Effects from feed restriction and/or dietary inclusion of vitamin E in primiparous rabbits on growth performances and gestation period

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ABSTRACT

Replacement rabbit does can be given restricted amount of feed until their first mating or parturition, this is necessary in order to avoid excessive fattening, higher perinatal mortality, low voluntary feed intake during early lactation, and shorter reproductive life of does. Thus, this study aimed to evaluate the effect of quantitative feed restriction at different gestation periods with or without vitamin E inclusion on the performance of pregnant rabbit does. Sixty (60) rabbits of 5 months old weighing between 1.7–2.0 kg were randomly assigned into 12 treatments of 5 replicates each. The rabbit does were divided into two groups and placed on two levels of quantitative feed restriction (0% and 15%) at three periods of gestation (15–19, 20–24, and 25–29 days) with or without vitamin E inclusion in their diet (0 and 300 mg/kg). Data obtained on feed intake, weight gain, feed conversion ratio and gestation length of the rabbit does were subjected to analysis of variance using a 2 × 3 × 2 factorial in a completely randomized design. Feed restriction at 15% increased the gestation length (31.20 ± 0.96 days) of rabbit does compared to the *ad libitum* (30.10 ± 0.30 days) fed groups. Gestating rabbit does on feed restriction at 25–29 days of gestation had longer gestation length (31.25 ± 1.16 days) than rabbit does on restriction at 15–19 days (30.40 ± 0.60 days) and 20–24 days (30.30 ± 0.47 days). Vitamin E supplementation did not influence the measured parameters. Final weight, weight gain, and feed conversion ratio were not affected by the levels and periods of feed restriction with or without vitamin E supplementation. Therefore, it can be concluded that feed restriction does not have any detrimental effect on final weight, weight gain, and feed conversion ratio of gestating rabbit does.

Keywords: Growth performance, quantitative feed restriction, vitamin E, pregnant rabbits, gestation length

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INTRODUCTION

There has been an increased interest in studying feed restriction in rabbits over the years as a means of reducing the cost of production and also enhancing the reproductive efficiency of growing rabbits. Basically, there are two methods for restricting feed intake in farm animals, namely, qualitative, and quantitative. Quantitative feed restriction entails reducing the quantity of feed distributed or given to an animal at a particular period of time (Szendrö *et al*., 2000). Feed restriction has been discovered to assist in reducing carcass fat. Limiting feed intake depresses growth during the period of restriction, but reduced growth can be later compensated by realimentation. Feed restriction can be practiced to prevent over-conditioning and can help in improving reproductive performance of

young females and their first litter weight (Rommers *et al*., 2001; Manal *et al*., 2010). Over fattening through *ad libitum* feeding can provoke or enhance subsequent dystocia and impaired reproductive performance (Partridge *et al.,* 1986). Therefore, feed restriction was suggested in pregnant rabbit does by Maertens (1992). Different studies by researchers in temperate regions have reported that restricted feeding can be used to stimulate the voluntary feed intake of rabbits, especially during the gestational period (Rommers *et al*., 1999). Most restriction studies carried out in pregnant rabbits were conducted in temperate regions of the world, thus there is a need to investigate the situation in a tropical environment.

Vitamin E (α-tocopherol) is an important antioxidant that cannot be synthesized by the body and therefore is supplied through the diet. Vitamin E is needed in the diet of young rabbits to prevent reproductive abnormalities, abortion, and poor survivability of kits (Salem and Gomaa, 2014). Diet deficiency in vitamin E can lead to infertility in animals**,** and this is why vitamin E is often referred to as the fertility vitamin (Bowen, 2003). Also, vitamin E inclusion in the diet may enhance the early conception rate in the rabbit. Vitamin E has been discovered as one of the antioxidants that can help to prevent stress during pregnancy (Krieger and Loch-Caruso, 2001). The present study was carried out to investigate the effect of quantitative feed restriction with or without vitamin E inclusion during pregnancy on performance of rabbit does.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Rabbitary Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State. The site is located in the rainforest vegetation zone of South-Western Nigeria on latitude 7° 13' 49.46' N, longitude 3° 26 11.98' E, and altitude 76 m above sea level. The climate is humid with a mean annual rainfall of 1,037 mm and means temperature and humidity of 34.7°C and 83%, respectively (Google Earth, 2018).

Experimental Animals and Management

Sixty (60) 20 weeks old rabbit does that are crosses of chinchilla and New Zealand White with an initial live weight of 1.7–2.0 kg were used for the study. The rabbits were purchased from a reputable farm in Abeokuta, Ogun State. Prior to the commencement of the experiment the hutches were washed and disinfected. The does were divided into two groups of thirty (30) rabbits each after balancing for weight. The rabbit does were subjected to two weeks of acclimatization, after which they were mated. Each doe was carried into the buck's hutch for mating and after successful natural mating, each doe was returned to its hutch. The mating process was carried out in the morning and 10 hours after the 1st mating. The mating ratio was a buck to 5 female does. The bucks were crosses of chinchilla and New Zealand White (24–26 weeks of age). All the females were mated on the same day (24 hours). Pregnancy was confirmed by palpation between 8–10 days after mating.

Experimental Design

Treatments consist of two (2) levels of feed restriction (0 and 15%) at three (3) different periods (15–19, 20–24, and 25–29 days) during pregnancy with or without vitamin E inclusion (0 and 300 mg/kg). The does were divided into 12 groups of 5 replicates of 1 rabbit each. The treatments were arranged as: 0% restriction (control) was fed 100 g/rabbit/day (*ad libitum* feeding) and 15% restriction was fed 85 g/rabbit/day. Rabbits on 0% restriction were offered 100 grams of feed with or without vitamin E inclusion daily throughout the experimental period of 32 days. Rabbits on 15% restriction were offered 100 grams of feed daily with or without vitamin E inclusion before and after the restriction periods, while 85 grams of feed were offered during the periods of feed restriction. The vitamin E was purchased from Rotinol Nigeria Limited. Vitamin E was included in the concentrate at 0 and 300 mg/kg mash given to the rabbit does daily. The composition of concentrate feed fed to the breeder rabbits is shown in Table 1.

Table 1 Composition of concentrate breeder diets

Composition	Diet A	Diet 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
Total	100.00	100.00
Vitamin E (300 mg/kg)	–Vit. E	+ Vit. E
Proximate analysis		
Metabolizable energy (kcal/kg)	2,578.80	2,578.80
Ash (%)	2.74	2.74
Crude fibre (%)	10.65	10.65
Crude protein (%)	16.20	16.20
Nitrogen free extract (%)	42.50	42.50

Note: * Premix contained: vitamin A 8,000 IU, vitamin D3 2,000 IU, vitamin E 4,000 IU, vitamin K 2 mg, riboflavin 4.20 mg, vitamin 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, and Zn 50 mg

Data Collection

The experiment lasted for 32 days during which data were collected on feed intake, changes in weight of rabbit does, feed conversion ratio, gestation length, and weight at kindling. The amount of feed consumed per doe per day was measured and it was used to calculate the average feed intake as follows:

$$\text{Average feed intake (g/rabbit/day)} = \frac{\text{Feed supplied} - \text{Feed leftover}}{\text{Number of days on trial}}$$

Weight gain was measured on weekly basis for 31 days by subtracting the initial weight from the final weight.

$$\text{Weight gain (g/rabbit)} = \text{Final live weight} - \text{Initial live weight}$$

Gestation length was determined by the length of time/duration between the date of successful mating and the date of successful kindling.

Statistical Analysis

The experimental layout was a 2 × 3 × 2 factorial arrangement in a completely randomized design. Significantly ($P < 0.05$) different means were separated using Duncan's new multiple range test of SAS statistical package (SAS, 1999).

Ethical Approval

All rules guiding animal welfare and procedures were strictly adhered to following the rules and regulations of the Animal Welfare Committee of the College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta.

RESULTS AND DISCUSSION

The effects of restriction levels, periods of feed restriction, and vitamin E inclusion on performance of gestating rabbit does are shown in Table 2. Significant ($P < 0.05$) differences were obtained on average feed intake during restriction and gestation length for the levels of feed restriction. Average feed intake during restriction was statistically higher (81.84 ± 2.50 g/day) in gestating does at 0% restriction level compared to 77.63 ± 0.98 g/day recorded for gestating does on 15% feed restriction level. The lower feed intake in the restricted group could be attributed to feed restriction applied on the does and this coincides with the findings of Tůmová *et al.* (2002; 2003) who reported that feed intake in feed restricted rabbits was lower than in rabbits fed *ad libitum*. Gestation length in days was statistically longer (31.20 ± 0.96 days) in 15% feed restricted does compared to 30.10 ± 0.30 days recorded for does on 0% restriction. The result obtained on gestation length in this study though significant is within the range reported by Aduku and Olukosi (1990) who reported that gestation length in normally fed rabbits last between 28–32 days which is in agreement with what was obtained in this study. The reason for the longer gestation length could be attributed to feed restriction. The results obtained on the final weight of the rabbit does showed that vitamin E inclusion did not significantly ($P > 0.05$) affect final weight. However, the results obtained shows that rabbit does fed with vitamin E had heavier weight than rabbit does fed without vitamin E inclusion. The heavier final weight obtained from does fed vitamin E diet could be attributed to addition of vitamin E in the diet of the rabbits, this corroborates the results of Ebeid *et al.* (2013) who reported a significantly heavier body weight in growing rabbits fed vitamin E inclusion. Heavier weight gain obtained for does on vitamin E could be attributed to the inclusion of vitamin E in the diet, this corroborates with the findings of Ebeid *et al.* (2013) who reported a better daily gain in growing rabbits fed vitamin E compared to the control group.

Table 3 shows the interactive effects between levels and periods of feed restriction on performance of gestating rabbit does. The feed conversion ratio was significant ($P < 0.05$) across the dietary treatment levels and periods of feed restriction with gestating does on 0% restriction between 15–19 days and 15% restriction between 25–29 days of gestation recording statistically similar and higher value while the least value 5.52 ± 0.81 and 5.67 ± 0.98 was obtained from gestating does on 15% restriction between 15–19 and 20–24 days of gestation. The best feed conversion ratio obtained from the restricted group could be attributed to better feed utilization. This result is in agreement with the findings of El-Speiy *et al.* (2015) who reported significant improvement in feed conversion ratio for rabbits group fed restricted diet.

Gestation length in days was significantly ($P < 0.05$) affected by levels and periods of feed restriction with gestating rabbit does on 15% restriction between 25–29 days of gestation having the longest gestation length of 32.30 ± 0.48 days compared to the least mean values obtained for gestating rabbit does on 0% restriction between 20–24 days of gestation that recorded the least 30.00 ± 0.21 days. Longer gestation obtained at 15% restriction between 25–29 days of gestation, might be due to feed restriction applied towards the end of pregnancy period, this result supports the work of Rasmussen (1998) who reported that food-restricted females mobilized body fat and reduce their energy expenditure for maintenance and activity especially when feed restriction occurred shortly before parturition.

Table 2 Effect of restriction levels periods of feed restriction and vitamin E inclusion on performance of gestating rabbit does

Parameters	Levels of feed restriction		P-value	Periods of feed restriction			P-value	Vitamin E inclusion		P-value
	0%	15%		15–19 days	20–24 days	25–29 days		-Vit. E	+Vit. E	
Initial weight (g)	1,905 ± 125	1,937 ± 183	0.44	1,958 ± 144	1,918 ± 191	1,888 ± 127	0.37	1,917 ± 167	1,925 ± 147	0.83
Final weight (g)	2,350 ± 138	2,397 ± 214	0.32	2,415 ± 165	2,383 ± 222	2,323 ± 139	0.26	2,362 ± 202	2,385 ± 157	0.62
Weight gain (g)	445 ± 69	460 ± 84	0.45	458 ± 63	465 ± 86	435 ± 80	0.44	445 ± 74	460 ± 80	0.45
Feed conversion ratio	5.96 ± 0.83	5.97 ± 1.03	0.97	5.79 ± 0.70	5.82 ± 1.01	6.28 ± 1.00	0.18	6.05 ± 0.88	5.88 ± 0.97	0.48
AFIBRES (g/rabbit/day)	89.67 ± 2.60	90.20 ± 2.89	0.07	92.86 ± 1.52^{a}	90.09 ± 1.26^{b}	86.86 ± 0.64^{c}	0.01	89.58 ± 2.56	90.29 ± 2.90	0.01
AFIDRES (g/rabbit/day)	81.84 ± 2.50^{a}	77.63 ± 0.98^{b}	0.01	80.16 ± 3.47	79.87 ± 3.31	79.17 ± 1.16	0.20	79.14 ± 2.26^{b}	80.33 ± 3.24^{a}	0.01
AFIDREA (g/rabbit/day)	80.76 ± 2.74	80.19 ± 2.44	0.38	79.65 ± 0.70^{b}	81.60 ± 4.08^{a}	80.16 ± 1.24^{ab}	0.04	80.38 ± 0.89	80.56 ± 3.58	0.78
Gestation length (day)	30.10 ± 0.30^{b}	31.20 ± 0.96^{a}	0.01	30.40 ± 0.60^{b}	30.30 ± 0.47^{b}	31.25 ± 1.16^{a}	0.01	30.76 ± 0.93	30.53 ± 0.86	0.11

Note: ^{a,b,c} Means in the same row with different superscripts differ significantly ($P < 0.05$). AFIBRES = average feed intake before restriction, AFIDRES = average feed intake during restriction, AFIDREA = average feed intake during realimentation

Table 3 Interactive effect between levels and periods of feed restriction on performance of gestating rabbit does

Levels of feed restriction	0%			15%			P-value
Periods of feed restriction	15–19 days	20–24 days	25–29 days	15–19 days	20–24 days	25–29 days	
Initial weight (g)	1,925 ± 130	1,905 ± 121	1,885 ± 133	1,990 ± 158	1,930 ± 249	1,890 ± 126	0.71
Final weight (g)	2,355 ± 136	2,360 ± 166	2,335 ± 120	2,475 ± 175	2,405 ± 274	2,310 ± 161	0.38
Weight gain (g)	430 ± 35	455 ± 86	450 ± 78	485 ± 75	475 ± 89	420 ± 82	0.38
Feed conversion ratio	6.06 ± 0.46^{a}	5.96 ± 1.07^{ab}	5.86 ± 0.93^{ab}	5.52 ± 0.81^{b}	5.67 ± 0.98^{b}	6.70 ± 0.92^{a}	0.03
AFIBRES (g/rabbit/day)	91.86 ± 1.41^{b}	90.64 ± 1.48^{c}	86.51 ± 0.39^{e}	93.86 ± 0.83^{a}	89.53 ± 0.71^{d}	87.20 ± 0.67^{e}	0.01
AFIDRES (g/rabbit/day)	83.40 ± 1.24^{a}	82.10 ± 3.41^{a}	80.04 ± 0.63^{b}	76.92 ± 0.81^{c}	77.65 ± 0.69^{c}	78.33 ± 0.94^{c}	0.01
AFIDREA (g/rabbit/day)	80.07 ± 0.27	81.65 ± 4.51	80.55 ± 1.53	79.24 ± 0.76	81.55 ± 3.85	79.77 ± 0.76	0.21
Gestation length (day)	30.10 ± 0.31^{d}	30.00 ± 0.21^{d}	30.20 ± 0.42^{cd}	30.70 ± 0.67^{b}	30.60 ± 0.51^{bc}	32.30 ± 0.48^{a}	0.01

Note: ^{a,b,c,d,e} Means in the same row with different superscripts differ significantly ($P < 0.05$). AFIBRES = average feed intake before restriction, AFIDRES = average feed intake during restriction, AFIDREA = average feed intake during realimentation

Table 4 shows the interactive effects between levels of feed restriction with or without vitamin E inclusion on performance of gestating rabbit does. The levels of feed restriction with or without vitamin E inclusion significantly ($P < 0.05$) influenced average feed intake during restriction and gestation length. Average feed intake during restriction was statistically higher (82.61 ± 3.09 g/day) in gestating does on 0% restriction with vitamin E inclusion which differs significantly ($P < 0.05$) from similar value obtained for gestating rabbit does on 15% restriction with or without vitamin E inclusion (78.05 ± 1.03 and 77.21 ± 0.75 g/day, respectively). Average feed intake during restriction was higher in *ad libitum* fed rabbits than in the restricted group, this could be attributed to daily full feeding of this does. This finding coincides with the report of Eiben *et al.* (2001) who reported higher average feed intake in *ad libitum* fed group than the restricted group. Gestation length in days was significantly ($P < 0.05$) influenced by levels of feed restriction and vitamin E inclusion. The longest gestation length (31.46 ± 0.83 days) was documented for rabbit does on 15% restriction without vitamin E inclusion while, comparable mean values were obtained for does on 0% restriction with (30.13 ± 0.35 days) and without (30.06 ± 0.25 days) vitamin E inclusion. The significant difference obtained in gestation length for the periods of feed restriction could be attributed to feed restriction applied towards the end of pregnancy. Gestation length obtained for the periods of feed restriction though significant is within the range reported by Adeyinka *et al.* (2007) who reported a gestation length of 30 and 33 days in rabbit does.

Table 4 Interactive effect between levels of feed restriction with or without vitamin E inclusion on performance of gestating rabbit does

Levels of feed restriction	**0%**		**15%**		**P-value**
Vitamin E inclusion	**+Vit. E**	**-Vit. E**	**+Vit. E**	**-Vit. E**	
Initial weight (g)	1,900 ± 132	1,910 ± 121	1,950 ± 161	1,923 ± 208	0.84
Final weight (g)	2,363 ± 138	2,337 ± 141	2,407 ± 175	2,387 ± 252	0.74
Weight gain (g)	463 ± 74	427 ± 59	457 ± 88	463 ± 83	0.51
Feed conversion ratio	5.79 ± 0.94	6.13 ± 0.70	5.96 ± 1.03	5.97 ± 1.05	0.81
AFIBRES (g/rabbit/day)	90.16 ± 2.91	89.18 ± 2.24	90.42 ± 3.00	89.98 ± 2.87	0.64
AFIDRES (g/rabbit/day)	82.61 ± 3.09^{a}	81.06 ± 1.45^{b}	78.05 ± 1.03^{c}	77.21 ± 0.75^{c}	0.01
AFIDREA (g/rabbit/day)	81.46 ± 3.80	80.05 ± 0.28	79.66 ± 3.23	80.71 ± 1.16	0.24
Gestation length (day)	30.13 ± 0.35^{c}	30.06 ± 0.25^{c}	30.93 ± 1.03^{b}	31.46 ± 0.83^{a}	0.01

Note: ^{a,b,c} Means in the same row with different superscripts differ significantly ($P < 0.05$). AFIBRES = average feed intake before restriction, AFIDRES = average feed intake during restriction, AFIDREA = average feed intake during realimentation

Table 5 shows the interactive effects with or without vitamin E inclusion and periods of feed restriction on performance of gestating rabbit does. Significant ($P < 0.05$) differences were obtained on weight gain, average feed intake before restriction, average feed intake during realimentation, and gestation length. Heavier weight gain was recorded for gestating rabbit does with and without vitamin E inclusion. Comparable mean values were obtained for weight gain for gestating rabbit does on most dietary treatments which differ significantly ($P < 0.05$) from rabbit does on 25–29 days of gestation without vitamin E inclusion. Average feed intake before restriction was statistically similar and higher for gestating rabbit does with or without vitamin E inclusion at 15–19 days of gestation compared to the least value obtained at 25–29 days of gestation with and without vitamin E inclusion. Gestation length

was significantly (P < 0.05) influenced by vitamin E inclusion and periods of feed restriction. The longest gestation length (31.30 ± 1.05 days) was recorded for rabbit does with vitamin E inclusion at 25–29 days of gestation while the shortest gestation length 30.10 ± 0.31 days was recorded from rabbit does with vitamin E inclusion at 15–19 days of gestation. However, final weight and average feed intake during restriction were not significantly (P > 0.05) influenced by the periods of feed restriction with or without vitamin E inclusion.

The interactive effect between levels and periods of feed restriction with or without vitamin E inclusion on performance of gestating rabbit does is shown in Table 6. Weight gain varies across the dietary treatments, comparable mean values were obtained for weight gain of rabbits at most restriction levels and periods with or without vitamin E inclusion however, weight gain of rabbit does on 15% restriction at 15–19 days of gestation without vitamin E inclusion differed significantly (P < 0.05) from those on 15% restriction at 25–29 days of gestation without vitamin E inclusion. The result obtained for higher weight gain from the restricted group could be attributed to a catch-up growth process that occurs during and after the restriction. This result agrees with the work of Tůmová *et al.* (2003) who also reported a form of compensatory growth and typical weight gain in the restricted group than *ad libitum* groups. Feed conversion ratio was best from does on 15% level of feed restriction at 15–19 days of gestation without vitamin E inclusion while the poorest feed conversion ratio was recorded from does on 15% restriction at 25–29 days of gestation without vitamin E inclusion. The result obtained on feed conversion ratio supports the findings of El-Speiy *et al.* (2015) who reported the best feed conversion ratio in the restricted rabbits than the control groups. Feed intake before restriction differs significantly (P < 0.05) across the dietary treatments. Gestating rabbit does on 15% restriction at 15–19 days of gestation with or without vitamin E inclusion recorded statistically higher mean values (94.25 ± 0.53 and 93.48 ± 0.95 g/day, respectively) which differ significantly (P < 0.05) from rabbit does on 0 and 15% restriction with or without vitamin E inclusion at 25–29 days of gestation. This result corroborates the work of Abdel-Khalek *et al.* (2008) who reported higher feed intake from rabbit does fed vitamin E inclusion during pregnancy than in the control groups. Average feed intake during restriction was highest from rabbit does on 0% restriction between 15–19 days of gestation without vitamin E inclusion, while the least value was obtained at 15% restriction between 15–19 days of gestation without vitamin E inclusion. The significant effect obtained on average feed intake during restriction with or without vitamin E inclusion across the dietary treatments could be attributed to restrictive feeding applied on rabbits in restricted group compared to the *ad libitum* fed group. Average feed intake during realimentation differed (P < 0.05) across the dietary treatments. Gestating rabbit does on 0% restriction between 20–24 days of gestation with vitamin E inclusion recorded a statistically higher (83.20 ± 6.92 g/day) value, while the least was obtained from does on 15% restriction at 15–19 days of gestation with vitamin E inclusion. Gestation length in days was significantly (P < 0.05) higher from does on 15% restriction at 25–29 days of gestation with or without vitamin E inclusion however, comparable mean values were obtained from does on 0% restriction with or without vitamin E inclusion. The result obtained might be due to feed intake adjustment of the does during restriction which resulted in lower feed intake during realimentation, this disagrees with the work of Rizzi *et al.* (2008) who recorded those animals under quantitative and qualitative feed restriction exhibited compensatory growth as a consequence of increase feed intake after restrictive feeding.

Table 5 Interactive effect with or without vitamin E inclusion and periods of feed restriction on performance of gestating rabbit does

Vitamin E inclusion	+Vit. E			-Vit. E			P-value
Periods of feed restriction	**15–19 days**	**20–24 days**	**25–29 days**	**15–19 days**	**20–24 days**	**25–29 days**	
Initial weight (g)	1,960 ± 149	1,930 ± 187	1,885 ± 97	1,955 ± 148	1,905 ± 203	1,890 ± 156	0.83
Final weight (g)	2,410 ± 174	2,385 ± 187	2,360 ± 110	2,420 ± 164	2,380 ± 263	2,285 ± 160	0.62
Weight gain (g)	450 ± 62^{a}	455 ± 86^{ab}	475 ± 95^{a}	465 ± 67^{ab}	475 ± 89^{a}	395 ± 28^{b}	0.04
Feed conversion ratio	5.84 ± 0.71	5.96 ± 1.11	5.82 ± 1.14	5.73 ± 0.72	5.67 ± 0.94	6.73 ± 0.57	0.10
AFIBRES (g/rabbit/day)	93.34 ± 1.54^{a}	90.42 ± 1.72^{b}	87.12 ± 0.68^{c}	92.39 ± 1.42^{a}	89.76 ± 0.44^{b}	86.59 ± 0.49^{c}	0.01
AFIDRES (g/rabbit/day)	80.75 ± 3.58	80.72 ± 4.41	79.52 ± 0.63	79.57 ± 3.45	79.02 ± 1.44	78.82 ± 1.48	0.05
AFIDREA (g/rabbit/day)	79.43 ± 0.85^{b}	82.13 ± 5.75^{a}	80.12 ± 1.78^{ab}	79.88 ± 0.44^{ab}	81.07 ± 1.19^{ab}	80.20 ± 0.32^{ab}	0.01
Gestation length (day)	30.10 ± 0.31^{b}	30.20 ± 0.42^{b}	31.30 ± 1.05^{a}	30.70 ± 0.67^{ab}	30.40 ± 0.51^{b}	31.20 ± 1.31^{a}	0.03

Note: ^{a,b,c} Means in the same row with different superscripts differ significantly ($P < 0.05$). AFIBRES = average feed intake before restriction, AFIDRES = average feed intake during restriction, AFIDREA = average feed intake during realimentation

Table 6 Interactive effect between levels and periods of feed restriction with or without vitamin E inclusion on performance of gestating rabbit does

Levels of feed restriction	Periods of feed restriction	Vitamin E inclusion	Initial weight (g)	Final weight (g)	Weight gain (g)	Feed conversion ratio	AFIBRES (g/rabbit/day)	AFIDRES (g/rabbit/day)	AFIDREA (g/rabbit/day)	Gestation length (day)
0%	15–19 days	+Vit. E	1,930 ± 140	2,370 ± 130	440 ± 22^{ab}	5.90 ± 0.26^{ab}	92.42 ± 1.73^{bc}	84.06 ± 1.10^{a}	80.10 ± 0.32^{ab}	30.00 ± 0.00^{d}
	20–24 days	+Vit. E	1,900 ± 170	2,350 ± 212	450 ± 100^{ab}	6.16 ± 1.32^{ab}	91.36 ± 1.87^{c}	83.92 ± 4.19^{a}	83.20 ± 6.92^{a}	30.00 ± 0.00^{d}
	25–29 days	+Vit. E	1,870 ± 104	2,370 ± 67	500 ± 79^{ab}	5.30 ± 0.91^{b}	86.71 ± 0.28^{e}	79.87 ± 0.67^{b}	81.09 ± 2.14^{ab}	30.40 ± 0.54^{cd}
	15–19 days	-Vit. E	1,920 ± 135	2,340 ± 156	420 ± 45^{ab}	6.21 ± 0.59^{ab}	91.30 ± 0.84^{c}	82.75 ± 1.10^{a}	80.04 ± 0.25^{ab}	30.20 ± 0.44^{d}
	20–24 days	-Vit. E	1,910 ± 65	2,370 ± 130	460 ± 82^{ab}	5.75 ± 0.87^{b}	89.93 ± 0.38^{d}	80.28 ± 0.65^{b}	80.11 ± 0.46^{ab}	30.00 ± 0.00^{d}
	25–29 days	-Vit. E	1,900 ± 170	2,300 ± 155	400 ± 35^{ab}	6.42 ± 0.57^{ab}	86.31 ± 0.41^{e}	80.15 ± 0.64^{b}	80.02 ± 0.04^{ab}	30.00 ± 0.00^{d}
15%	15–19 days	+Vit. E	1,990 ± 167	2,450 ± 218	460 ± 89^{ab}	5.78 ± 1.03^{ab}	94.25 ± 0.53^{a}	77.45 ± 0.68^{cd}	78.76 ± 0.65^{b}	30.20 ± 0.44^{d}
	20–24 days	+Vit. E	1,960 ± 219	2,420 ± 175	460 ± 82^{ab}	5.76 ± 0.96^{b}	89.47 ± 0.95^{cd}	77.53 ± 0.86^{cd}	81.06 ± 5.67^{ab}	30.40 ± 0.54^{cd}
	25–29 days	+Vit. E	1,900 ± 100	2,350 ± 150	450 ± 100^{ab}	6.34 ± 1.20^{ab}	87.54 ± 0.74^{e}	79.17 ± 0.39^{bc}	79.16 ± 0.47^{b}	32.20 ± 0.44^{a}
	15–19 days	-Vit. E	1,990 ± 167	2,500 ± 141	510 ± 55^{a}	5.26 ± 0.51^{b}	93.48 ± 0.95^{ab}	76.39 ± 0.56^{d}	79.72 ± 0.57^{b}	31.20± 0.44^{b}
	20–24 days	-Vit. E	1,900 ± 298	2,390 ± 371	490 ± 99^{ab}	5.59 ± 1.10^{b}	89.59 ± 0.47^{d}	77.76 ± 0.54^{cd}	82.04 ± 0.81^{ab}	30.80 ± 0.44^{bc}
	25–29 days	-Vit. E	1,880 ± 160	2,270 ± 179	390 ± 22^{b}	7.05 ± 0.39^{a}	86.87 ± 0.42^{e}	77.48 ± 0.28^{cd}	80.39 ± 0.39^{ab}	32.40 ± 0.54^{a}
P-value			0.98	0.85	0.03	0.02	0.01	0.01	0.03	0.01

Note: ^{a,b,c,d,e} Means in the same column with different superscripts differ significantly ($P < 0.05$). AFIBRES = average feed intake before restriction, AFIDRES = average feed intake during restriction, AFIDREA = average feed intake during realimentation

CONCLUSIONS

Based on the results of this study it can be concluded that feed restriction does not have any detrimental effect on the final weight, weight gain, and feed conversion ratio of gestating rabbit does. Feed restriction with or without E inclusion did not have any influence on the length of gestation periods of the pregnant rabbit does.

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