164.04[b]	2178.33 ± 3.04[a]
Percentage (%) weight loss	3.89 ± 6.95	3.56 ± 7.98	5.15 ± 8.80	2.54 ± 6.29	3.48 ± 7.09	4.41 ± 7.65	3.04 ± 7.25

[a, b,]:Means in the same row with different superscripts differ significantly (p<0.05)

Table 3: Interactive effect between levels and periods of feed restriction during breeding on doe weight at kindling and doe weight at weaning

Levels of feed restriction	**0%**			**15%**		
Periods of feed restriction Parameters	**15-19days**	**20-24days**	**25-29days**	**15-19days**	**20-24days**	**25-29days**
Initial weight(g)	1925.00 ± 129.63	1905.00 ± 121.22	1885.00 ± 133.43	1990.00 ± 157.76	1930.00 ± 248.55	1890.00 ± 126.49
Doe weight at kindling (g)	2215.00 ± 159.94	2195.00 ± 164.06	2145.00 ± 140.33	2315.00 ± 198.67	2215.00 ± 239.26	2145.00 ± 189.22
Doe weight at weaning (g)	2085.00 ± 97.32	2120.00 ± 217.56	2080.00 ± 143.75	2195.00 ± 226.62	2175.00 ± 248.60	2055.00 ± 233.86
Percentage (%) weight loss	5.47 ± 7.49	3.34 ± 7.58	2.86 ± 6.13	4.83 ± 10.36	1.74 ± 4.95	4.10 ± 8.23

[a, b,]:Means in the same row with different superscripts differ significantly (p<0.05)

Table 4: Interactive effect between levels of feed restriction with or without vitamin E inclusion during breeding on doe weight at weaning and doe weight at kindling

Levels of feed restriction	**0%**		**15%**	
Vitamin E inclusion Parameters	**+Vit. E**	**-Vit. E**	**+Vit. E**	**-Vit. E**
Initial weight(g)	1900.00 ± 132.28	1910.00 ± 121.30	1950.00 ± 161.46	1923.33 ± 207.76
Doe weight at kindling (kg)	2240.00 ± 147.84	2130.00 ± 141.16	2256.66 ± 200.77	2193.00 ± 230.57
Doe weight at weaning (kg)	2106.66 ± 177.14[b]	2083.33 ± 137.14[b]	2250.00 ± 235.28[a]	2033.33 ± 188.66 [b]
Percentage (%) weight loss	5.92 ± 5.27[a]	1.87 ± 7.96[ab]	0.17 ± 7.96 [b]	6.94 ± 6.64[a]

[a, b]:Means in the same row with different superscripts differ significantly (p<0.05)

Table 5: Interactive effect with or without vitamin E inclusion and periods of feed restriction during breeding of gestating rabbit does on doe weight at kindling and doe weight at weaning

Vitamin E inclusion	+Vit. E			-Vit. E		
Period of Restriction	**15-19days**	**20-24days**	**25-29days**	**15-19days**	**20-24days**	**25-29days**
Parameters						
Initial weight(g)	1960.00 ± 148.69	1930.00 ± 187.37	1885.00 ± 97.32	1955.00 ±148.04	1905.00 ± 203.37	1890.00 ± 155.99
Doe weight at kindling (g)	2260.00 ± 186.78^{a}	2265.00 ± 197.27^{a}	2220.00 ± 147.57^{ab}	2270.00 ± 188.85^{a}	2145.00 ± 193.57^{ab}	2070.00 ± 145.67^{b}
Doe weight at weaning (g)	2195.00 ± 195.00^{a}	2180.10 ± 250.77^{a}	2160.00 ± 224.59^{ab}	2085.00 ± 151.01^{ab}	2115.00 ± 213.50^{ab}	1975.00 ± 79.05^{b}
Percentage (%) weight loss	2.63 ± 8.11	3.79 ± 6.30	2.71 ± 7.94	7.67 ± 9.16	1.29 ± 6.35	4.25 ± 6.46

$^{a, b}$:Means in the same row with different superscripts differ significantly (p<0.05) Table 6: Interactive effect between levels and periods of feed restriction with or without vitamin E inclusion during breeding of gestating rabbit doe during breeding on doe weight at kindling and doe weight at weaning

Table 6: Interactive effect between levels and periods of feed restriction with or without vitamin E inclusion during breeding of gestating rabbit doe during breeding on doe weight at kindling and doe weight at weaning

Levels of feed restriction	0%						15%					
Periods of feed restriction	**15-19days**	**20-24days**	**25-29days**	**15-19days**	**20-24days**	**25-29days**	**15-19days**	**20-24days**	**25-29days**	**15-19days**	**20-24days**	**25-29days**
vitamin E inclusion	**+Vit. E**	**+Vit. E**	**+Vit. E**	**-Vit. E**	**-Vit. E**	**-Vit. E**	**+Vit. E**	**+Vit. E**	**+Vit. E**	**-Vit. E**	**-Vit. E**	**-Vit. E**
Parameters												
Initial weight(g)	1930.00 ± 139.64	1900.00 ± 169.55	1870.00 ± 103.68	1920.00 ± 135.09	1910.00 ± 65.19	1900 ± 169.55	1990.10 ± 167.33	1960.00 ± 219.08	1900.00 ± 100.00	1990.00 ± 167.33	1900.00 ± 297.90	1880.00 ± 160.46
Doe weight at kindling (g)	2250.00± 132.28^{ab}	2250.00 ±223.60^{ab}	2220.00 ±90.82^{ab}	2180.00± 192.35^{ab}	2140.00 ±54.77^{ab}	2070.00± 148.32^{b}	2270.00± 246.47^{ab}	2280.00± 192.35^{ab}	2220.00± 201.86^{ab}	2360.00± 151.65^{a}	2150.00± 285.04^{ab}	2070.00± 160.46^{b}
Doe weight at weaning (g)	2090.00± 119.37^{ab}	2080.00 ±246.47^{ab}	2150.00 ±176.77^{ab}	2080.00± 83.66^{ab}	2160.00 ±204.32^{ab}	2010.00± 54.77^{ab}	2300.00± 209.16^{a}	2280.00± 230.11^{a}	2170.00± 286.35^{ab}	2090.00± 210.35^{ab}	2070.00± 236.11^{ab}	1940.00± 89.44^{b}
Percentage (%) weightloss	7.08±1.76^{ab}	7.49 ±6.09^{ab}	3.17± 5.56^{ab}	3.86± 10.81^{ab}	0.80± 7.02^{b}	2.55± 6.42^{ab}	1.80± 9.76^{b}	0.08± 4.23^{b}	2.25± 9.92^{ab}	11.48± 5.97^{a}	3.39± 5.51^{ab}	5.95± 6.74^{ab}

$^{a, b,}$:Means in the same row with different superscripts differ significantly (p<0.05)

Conclusion

This study evaluated the effect of feed restriction and vitamin E inclusion during pregnancy on weight of does. The result obtained in this study shows that the intensity (levels) of the feed restriction applied during pregnancy did not affect the body condition of the rabbit does. Furthermore the inclusion of vitamin E in the diets of pregnant rabbits resulted in heavier does. It can be concluded that feed restriction and periods of feed restriction with or without vitamin E inclusion during pregnancy improved doe weight at kindling, and weaning.

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