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Influence of Genotype, Sex, Litter Size and Gestation Length on Body Weights and Measurements of Rabbit at Pre-and Post -Weaning Ages

Chineke, C.A.[1], Agaviezor ,B, Ikeobi [2] ,C O N and Ologun [1], A.G

[1]Department of Animal Production and Health Federal University of Technology, P M B 704 Akure, Ondo State, Nigeria
[2]Department of Animal Breeding and Genetics University of Agriculture, Abeokuta, Nigeria.

Target Audience: Rabbit farmers, Academics/ Researchers in animal production, Animal Scientists/Breeders

Abstract

Data from 77 growing rabbits obtained from a crossbreeding programme involving New Zealand White (NZW), Chinchilla (CHA), Dutch-belted (DBD) and Croel (CRL) breeds at FUTA Teaching and Research Farm, were analysed. The aim was to evaluate the influence of genotype, sex, litter size and gestation length on body weights (BWT) and linear body measurements viz Heart girth (HGT), Height at withers (HTW) and Body length (BLT) at pre-weaning ages of 7 and 21 days and post-weaning ages of 42 and 56 days. Weaning was at 35 days. The 77 rabbits, 35 males and 42 females used in the study were made up of 35 New Zealnad white x New Zealand white (NZW x NZW) 22 New Zealand white x Chinchilla (NZW x CHA), 13 New Zealand white x Dutch Belted (NZW x DBD) and 7 New Zealand white x Croel (NZW x CRL). The body weight and linear measurement means at various ages by genotype, sex, litter size and gestation were significantly (P<0.05) different. The knowledge of these factors and their effects on the physical body traits might be useful in improvement programmes for increasing meat yield from rabbits.

Kewords: Body weight, measurement, rabbit, weaning.

Description of Problem

The hereditary and environmental influence are responsible for variations in the performance of animals. Variations due to heredity result from gene actions and combinations provided for individuals in a particular population. Environmental differences include the non-genetic variations resulting from managerial, nutritional and climatic influences. The effects of some of these genetic and non-genetic factors on production traits of cattle (1,2); sheep (3); goat (4,5,6); poultry (7,8); pig (9) and rabbit (10,11) have been reported. However, reports on the effects of several genetic and non-genetic factors on physical body characteristics of domestic rabbits in the tropics are scanty. The study therefore was undertaken to investigate the influence of genotype, sex, litter size and gestation length on the pre-and post-weaning body weights and measurement in rabbits.

Materials and Methods

Data used for this study were collected on 77 young rabbits obtained from a crossbreeding experiment involving 12 does and 6 bucks at FUTA Teaching and Research Farm between 2000 and 2001 The 12 does which comprised 5 New Zealand white, 3 Chinchilla, 2 Dutch -belted and 2 Croel, were randomly assigned to the 6 New Zealand white bucks for mating early in the morning. Pregnancy diagnosis by abdominal palpation was carried out 10 days later. Non pregnant does were returned for mating. The 77 young rabbits (35 males, and 42 females) that evolved from the mating procedure comprised 35 New Zealand White x New Zealand white (NZW x NZW), 22 New Zealand white x Chinchilla (NZW x CHA),13 New Zealand white x Dutch belted (NZW x DBD) and 7 New Zealand white x Croel (NZW x CRL). Sex was recorded at 21days Weaning was at 35day. The experiment was designed primarily to examine some factors that would influence body weights (BWT) and linear body measurements namely heart girth (HGT), height at withers (HWT) and body length (BLT) at pre-wearing ages of 7and 21 days and post -wearing ages of 42 and 56 days The description of the measurements are as follows: Hearth girth: the circumference of the chest. Height at withers: the distance between the most dorsal point of the withers and the ground level. Body length: the distance from the anterior point of the shoulder (tuberosity of the humerus) to the posterior extremity of the pinbone (tuber ischium). The measurements were made in the morning before feeding the animals, using electronic weighing scale and measuring tape.

The rabbits were caged. They were fed ad *libitum* on mash diet of 19% crude protein supplemented with sweet potato *(Ipomea batata)* leaves and Aspillia *(Aspilla africana)*. Clean water was also provided regularly.

Statistical analysis:

The body weight and linear measurement means at various ages by genotype, sex, litter size and gestation length were computed using (12) procedure and using model represented as Yijklmn = U+Bi + Cj + Dk + Fl + eijkl

Where Yijkl = record of dependent variable

U = Overall mean

Bi = effect of the i^{th} genotype (i = 1-4)

Cj = effect of the J^{th} sex (j = 1 and 2)

Dk = effect of the k^{th} litter size (k = 1-6)

Fl = effect of the I^{th} gestation length (I = 1-5)

eijkl = random error.

Results and Discussion

Body weights at pre-and post-weaning ages:

The body weight data for pre-weaning ages of 7 and 21 days; weaning age of 35 days and post-weaning ages of 42 and 56 days are given in Table 1. The overall mean weights were 92.73±4.41g, 177.82±5.57g, 333.45±11.58g, 427.11±11.10g and 581.78±15.92 for 7, 21, 35, 42 and 56 days respectively. The mean values for 35, 42 and 56 days were in agreement with reported figures in literature (13,14,15,16,17,18,19,20,21).

Genotype mean weights at 7, 35 and 42 days were significantly (P<0.05) different and were not significant (P>0.05) at 21 and 56 days. The NZW x CHA kits had significant (P<0.05) heavier body weight at day 7. But NZW x DBD was consistently superior in body weights over other genotypes at day 21, 35, 42 and 56. The NZW x NZW had the least performance for the body weights at all ages except at 56 days. Cross-bred rabbits recorded high performance when compared with pure-bred No doubt, crossbreeding would lead to improvement in production traits. Several authors (22, 23) had observed similar differences for production traits in crossbred rabbits. These authors attributed the higher performance to heterosis.

Sex had no significant (p > 0.05) influence on all body weights Heavier body weights of females, agreed with the findings of (24).

The mean weights by litter size were not significantly (p > 0.05) different except 21-day weight where heaviest weight was recorded for rabbits born as twins (table 1). Twin rabbits were also heavier than other litters at 7days The rabbits that were born as single were heavier than others at 35,42 and 56days This corroborated observation made in goat by (6) that kids born as single weighed heavier than those born as twins and triplets The litter size obtained in this study compared favourably with reports in available literature (14,25) These workers observed that litter size was dependent on the number of eggs produced by doe after mating and this number was dependent on the body size of the breed.

Mean weights of rabbits by gestation length were significantly (P<0.05) different at pre-weaning ages of 7 and 21 days. No significance (P>0.05) was observed at 35, 42 and 56 days (Table.1). The

Table 1: Effect of Genotype, sex, litter size and gestation length on 7, 21, 35, 42 and 56 days Body weight(kg) of Rabbit.

Factor Genotype:	N	7- day wt (kg)	21- day wt	35-day wt	42-day wt	56 - day wt
NZW x NZW	35	96.57 ± 5.54^{ab}	167.29 ± 9.21	28.57 ± 19.78^{a}	367.60 ± 21.22^{a}	531.65 ± 31.82
NZW x CHA	22	103.50 ± 6.33^{a}	188.14 ± 10.39	379.59 ± 13.21^{b}	442.58 ± 13.3^{b}	568.55 ± 21.46
NZW x DBD	13	59.46 ± 15.93^{b}	195.69 ± 4.66	379.23 ± 15.13^{b}	449.92± 10.64^{b}	586.38 ± 34.86
NZW x CRL	7	101.43 ± 5.65^{a}	164.86 ± 19.22	342.86 ± 34.04^{bc}	398.43 ± 10.64^{c}	509.57 ± 34.19
Sex:						
Male	35	91.78 ± 6.82	175.90± 8.11	310.30 ± 18.46	415.60 ± 18.91	532.33 ± 25.42
Female	42	92.55 ± 6.23	179.64± 7.88	351.71 ± 15.08	437.41 ± 14.00	567.72 ± 21.23
Litter size:						
1	3	89.00 ± 6.51	208.33 ± 5.33^{a}	455.33 ± 86.27	597.33 ± 81.96	765.67 ± 20.34
2	8	123.88 ± 12.99	232.88 ± 10.06^{a}	376.50 ± 61.31	441.17 ± 33.99	624.67 ± 53.97
3	9	96.22 ± 7.34	182.33 ± 11.34^{b}	306.00 ±29.46	378.56 ± 33.28	494.11 ± 46.18
4	31	80.45 ± 8.41	182.33 ± 7.44^{b}	339.55 ± 15.34	435.39 ± 12.4	512.68 ± 21.-01
5	20	92.70 ± 7.23	139.05 ± 11.96^{c}	292.10 ± 18.94	422.33 ± 25.7	593.99 ± 31.16
6	6	111.33 ± 2.36	186.00 ± 805^{b}	362.67 ± 13.89	372.33 ± 12.5	556.75 ± 44.19
Gestation: (days)						
29	4	118.28 ± 6.09^{a}	219.25 ± 12.51^{a}	350.00 ± 54.01	425.00 ± 32.27	450.00 ± 64.55
30	17	78.41 ± 9.65^{b}	175.47 ± 6.73^{b}	360.76 ± 15.02	440.82 ± 15.20	550.53 ± 24.61
31	36	94.78 ± 4.47^{b}	163.47 ± 8.66^{b}	319.72 ± 18.87	429.53 ± 20.40	553.14 ± 28.48
32	7	123.00 ± 3.75^{a}	179.29 ± 27.47^{b}	266.29 ± 55.04	449.86 ± 47.25	547.29 ± 47.91
33	13	76.77 ± 16.42^{b}	207.08 ± 9.85^{a}	366.85 ± 17.22	391.62 ± 16.43	583.92 ± 32.73
Overall mean	77	92.73 ± 4.41	177.82 ± 5.57	333.45 ± 11.58	427.11 ± 11.10	581.78 ± 15.92

Means with different superscripts in the same column are significantly different (P<0.05)

gestation lengths obtained in the study were similar to values reported by other workers (14,24). The body weights did not increase with gestation length. This agreed with a report by (9).

Linear body measurements at pre-and post-weaning ages:

The means of heart (HGT), height at withers (HWT) and body length (BLT) by genotype, sex, litter size and gestation length at 7, 21, 35, 42 and 56 days of age are presented in Tables 2, 3, and 4. Heart girth (HGT) mean values by genotype differed significantly (P<0.05) in 21-day HGT and 35-days HGT. (Table 2). The heart girths at other ages among the genotypes were not different.

The NZW x DBD kits were superior over other genotypes in heart girth measurements. It was followed by NZW x CHA and NZW x NZW. The least performance in HGT measurement was obtained for NZW x CRL at all ages except in 7-day. HGT where NZW x NZW kits recorded least value. Breed differences in heart girth values had been reported (10). There was no difference (P>0.05) in HGT by sex at all ages except at 56 day (P<0.05). The females having larger HGT at almost all ages corroborated the findings of (6,24). Litter size means for HGT were significantly (P<0.05) different at days 21 and 35. HGT was not consistent

Table 2: Effect of Genotype, sex, litter size and gestation length on 7, 21, 35, 42 and 56 days Heart girth (HGT) of Rabbit.

Factor Genotype:	N	7- day HGT (cm)	21- day HGT	35 -day HGT	42- day HGT	56- day HGT
NZW x NZW	35	12.05 ± 0.24	14.13 ± 0.19^{ab}	16.18 ± 0.26^{a}	17.12 ± 0.24	19.00 ± 0.267
NZW xCHA	22	12.20 ± 0.38	14.49 ± 0.20^{ab}	17.04 ± 0.25^{a}	17.72 ± 0.024	19.01 ± 0.19
NZW x DBD	13	12.58 ± 0.17	15.19 ± 0.21^{a}	17.15 ± 0.12^{a}	16.83 ± 0.83	19.12 ± 0.24
NZW x CRL	7	12.33 ± 0.13	13.67 ± 0.38^{b}	14.99 ± 1.18^{b}	16.40 ± 0.67	19.21 ± 0.67
Sex:						
Male	35	12.44 ± 0.17	14.07 ± 0.16	16.20. ± 0.52	17.12 ±0.22	18.80 ± 0.20^{a}
Female	42	12.07 ± 0.31	14.60 ± 0.17	16.71 ± 0.29	17.35 ± 0.31	19.35 ±0.18^{b}
Litter size:						
1	3	11.83 ± 0.33	14.17 ± 0.64^{b}	18.07 ± 0.74^{c}	18.30 ± 0.76	20.33 ±0.60
2	8	12.64 ± 0.50	15.23 ± 0.29^{c}	16.84 ± 1.31^{b}	18.10 ± 0.46	19.85 ± 0.50
3	9	12.82 ± 0.83	14.28 ± 0.33^{b}	16.56 ± 0.27^{b}	16.48 ± 0.19	18.09 ± 0.44
4	31	11.95 ± 0.13	14.55 ± 0.18^{b}	16.68 ± 0.25^{b}	17.14 ± 0.38	18.86 ± 0.15
5	20	12.03 ± 0.36	13.49 ± 0.18^{a}	15.53 ± 0.14^{a}	17.58 ± 0.36	19,15 ± 0.22
6	6	12.80 ± 0.02	15.50 ± 0.27^{c}	17.27 ± 0.13^{bc}	16.42 ± 0.24	19.63 ± 1.19
Gestation: (days)						
29	4	11.50 ± 00^{a}	15.08 ± 0.43^{c}	18.23 ± 0.27^{c}	17.40 ± 0.67	18.90 ± 0.77
30	17	12.23± 0.27^{b}	14.88 ± 0.24^{bc}	17.01 ± 0.14^{b}	16.46 ± 0.61	19.33 ± 0.36
31	36	36 70 ± 0.20^{a}	14.09 ± 0.17^{ab}	16.11 ± 0.33^{a}	17.54 ± 0.22	18.93 ± 0.20
32	7	13.60 ± 0.12^{c}	13.73.0.56^{a}	15.96 ± 0.54^{a}	18.13 ± 0.75	19.71 ± 0.37
33	13	13.05 ± 0.48^{c}	14.6 ± 0.25^{bc}	16.58 ± 0.40^{ab}	16.96 ± 0.24	18.82 ± 0.29
Overall mean	77	12.21 ± 0.15	14.37 ± 0.12	16.48 ± 0.19	17.23 ± 0.20	19.08 ± 0.14

Means with different superscripts in the same column are significantly different (P<0.05)

with litter size. However, the kids that were born as singles had larger HGT at days 35, 42 and 56. Mean values for HGT by gestation length differed significantly (P<0.05) at 7 and 21 days. The HGT did not follow any trend with gestation.

The means for HWT were similar except at 56 days where significant (P<0.05) difference was observed among the genotypes. (Table 3).

NZW x DBD was significantly (P<0.05) superior over others in 56-day HWT. It recorded highest mean values for the same trait at other ages. It was followed by NZW X CHA at days 7, 35 and 42. NZW x CRL recorded the shortest HWT at 35 and 42 days.

Sex means for HWT at all ages did not differ significantly (P>0.05). Females were longer in HWT at all ages than males except at day 7. It had been observed that females were longer than males (24). The mean values for HWT by litter size were significant (P<0.05) at 21, 35 and 56 days. HWT was inconsistent with litter size at various ages. The rabbits that were born as singles had better performance in HWT at 35, 42 and 56 days than other litters. It had been reported elsewhere that

Table 3: Effect of Genotype, sex, litter size and gestation length on 7, 21, 35, 42 and 56 days Height at Withers (HWT) of Rabbit.

Factor Genotype:	N	7- day HWT (cm)	21- day HWT	35 -day HWT	42- day HWT	56 day HWT
NZW x NZW	35	5.17± 0.21	7.14± 1.35	9.45± 0.15	10.00 ± 1.03	11.10± 0.24^{b}
NZW x CHA	22	5.60 ± 0.25	6.73 ± 1.65	9.64 ± 0.16	10.07± 1.01	10.91±0.78^{a}
NZW x DBD	13	4.83± 0.15	7.53±0.20	9.80 ± 0.14	10.14± 0.10	11.40 ± 0.27^{b}
NZW x CRL	7	5.37±0.02	7.07± 0.74	8.93±0.30	9.75± 1.3	11.14± 0.65^{b}
Sex:						
Male	35	5.44 ± 0.27	7.08± 0 28	9.38± 0.15	9.88± 0.17	10.95±0.21
Female	42	5.10 ±0.11	7.12± 0.17	9.63± 0.11	9.97 ±0.16	11.28 ± 0.18
Litter size:						
1	3	4.83 ± 0.34	6.83 ± 0.82b	10.33± 0.27^{bc}	11.03 ± 0.29	12.27 ± 0.12^{c}
2	8	4.93 ± 0.22	7.51 ± 0.20^{bc}	10.15 ± 0.23^{bc}	10.17 ± 0.54	11.77 ± 0.42^{b}
3	9	5.89 ± 0.53	7.72 ± 0.38^{bc}	9.16 ± 0.20^{ab}	9.52 ± 0.28	10.26 ± 0.43^{a}
4	31	4.94 ± 0.21	7.36 ± 0.19^{bc}	9.64 ± 0.11^{ab}	9.89 ± 0.17	11.04 ± 0.16^{b}
5	20	5.67 ± 0.22	6.07 ± 0.36^{a}	8.99 ± 0.22^{a}	10.24 ± 0.23	11.19 ± 0.21^{b}
6	6	5.12 ± 0.02	7.62 ± 0.02^{bc}	9.97 ± 0.10^{ab}	9.25 ± 0.25	11.93 ± 1.11^{b}
Gestation: (days)						
29	4	5. ± 0.17^{b}	5.73 ± 0.30^{a}	9.30 ± 0.34	8.00 ± 0.41^{a}	10.50 ± 0.25
30	17	4.65± 0.14^{a}	7.36 ± 0.02^{b}	9.81 ± 0.15	9.86 ± 0.16^{b}	11.80 ± 0.31
31	36	5.45± 0.17^{b}	6.96 ± 0.22^{b}	9.47 ± 0.15	10.01 ± 0.16^{b}	10.86 ± 0.19
32	7	6.11± 0.38^{c}	5.99 ± 0.77^{a}	9.46 ± 0.29	11.00 ± 0.39^{c}	11.83 ± 0.28
33	13	5.04± 0.45^{b}	8.07 ± 0.19^{c}	9.38 ± 0.21	9.88 ± 0.21^{b}	10.81 ± 0.29
Overall mean	77	5.25± 0.13	7.08 ± 0.15	9.52 ± 0.02	9.94 ± 0.12	11.14 ± 0.13

Means with different superscripts in the same column are significantly different ($P<0.05$)

animals born as singles performed better than those born as twins or triplets (6). The mean values for HWT by gestation were statistically different ($P<0.05$) at days 7,21 and 42. The HWT did not follow any particular trend with gestation length. The kids that were born on the 29th day, had higher HWT measurements at days 7, 42 and 56.

Genotype means did not differ significantly ($P>0.05$) for BLT at various ages (Table 4). However NZW x DBD maintained superiority in BLT over other genotypes, followed by NZW x CHA at days 35, 42 and 56. The least performance in BLT was recorded for NZW x CRL.

Table 4: Effect of Genotype, sex, litter size and gestation length on 7, 21, 35, 42 and 56 days Body Length (BLT) of rabbit.

Factor Genotype:	N	7 -day BLT (cm)	21 - day BLT	35- day BLT	42 - day BLT	56 - day BLT
NZW x NZW	35	11.83 ± 0.27	14.92 ± 0.20	18.35 ± 0.34	19.52 ± 0.35	21.87 ± 0.44
NZW x CHA	22	11.70 ± 0.42	14.38 ± 0.68	19.41 ±1.69	20.25 ± 0.38	21.92 ± 0.36
NZW x DBD	13	12.04 ± 0.21	15.25 ± 0.15	18.68 ± 0.31	18.90 ± 1.41	22.29 ± 0.27
NZW x CRL	7	10.76 ± 0.29	13.59 ± 0.96	17.66 ± 0.95	19.02 ± 0.37	21.74 ± 0.85
Sex:						
Male	35	12.10 ± 0.33	14.09 ± 0	18.35 ± 0.31	19.66 ± 0.30	21.81± 0.38
Female	42	11.50 ± 0.20	15.19 0.20[b]	18.92 ± 0.30	19.53 ± 0.53	22.09 ± 0.29
Litter size:						
1	3	10.59 ± 0.63	15.10± 0.40	21.57 ± 72[c]	22.83 ± 1.04	24.69 ± 1.17[c]
2	8	11.65 ± 0.63	16.24 ± 36	20.68 ± 0.38[b]	20.48 ± 1.74	23.07 ± 0.63[b]
3	9	12.00 ± 0.73	14.24 ± 1.65	19.23 ± 0.39[c]	19.57 ± 1.83	21.37 ± 0.84[a]
4	31	11.57 ± 0.14	14.65 ± 0.21	18.74 ± 00[ab]	19.08 ± 3.35	21.50 ± 0.309[a]
5	20	11.85 ± 0.49	14.09 ± 0.33	17.16 ± 0.39[a]	18.82 ± 1.93	21.95 ± 0.32[a]
6	6	12.47 ± 0.02	15.43 ± 0.23	18.10 ± 0.27[ab]	18.67 ± 1.45	23.05 ± 1.05[b]
Gestation: (days)						
29	4	11.33 ± 0.11[ab]	14.13 ± 0.14	18.45 ± 1.3	17.75 ± 1.20	19.45 ± 0.91
30	17	12.15 ± 0.18[b]	14.93 ± 024	18.65 ± 0.23	20.03 ± 0.35	22.76 ± 0.36
31	36	10.92 ± 0.23[a]	14.93 ± 0.27	18.50 ± 0.38	19 95 ± 0.34	21.82 ± 0.36
32	7	14.11 ± 0.34[c]	14.33 ± 0.29	18.39 ± 0.73	20.39 ± 0.77	22.10 ± 0.74
33	13	12.27 ± 0.45[b]	14.14 ± 1.13	19.27 ± 0.43	18.15 ± 1.39	22.00 ± 0.44
Overall mean	77	11.73 ± 0.18	14.70 ± 0.23	18.65 ± 0.22	19.56 ± 0.32	21.95 ± 0.23

Means with different superscripts in the same column are significantly different (P<0.05)

The BLT measurement by sex was significant (P<0.05) at all ages except at day 7. This observation corroborated report in goat (6). Litter size means for BLT were statistically different (P<0.05) at 35 and 56 days. The litter size of one kid performed better in BLT at 35, 42 and 56 days than other litters. Generally BLT was inconsistent with litter size.

Gestation length means for BLT differed significantly (P<0.05) at day 7 but was similar at other ages. The BLT measurements did not show consistent trend with gestation length. The rabbits that were born on 30[th] day recorded longer BLT at 21 and 56 days.

Conclusions And Applications

1. Genotype, sex, litter size and gestation length mean values for body weights and measurementsdiffered significantly at various ages
2. The NZW x DBD kits recorded superior performance in body weights and

measurements. This genotype might be considered in rabbit experiment for improvement of production characteristics.

3. The mean values for the body weights and measurements by sex, litter size and gestation length were different in few cased. This suggested that these factors were minor sources of variation in rabbit production trait and should not be a source of worry in rabbit production.

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