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Pre weaning and post weaning performance of kits from rabbits does exposed to different restriction levels at different periods of gestation

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Target Audience: Rabbit farmers and Researchers

Abstract

It is a common practice in commercial rabbit production to feed rabbit does to appetite directly after mating and during gestation. The young does fed ad libitum with diets of high energy level often show parturition problems and excessive fatness; Thus this study aimed to examine whether feed restriction during pregnancy could induce compensatory growth after kindling in growing rabbits. A total of 36 nulliparous does of mixed breeds were randomly assigned into nine treatments of 4 replicates each during pregnancy. The rabbit does were exposed to three levels of quantitative feed restriction (0%, 15% and 30%) at three different periods of gestation (15-19days, 20-24days, 25-29days). At weaning, the kits were subdivided into 4 replicates of 3 rabbits each; thus making 9 treatments of 12 rabbits each making a total of 108 rabbit litters. After weaning, the rabbits were fed ad libitum. Data were collected on pre and post weaning performance. Results obtained showed that kits from rabbit does fed ad libitum during gestation and does on 15% restriction at the 15 - 19th day of gestation recorded significantly ($p<0.05$) higher mean values for average weight at birth. Post weaning performance showed that weight gain was highest ($p<0.05$) in kits from does exposed to 15% restriction restricted at the 20 – 24th day of gestation. It can be concluded that maintaining gestating rabbit does on 15% restriction level between the 20th to 24th day and 25th to 29th day of pregnancy will not have adverse effect on their offsprings at growing phase.

Keywords*:* Feed restriction; pre weaning and post weaning performance; kits and does.

Description of Problem

Nutritional disorders are known to reduce reproductive and productive performance (1, 2). Diets with inadequate energy contents can induce both an excessive fatness and malnutrition of the does with subsequent reduction in number and growth of newborns (3, 4). A wide range of evidence indicates that nutritional and hormonal environment during pregnancy influences not only foetal growth but also postnatal development (5). In commercial rabbit farm, the body condition and the energy balance of females are particularly critical because the does are generally inseminated during lactation and this could affect does and kits performance (6). It is important to find specific feeding plans to stimulate voluntary feed intake during the gestational period in the does which may be a feasible approach towards reduction of the energy deficit and improvement of performance (7). Several studies have demonstrated that after a restricted feeding, the appetite of rabbits improves and a sharp

increase for voluntary feed intake occurs (8). Furthermore, In order to reduce the excessive fatness of young does, restricted feeding during pregnancy is frequently applied to obtain uniformity in their body weights, to avoid fattening and high mortalities around parturition (9), to increase voluntary (8) intake at the beginning of the lactation period, and to allow a long productive life (10). Also, feed restriction could be exploited in the feeding regimen of rabbits, especially in periods of inadequate supply of concentrates and forages (11). But, feed restriction for rabbits has to be considered as a stress condition and applied with attention when other stressors occur (12). In as much as previous studies have examined the effect of feed restriction on the reproductive performance of rabbit does (13) (14), these studies have failed to examine its effect at different periods of pregnancy on their reproductive performance, pre and post weaning performances. Therefore, this study aimed at investigating the effect of exposing rabbit does to different levels of feed restriction at different stages of pregnancy on reproductive, pre and post weaning performances.

Materials and Methods

The experiment was carried out at the rabbitary Unit of the Directorate of University Farms, Federal University of Agriculture, Abeokuta, Ogun State. The site is located in the rain forest vegetation zone of South-Western Nigeria on latitude 7^{o} 13' 49.46'' N, longitude 3^{o} 26 11.98E and altitude 76m above the sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature and humidity of 34.7^{0}C and 83%, respectively (15).

Experimental Animals and Management

Thirty six nulliparous rabbits does of mixed breed were exposed to 3 levels of quantitative feed restriction (0%, 15% and 30%) at 3 pregnancy periods (15-19d, 20-24d, 25-29d). The rabbit does were randomly allotted into nine treatments of four replicates per treatment. Natural mating was done and the rabbit does were mated twice (early in the morning and 10 hours after the first mating) at a mating ratio of 1 buck to 5 does. After parturition, all does and their kits were provided *ad libitum* quantity of feed till weaning. At weaning, three rabbits kits were selected on the basis of closeness to the replicates mean weight from each replicate doe. This was subdivided into 4 replicates of 3 rabbits each; thus making 9 treatments of 12 rabbits each. After weaning, all rabbits selected were fed *ad libitum* each day.

Experimental Design

The pregnant does were exposed to three levels of restricted concentrate feeding (0, 15 and 30%) at three periods of pregnancy (15-19, 20-24, 25-29 days) in a 3 x 3 factorial arrangement in a one-way ANOVA. Composition of concentrate diets fed during pregnancy, after pregnancy and after weaning the kits are shown in Table 1. The composition of concentrate diet fed to growing rabbit after weaning is shown in Table 1 under B

0% Restriction (control) was fed (100 g/rabbit/day). (*Ad libitum fed*)

15% Restriction was fed (85 g/rabbit/day).

30% Restriction was fed (70 g/rabbit/day).

Table 1: Composition of concentrate diet (% as fed)

Ingredients	A **%**	B **%**
Maize	47.50	48.00
Fish meal	2.00	2.00
Soybean meal	3.00	3.00
Wheat offal	23.00	10.00
Groundnut cake	12.00	14.00
Rice husk	7.00	20.00
Bone meal	3.00	1.50
Oyster shell	2.00	1.00
Salt	0.25	0.25
Vitamin and Mineral premix	0.25	0.25
	100	100.00
Determined Analysis		
ME (Kcal/kg)	2578.8	2591.80
Ash (%)	2.74	2.74
Crude fibre %	10.65	15.50
Crude protein	16.20	15.80
Nitrogen free extract	42.50	40.50

Note*: premix: Vit A 8000 iu, Vit D3 2000 iu, Vit E 5 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 fed to rabbit does during pregnancy

B- Composition of concentrate diet fed to post-weaned rabbits

Pre-weaning performance

Records of kit weight at birth, weaning weight, litter size at birth and at weaning were taken. The pre-weaning period lasted for 6 weeks.

Post-weaning performance

The post-weaning period lasted for 10 weeks. At weaning, 12 kits whose weights were close to the treatments mean weight were selected from each treatment making a total of one hundred and eight (108) weaned rabbits. The following parameters were measured during the post weaning period; Feed intake of rabbit after weaning**,** Weight gain**,** Feed conversion ratio of the weaned rabbit (FCR).

Statistical Analysis

All data collected from the 3 x 3 factorial design were subjected to a one-way ANOVA using SAS (2005). Significantly ($p<0.05$) different means were separated using Duncan's Multiple Range Test of the same statistical package.

Results and Discussion

Table 2 shows the effects of levels of feed restriction and periods of feed restriction during pregnancy on pre-weaning performance of kits. Result obtained showed that kits from rabbit does fed *ad libitum* during the pregnancy period recorded significantly higher average litter weight at birth and average weight of kit at birth. This result indicates that *ad libitum* feeding during pregnancy helps in enhancing kit weight at birth. According to (16), nutrient supply to embryos and foetuses is exclusively dependent upon the condition of

the does. Consequently, as the body size of the does decreases, the litter weight at kindling also reduces (17). Furthermore, reduction of total caloric intake during pregnancy, eating disorders, and related indicators such as low pregnancy weights of does account for a significant proportion of foetal growth retardation (18). Feed restriction at all levels examined in this study did not significantly influence pre-weaning weight gain and average litter weight at weaning. This result shows that despite the significantly reduced birth weight of kit from restricted does, kits from restricted does were still able to catch up with kits from does fed *ad libitum* during pregnancy thereby having similar weights at weaning. This result coincides with the reports of (1, 14) and (19) that reported that applying restricted feeding during gestation period did not affect weaning weight of the kits.

The interaction between feed restriction level and period of feed restriction on litter performance indices (Table 3) shows that litter size at birth and litter weight at birth were not significantly ($p>0.05$) affected by the interaction between levels of feed restriction and periods of feed restriction during pregnancy. According to (20) litter size at birth and litter weight at birth are economic traits which have been identified to affect the profit functioning of rabbit farm. This result suggests that exposing rabbit does to up to 30% restriction level at any period of pregnancy will not adversely affect the litter size and litter weight at birth of the kits. This result also supported the report of (21) who reported a strong correlation between litter size at birth and litter weight at birth in rabbit does. Kits from does exposed to 15% restriction level at the 25th – 29th day of pregnancy recorded the highest value for pre-weaning weight gain while the least was obtain from the same level at 20- 24th day of pregnancy. This is an indication that exposing pregnant does to *ad libitum* feeding throughout pregnancy did not have an advantage on weight gain of the kits at the end of the pre-weaning phase. This results also supports the findings of (19) who reported higher pre-weaning weights on kits from rabbit does placed on 15% restriction at the first half of pregnancy.

Table 2: Main effect of level and period of feed restriction during pregnancy on pre-weaning performance of kits

	Level of feed restriction of does				Period of feed restriction of does			
Parameters	0%	15%	30%	SEM	15-19 days	20-24 days	25-29 days	SEM
Average litter size at birth/doe	5.50	5.16	4.83	0.37	5.00	5.33	5.25	0.40
Average litter weight at birth/(g)/doe	266.58^{a}	212.51^{b}	185.58^{b}	15.36	217.24	225.48	221.94	18.43
Average weight of kit at birth/(g)/kit	48.46^{a}	41.18^{b}	38.42^{c}	0.91	43.44	42.30	42.27	1.54
Average litter size at weaning/doe	4.92^{a}	4.00^{ab}	3.67^{b}	0.35	4.25	4.33	4.00	0.38
Litter weight at weaning/(g)/doe	2530^{a}	2053^{b}	2002^{b}	166.04	2182	2015	2305	180.50
Pre weaning weight gain/(g)/kit	465.76	472.29	507.08	43.92	469.97^{ab}	423.05^{b}	533.98^{a}	40.72
Average litter weight at weaning/(g)/kit	514.22	513.47	545.50	42.81	513.41	465.35	576.25	41.16

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

SEM: Standard error of mean

Table 3: Interaction between level and period of feed restriction during pregnancy on pre-weaning performance of kits

Level of feed restriction	0%			15%			30%			
Period of feed restriction	15-19 days	20-24 days	25-29 days	15-19 days	20-24days	25-29 days	15-19 days	20-24 days	25-29 days	SEM
Average litter size at birth	5.50	5.50	5.50	4.75	5.25	5.50	4.50	5.25	4.75	0.77
Litter weight at birth/(g)/doe	264.75	269.25	265.75	216.42	209.35	211.75	170.56	197.85	188.32	30.26
Average weight at birth/(g)/kit	48.13^{a}	48.95^{a}	48.31^{a}	45.56^{a}	39.87^{b}	38.50^{b}	37.90^{b}	37.68^{b}	39.64^{b}	1.59
Average litter size at weaning/doe	4.75^{ab}	4.75^{ab}	5.25^{a}	4.5^{ab}	4.5^{ab}	3.00^{b}	3.50^{ab}	3.75^{ab}	3.75^{ab}	0.64
Litter weight at weaning/(g)/doe	2525	2530	2535	2185	1672	2050	1835	1843	2330	302.75
Av. litter weight at weaning/(g)/kit	531.57^{ab}	532.63^{ab}	482.85^{ab}	485.55^{ab}	371.55^{b}	683.33^{a}	524.28^{ab}	491.46^{ab}	621.33^{ab}	71.08
Pre-weaning weight gain/(g)/kit	483.44^{ab}	483.80^{ab}	434.54^{ab}	439.99^{ab}	331.68^{b}	644.83^{a}	486.38^{ab}	453.78^{ab}	581.69^{ab}	72.78

$^{a, b, c}$:Means in the same row with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

Table 4 shows the effects of restriction levels and the periods of restriction during pregnancy on the post weaning performance of rabbit kits. Final weight and weight gain of the weaned rabbits were significantly ($p<0.05$) influenced by the restriction levels. Weaned rabbits from does fed *ad libitum* throughout pregnancy recorded the highest values for final weight and weight gain. This suggests that maternal feed restriction during pregnancy may have an aftermath effect on rabbit kits at the growing or post weaning stage. Despite the significant differences obtained on weight gain on post weaning performance, feed conversion ratio and average daily feed intake were not significantly ($p>0.05$) affected by the maternal restriction during pregnancy. This result is similar to what was reported by (22) when pregnant rabbit does were placed on 50% restriction level and others fed *ad libitum* diets.

From this study, off springs from rabbit does exposed to 15% restriction level at the 25th to 29th day of pregnancy recorded the highest weight gain at the post weaning stage. According to (23) the rabbit's growth is mainly dependent on two factors, birth weight and litter size. This might have been responsible for the significantly higher value recorded by off springs from rabbit does restricted at the 25th to 29th day of pregnancy because they are among the treatments that recorded significantly higher values for birth weight and litter size. This might also be attributed to compensatory growth, a phenomenon well documented in rabbits, when *ad libitum* feeding is applied after restricted feeding (24).

Table 4: Main effect of level and period of feed restriction during breeding on post-weaning performance

Parameters	Level of feed restriction of does				Period of feed restriction of does			
	0%	15%	30%	SEM	15-19 days	20-24 days	25-29 days	SEM
Initial weight (g)	514.42	519.11	540.16	40.23	509.91	469.48	594.29	42.25
Final weight (g)	1402.22^{a}	1347.22^{ab}	1347.22^{ab}	28.45	1308.61^{b}	1358.88^{b}	1429.16^{a}	29.56
Weight gain (g)	887.8^{a}	828.11^{b}	807.05^{b}	32.91	798.23^{c}	889.4^{a}	834.87^{b}	30.15
Average feed intake /rabbit/day	57.98	52.94	57.53	1.17	57.66	55.58	55.21	1.15
Feed conversion ratio	4.56	4.47	4.98	0.24	5.08^{a}	4.40^{b}	4.62^{b}	0.20

$^{a, b, c}$:Means in the same row with different superscripts differ significantly ($p<0.05$) *SEM*: standard error of means

Table 5: Interaction between level and period of feed restriction during breeding on post-weaning performance

Level of feed restriction of does	0%			15%			30%			SEM
Periods of restriction of does Parameters	15-19 days	20-24 days	25-29 days	15-19 days	20-24 days	25-29 days	15-19 days	20-24 days	25-29 days	
Initial weight (g)	528.25	530.45	484.56	481.50	392.50	683.33	520.00	485.50	615.50	38.69
Final weight (g)	1400.83^{a}	1405.83^{a}	1400.00^{a}	1212.50^{b}	1379.16^{a}	1450.00^{a}	1312.50^{ab}	1291.66^{ab}	1437.50^{a}	46.01
Weight gain (g)	872.58^{ab}	875.38^{ab}	915.44^{a}	731^{b}	986.66^{a}	766.67^{b}	792.5^{b}	806.16^{ab}	822.50^{ab}	51.80
Average feed intake/rabbit/day	57.93	58.02	57.99	59.12	53.61	46.10	55.94	55.13	61.54	0.29
Feed conversion ratio	4.64.	4.63	4.43	5.66	3.80	4.20	4.94	4.78	5.23	0.34

$^{a, b, c}$:Means in the same row with different superscripts differ significantly ($p<0.05$)
SEM: Standard error of mean

Conclusion and Application:

This study revealed that:

1. Feed restriction during pregnancy did not result into abortion or skeletal malformation of rabbit does during pregnancy.
2. Feed restriction did not affect litter size at birth, litter weight at birth and litter weight at weaning.
3. Feed restriction during pregnancy did not affect post weaning performance as some of the growing rabbits whose does were restricted during pregnancy were able to catch up with the *ad libitum* fed groups.
4. Maintaining gestating rabbit does on 15% restriction level between the 20th to 24th day and 25th to 29th day of pregnancy will not have adverse effect on the performance of their offsprings at growing phases.

References

1. Rommers, J. M., Meijerhof, R., Noordhuizen, J. P. T. M. and Kemp, B. *2004* "The effect of level of feeding in early gestation on reproductive success in young rabbit does," *Animal Reproduction Science, volume 81, no. 1-2, pp. 151–158.*
2. Brecchia, G., Bonanno, A., Galeati, G., Federici, C., Maranesi, M., Gobbetti, A., 2006. Hormonal and metabolic adaptation to fasting: effects on the hypothalamic-pituitary-ovarian axis and reproductive performance of rabbit does. *Domestic Animal Endocrinology* 31, 105–122.
3. Fortun-Lamothe L.and Lebas 2006. Energy balance and reproductive

performance in rabbit does. *Animal Reproduction Science, 93, 1–15*.

4. Matsuoka, T., Mizoguchi, Y., Serizawa, K., Ishikura, T., Mizuguchi, H. and Asano,Y. 2006."Effects of stage and degree of restricted feeding on pregnancy outcome in rabbits," *Journal of Toxicological Sciences*, vol. 31, no. 2, pp. 169–175,.
5. Godfrey K.M., Barker D.J. 2001. Foetal programming and adult health. Public Health Nutrition, 4, 611–624.
6. Fernández-Carmona, J., Pascual, J.J., Cervera C. 2000. The use of fat in rabbit diets. *World Rabbit Science, 8(C), 29–59.*
7. Castellini, C., Dal Bosco A., Arias-Álvarez M., Lorenzo P.L., Cardinali, R., Rebollar P.G. 2010. The main factors affecting the reproductive performance of rabbit does: a review. *Animal Reproduction Science*, 122; 174-82.
8. Rommers, J.M., Kemp, B., Meijerhof, R., Noordhuizen, J.P.T.M.,1999. Rearing management of rabbit does. A review. World Rabbit Sci., 7, 125–138.
9. Rommers, J.M., Kemp, B Meijerhof, R. and Noordhuizen, J.P.T.M 2001. "The effect of litter size before weaning on subsequent body development, feed intake, and reproductive performance of young rabbit does, *Journal of Animal Science* vol. 79, no. 8, pp. 1973–1982,
10. Partridge, G. G., Daniels, Y., and Fordyce, R. A, 1986. The effects of energy intake during pregnancy in doe rabbits on pup birth weight, milk output and maternal body composition change in the ensuing lactation. *Journal of Agricultural Science*, vol.107, pp. 697–708.
11. Yakubu, A., Salako, A. E., Ladokun, A. O., Adua, M. M., and Bature, T. U.K. 2007. Effects of feed restriction on performance, carcassyield, relative organ weights and some linear body measurements of weaner rabbits, *Pakistan Journal of Nutrition*, vol. 6,no. 4, pp. 391–396
12. Bovera, F., Di Meo, C., Marono, S., Vella, N. and Nizza, A. 2008. Feed restriction during summer: effect on rabbit growth performance, in *Proceedings of the 9th World Rabbit Congress of Nutrition and Digestive Physiology*, Verona, Italy,.
13. Abeer, N, Souad, A.E. and Said, F.H. 2011. Effect of feed restriction during pregnancy on performance and productivity of New Zealand white rabbit does. *Journal of Veterinary Medicine International* 2011; volume (11) Article ID 183973, 5pages
14. Menchetti, L., Brecchia, G., Cardinali, r.,Polisca, A. and Boiti, A. 2015. Feed restriction during pregnancy: Effects on body condition and productive performance of primiparous rabbit does. *World Rabbit Science. 23: 1-8 doi:10.4995/.1703.*
15. Google Earth, 2014.http//www.goggle.earth.
16. Szendro, Z., and Maertens, L. 2001. Maternal effects during pregnancy and lactation in rabbits," *Acta Agraria Kaposvariensis*, vol. 5, no. 2, pp. 1–21,.
17. Holdas, S. and Szendro ,Z. 2001. "Breeds of rabbits," in *Breeds of Domestic Animals*, S. Mihok, Ed.,Mez˝ogazdaKiad ´ o, Budapest,Hungary,.
18. Kramer, M. S. 1993.Determinants of low birth weight: methodological assessment and meta-analysis, *Bulletin of the World Health Organization*, vol. 65, no. 5, pp. 663–737,.
19. Nafeaa, A, Ahmed, SAE., Hallah, S.F. (2011) Effect of Feed Restriction during Pregnancy on Performance and Productivity of New Zealand White Rabbit Does. *Journal of Veterinary Medicine International*, Article ID

839737, 5 pages. doi: 10.4061/ 2011/ 705358 PMID: 22195295

20. Eady, S.J. and Prayaga, K.C. 2000. Rabbit farming for meat production in Australia: Profitability in the industry and economic values for production traits. *Proceedings of the world rabbit congress Valencia Spain.*
21. Adeyinka, I.A. Akanwa,C.L.Iyeghe-Erakpotobor, G.T.Adeyinka F.D. and Orunmuyi,M. 2007. Factors Affecting Some Traits of Economic Importance in Rabbit in a Tropical Environment of Northern Nigeria. *Journal of Biological Sciences, 7: 425-428.*
22. Symeon, G.K, Goliomytis, M., Bizelis, I., Papadomichelakis, G., Pagonopoulou, O., Abas, Z. (2015) Effects of Gestational Maternal Undernutrition on Growth, Carcass Composition and Meat Quality of Rabbit Offspring. PLoS ONE 10(2): e0118259. doi:10.1371/journal.pone.0118259
23. Poigner, J., Szendro, ZS, Levai A, Radnai I, Biro-Nemeth E (2000) Effect of birth weight and litter size on growth and mortality in rabbits. *World Rabbit Science 8: 17–22.*
24. Ledin, I., (1984) Effect of restricted feeding and realimentation on compensatory growth, carcass composition and organ growth in rabbit. *Annas Zootech 33: 33–50*.
25. SAS Institute, Inc. (2005) Statistical analysis systems user's guide. Version 9.1.3. SAS Institute, Inc., Cary, NC. doi: 10.4137/BBI.S19057 PMID: 25574136 *Science*, vol. 81, no. 1-2, pp. 151–158.