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Effect of feeding frequency on the growth and reproductive performance of two rabbit breeds

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Target Audience: Animal Scientists

Abstract

Twenty-eight rabbits from two breeds; New Zealand Red (NZR) and Florida White (FW) (twelve does and two bucks per breed) were used to examine the effect of feeding frequency on the reproductive performance of two rabbit breeds. Each of the two rabbit breeds were divided into two groups (A and B) on the basis of feeding frequency of once (7a.m only) or twice daily (7a.m and 4p.m). The experiment lasted for 30weeks (10 weeks in each parity). Data obtained were subjected to Analysis of Variance in a 2x2 experimental layout. The litter size of rabbits fed once was 4.33 while those fed twice daily had 2.67 litter size. Rabbits fed twice daily had higher ($p<0.05$) weaning weight and weaning weight gain than rabbits fed once daily in both breeds. In the third parity, the breeds differed significantly ($p<0.05$) only in the final weight with FW having a higher value of 2267.50g/rabbit/day than NZR. Significantly ($p<0.05$) higher mortality was obtained in rabbits fed once daily than those fed twice daily at the second and third parities in both breeds. The results showed that feeding frequency affected the weaning weight, weaning weight gain and mortality of the does from the second parity.

Keywords: Rabbit; Breed; Feeding frequency; Parity

Description of Problem

The increase in world population most especially in recent time has amplified the demand for animal protein. This demand is more than the supply from the five major livestock species (cattle, sheep, goats, swine and poultry). This has increased the interest in non-ruminants such as rabbit, because its production has vast prospects in lessening the problem of animal protein supply (1, 2), due to its high rate of reproduction (prolific), short gestation period, early sexual maturation, rapid growth rate, ability to rebreed immediately after parturition, efficient food utilization and high nutrient profile of its meat (3, 4, 5).

The cost of feed in animal production could be as high as 70% of the total production cost. To improve economic balance and reduce wastage, there is need to ensure feed efficiency (6). Rabbits are produced nearly exclusively in closed farms and their feeding cost represents between 55% and 60% of production costs (7). Rabbits are produced optimally by using mixture of forage and formulated feeds

although they can survive on all forage diet (8, 9). Research has shown that feed restriction in growing rabbits influences the growth of rabbit (10) by enhancing feed efficiency and reducing carcass fat (11, 12, 13). Chodova *et al*., (10) concluded that the effect of feed restriction explicitly hinge on timing of its beginning, its duration and its intensity. According to Chodova *et al*., (14), feeding regime is one of the major factors that influence meat quality of farm animals.

The reproduction performance of rabbits is also an important aspect that determines the success and profitability as commercial production depends largely and directly on reproduction (4, 15). Among other factors, breed or species and weight of female animal has been identified to influence reproductive performance (15).

Therefore this study aimed to determine the effect of feeding frequency on reproductive and growth performance of New Zealand Red and Florida White.

Materials and Methods

Experiment site, sample size and animal management

The study was carried out at the Rabbit Unit, Teaching and Research Farm, University of Agriculture, Abeokuta. The farm is located in the derived savanna region with an average temperature of 34^0C and a relative humidity of 82%. It is in the region 70m above sea level of latitude 7^0 53'N and longitude 3^0 20'E. It receives a mean precipitation of 1037mm per annum.

The experimental animals consist of fourteen (14) New Zealand Red (12 does and 2 bucks) and fourteen (14) Florida White (12 does and 2 bucks). The ages of the does used were within 4 and 5 months and the age of the bucks from 7-9 months. The rabbits were acclimatized for two weeks. They were weighed at the beginning of the experiment and every week thereafter. The two rabbit breeds were divided into two groups each of A and B, respectively on the basis of feeding. The experiment lasted for about 30 weeks as 3 parities were considered.

Group A rabbits were fed breeder ration required for a day once while Group B rabbits were fed the first half of the daily requirement of breeder ration in the morning and the second half in the afternoon. Concrete pots were used for supplying feed to the animals and clay pots were used to supply fresh clean water *ad libitum*. Forages like *Tridax procumbens*, *Aspillia africana* and succulent *Panicum maximum* were supplied twice per week. The nutrient composition of the diet is shown in Table 1:

Table 1: Composition (%) of Experimental Diet

Ingredient	Composition (%)
Maize	31.50
Wheat Offal	46.00
Groundnut Cake	12.00
Fish Meal	4.50
Salt	0.50
Oyster Shell	1.50
Bone Meal	3.50
*Vitamin/Mineral Premix	0.50
Total	**100.00**
Calculated Analysis	
Crude Protein (%)	18.22
Ether Extract (%)	5.07
Crude Fibre (%)	5.97
Ash (%)	4.78
Gross Energy (MJ/Kg)	8.745
Calcium	2.06
Phosphorus	1.40

Vitamin/Mineral Premix (Roche Nutripoul 5®) based on 2.5kg per ton.

Vit. A: 10 000 000iu, Vit. D_3: 2 500 000, *Vit. E: 20 000mg, Vit. K3: 2000mg, Vit. B1: 3000mg, Vit. B2: 7000mg, Vit. B6: 5000mg, Vit. B12: 25mg, Niacin: 30 000mg, Panthotenic Acid: 10 000, Folic Acid: 800mg, Biotin: 50mg, Manganese: 80 000mg, Iron: 40 000mg, Zinc: 60 000mg, Copper: 8000mg, Cobalt: 250mg, Iodine: 1000mg, Selenium (1%): 150MG, Cholin: 200000mg and Antioxidant: 100000mg.*

Mating and Pregnancy Management

The does were introduced to the bucks when they were 6 months old. Mating was done early in the morning. Each doe was taken to the buck's pen and observed until mating has occurred. This was assured when the buck falls off the doe on his back with a characteristic vocal sound. The does were returned thereafter to their respective pens. Pregnancy test, which was done by palpating the abdominal region between the thighs was carried out 17 days after mating. The pregnant does were supplied with clean, disinfected dry nest boxes 3 days prior to kindling.

Data Collection

The reproductive performance of the two breeds, in terms of litter size at birth and weaning, litter weight at birth and weaning, age at first kindling and gestation length as influenced by feeding frequency and parity (first to third) were determined. The weight gain at weaning (g/rabbit/day) was evaluated by subtracting the litter birth weight (g/rabbit/day) from the weaning weight (g/rabbit/day). The body weights were determined according to the patterns of Rommers *et al*. (16)**.** All feed administered were weighed and recorded. The carcass of the two breed were also carried out.

Experimental Design and Statistical Analysis

The experiment was a 2 X 2 factorial design, with Breeds and Feeding Frequency serving as the two factors and each factor was at two levels, thereby resulting into four treatments. Each treatment was replicated thrice.

The data obtained was subjected to a two-way Analysis of Variance in a 2 X 2 factorial experimental layout. Significantly ($P < 0.05$) different means were separated using Duncan's Multiple Range Test (17).

Model: $Y_{ijk} = \mu + B_i + F_j + (BF)_{ij} + \Sigma_{ijk}$

Where Y_{ijk} = Observed value of the dependent variable

μ = Overall mean

B_i = Effect of ith Breed (i = 1, 2)

F_j = Effect of ith Feeding Frequency (j = 1, 2)

$(BF)_{ij}$ = Effect of interaction of ith Breed and jth Feeding frequency

Σ_{ijk} = Residual Error

Results and Discussion

In the experiment, a significant effect of feeding frequency on litter size was observed at the first parity (Table 2). The litter size obtained for rabbits fed once (4.33) was significantly ($p<0.05$) higher than those fed twice (2.67). According to Rommers *et al.* (16), the body weight of the does has a direct effect on the birth weight and litter size at first kindling. The values obtained for the litter size 4.33 and 2.67 for T_1 and T_2 respectively is lower compared with 6.67 ± 1.03 obtained by Iyeghe-Erakpotobor (18).

In most of the parameters measured in the first parity, rabbits fed all at once (T_1) had higher values when compared with those whose daily diets were divided into two and fed twice (T_2). The weight gain and the feed conversion ratio were better. The litter size, litter birth weight and weaning weights were higher than the T_2 rabbits. The mortality rate was also lower when compared with the T_2 rabbit. Sobayo *et al*. (19) reported 7.94 and 8.23 feed conversion ratios with 25 and 50 maize gluten levels in feed respectively. These values are in line with the ones obtained in this experiment. Oduguwa (20) also recorded similar value 7.5, 7.2, 10.2 and 15.2 feed conversion ratios. The values for feed conversion ratio are however slightly higher than the 6.94 obtained by Adejinmi *et al*. (21).

Table 2: Main and Interactive Effect of Feeding Frequency and Breed on the Reproductive Characteristics of Rabbit at First Parity

	Feeding Frequencies			Breed			
Parameters	**Once (T_1)**	**Twice (T_2)**	**SEM**	**New Zea-land Red**	**Florida White**	**SEM**	**FFxBreed**
Initial weight (g/rabbit)	1701.25	1541.67	53.60	1617.92	1625.00	53.60	NS
Final weight (g/rabbit)	2013.33	1833.33	56.81	1938.33	1908.33	56.81	NS
Weight gain (g/rabbit/day)	11.15	10.42	0.88	11.45	10.12	0.88	NS
Feed intake (g/rabbit/day)	87.67	85.67	2.76	87.83	85.50	2.76	NS
Feed conversion ratio	7.92	8.75	0.57	7.73	8.93	0.57	NS
Litter size	4.33[a]	2.67[b]	0.50	3.67	3.33	0.50	NS
Litter birth weight (g/rabbit)	51.59	33.82	8.65	41.88	43.53	8.65	NS
Weaning weight (g/rabbit)	185.28	116.83	30.18	158.33	143.78	30.18	NS
Weight gain at weaning (g/rabbit/day)	4.11	2.42	0.63	3.17	3.36	0.63	NS
Mortality (%)	18.33	20.83	12.15	24.17	15.00	12.15	NS

The result obtained from the study also reveals no significant effect of breed on the parameters taken in the first parity (Table 2). There were correlation between initial weight and the weaning weight gain of kittens as the breed with higher initial weight records higher weaning weight gain. Adams (22) reported that the breed with the smallest litter size had a gestation length higher than the breed that had the largest litter size.

Table 3: Main and Interactive Effect of Feeding Frequency and Breed on the Reproductive Characteristics of Rabbit at Second Parity

	Feeding Frequencies			Breed			
Parameters	**Once**	**Twice**	**SEM**	**New Zea-land Red**	**Florida White**	**SEM**	**FFxBreed**
Initial weight (g/rabbit)	2158.33[a]	1966.67[b]	30.05	2000.00[b]	2125.00[a]	30.05	S
Final weight (g/rabbit)	2258.33[a]	2108.33[b]	33.85	2150.00	2216.67	33.85	S
Weight gain (g/rabbit/day)	14.28	20.25	3.26	21.43	13.09	3.26	NS
Feed intake (g/rabbit/day)	110.50	108.33	4.71	116.67	102.17	4.71	NS
Feed conversion ratio	9.18	7.27	1.58	5.90	10.55	1.58	NS
Litter size	5.17	4.33	0.44	5.00	4.50	0.44	NS
Litter birth weight(g/rabbit)	54.88	66.75	8.31	56.93	64.70	8.31	NS
Weaning weight (g/rabbit)	200.58[b]	321.95[a]	30.07	249.17	273.37	30.07	S
Weight gain at weaning (g/rabbit/day)	5.13[b]	8.87[a]	0.79	6.55[b]	7.45[a]	0.79	S
Mortality (%)	16.27	0.00	5.46	2.38	13.88	5.46	S

[a,b] - Means on the same row having different superscript are significantly different ($P < 0.05$)

At the second parity (Table 3), the significant effect of feeding frequency was on weaning weight and weaning weight gain. This showed that the kits whose dams were fed twice benefited more from the daily diet given. In groups fed twice, lesser quantity of feed was available in the feeder per time and feed wastage was minimal. This may have

contributed to the better feed conversion ratio though not significant. Iyeghe-Erakpotobor (18) from his findings reported that flushing does with 20-24% crude protein diets gave better reproductive performance than with 16% and 18% CP diets.

The values obtained for the weaning weight under rabbits fed twice (321.95) fell within the range 310.62 ± 3.56 and 408.12 ± 3.85 obtained by Hasanat *et al.* (23). The kits from the Florida White had a higher weaning weight gain of 7.45 while kits from New Zealand breed had 6.55 (Table 3).

The interactive effects of breed and feeding frequency on the reproductive characteristics of rabbits at second parity is presented in Table 4.The final weight of the does were significantly ($p<0.05$) in both breeds fed once per day although directly proportional to the initial weight. However, the weaning weight and weight gain at weaning of the kits were higher ($p<0.05$) in both breeds fed twice than those fed once per day. The percentage mortality was lower ($p<0.05$) in rabbit groups fed twice in both breeds. The kits mortality also follows the same pattern. The kits from Florida white had a higher mortality of 13.88% while kits from New Zealand had 2.38%. However, the highest mortality observed in kits from the breeds could not be attributed to treatment effects. This is supported by the findings of Mendez *et al.* (24) that mortality of kits at birth was independent of treatments. Similar high mortality in first week of birth has been reported in literature (25, 26).

Table 4: Interactive Effects of Breed and Feeding Frequency on the Reproductive Characteristics of Rabbits at Second Parity

Breed	New Zealand Red		Florida White		
Feeding Frequency	Once	Twice	Once	Twice	SEM
Initial weight (g/rabbit)	2116.67^{ab}	1883.33^{c}	2200.00^{a}	2050.00^{b}	136.72
Final weight (g/rabbit)	2233.33^{a}	2066.67^{b}	2283.33^{a}	2150.00^{ab}	111.46
Weight gain (g/rabbit/day)	16.67	26.20	11.89	14.29	8.86
Feed intake (g/rabbit/day)	118.33	115.00	102.67	101.67	12.49
Feed conversion ratio	7.30	4.50	11.07	10.03	4.24
Litter size	5.33	4.67	5.00	4.00	1.06
Litter birth weight (g/rabbit)	45.87	68.00	63.90	65.50	19.63
Weaning weight (g/rabbit)	155.00^{b}	343.33^{a}	246.17^{ab}	300.57^{a}	96.67
Weight gained at weaning (g/rabbit per day)	3.77^{b}	9.33^{a}	6.50^{ab}	8.40^{a}	2.77
Mortality (%)	4.77^{ab}	0.00^{b}	27.78^{a}	0.00^{b}	16.57

^{a,b} - Means on the same row having different superscript are significantly different ($P < 0.05$)

The third parity reproductive performance (Table 5) followed the same pattern with that of second parity. The weaning weight under treatment 2 (301.88g) was higher than that of treatment 1 (T_1 258.47g). This again suggests that does under treatment 2 (T_2) must have had access to more of the feed and consequently more crude protein that those under treatment 1 who has the tendency of wasting some of the feed. Also at the third parity (Table 6), lower mortality percentage was recorded in Florida white kits fed twice a day. Yono *et al.* (27) also reported less mortality of kits on diet with 17.5% crude protein. These results indicated that there were better growth performance when does were fed their daily diet in two successions.

Table 5: Main and Interactive Effect of Feeding Frequency and Breed on the Reproductive Characteristics of Rabbit at Third Parity

Parameters	Feeding Frequencies			Breed			
	Once	Twice	SEM	New Zealand Red	Florida White	SEM	FFxBreed
Initial weight (g/rabbit)	2204.67	2063.33	253.35	1725.00[b]	2150.00[a]	253.35	NS
Final weight (g/rabbit)	2302.11	2183.33	267.68	1825.00[b]	2267.50[a]	267.68	NS
Weight gain (g/rabbit/day)	13.92	16.65	3.34	14.27	16.30	3.34	NS
Feed intake (g/rabbit/day)	96.17	113.33	13.51	89.17	120.33	13.51	NS
Feed conversion ratio	6.07	8.05	1.49	6.05	8.07	1.49	NS
Litter size	5.17	4.50	0.87	4.67	5.00	0.87	NS
Litter birth weight (g/rabbit)	53.87	69.03	7.98	58.42	64.48	7.98	NS
Weaning weight (g/rabbit)	258.47	301.88	37.47	255.22	305.13	37.47	NS
Weight gained at weaning (g/rabbit per day)	7.30	8.32	1.07	7.03	8.58	1.07	NS
Mortality (%)	23.54	5.56	5.31	13.06	16.04	5.31	S

[a,b] - Means on the same row having different superscript are significantly different ($P < 0.05$)

Table 6: Interactive Effects of Breed and Feeding Frequency on the Reproductive Characteristics of Rabbits at the third Parity

Breed	New Zealand Red		Florida White		
Feeding Frequency	Once	Twice	Once	Twice	SEM
Initial weight (g/rabbit)	2050.03	2033.33	2206.67	2093.33	118.83
Final weight (g/rabbit)	2133.33	2150.00	2318.33	2216.67	152.00
Weight gain (g/rabbit/day)	11.90	16.63	15.93	16.67	7.28
Feed intake (g/rabbit/day)	73.33	105.00	119.00	121.67	34.63
Feed conversion ratio	4.20	7.89	7.93	8.20	3.57
Litter size	4.33	5.00	6.00	4.00	1.99
Litter birth weight (g/rabbit)	43.50	73.33	64.23	64.73	7.70
Weaning weight (g/rabbit)	210.27	300.17	306.67	303.60	88.93
Weight gained at weaning (g/rabbit per day)	5.97	8.10	8.63	8.53	2.50
Mortality (%)	15.00[ab]	11.11[ab]	32.08[a]	0.00[b]	16.37

Conclusions and Applications

The result obtained in this study indicates that

1. Feeding frequency increased the weaning weight, weight gain at weaning and mortality of the does from the second parity.
2. Does whose daily feed were divided and fed morning and afternoon produced higher litter size in the first parity and better weaning weight at second parity.

3. Numerically lower mortality rate was recorded in kits whose does were fed twice in the second and third parities.

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