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Genotype Effect on Body Weight of Different Rabbit Breeds and Their Crosses

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INTRODUCTION

Many of the developing regions of the world are now facing a double burden of a growing population and malnutrition (Weingartner, 2005). The need to go into agriculture by individuals, families, corporate bodies and the nation at large will not only improve food availability but it will also serves as a source of employment to the ever-increasing human population.

Animal rearing is a major component of agriculture. Although the emphasis when it comes to animal production has always been on poultry production in developing countries like Nigeria, however, there are also other aspects of animal production which should be of equal interest to farmers. A good example is rabbit production. According to the FAO (2001), backyard rabbit keeping provides additional income and supplies additional protein for poor rural and urban households with low investment and labor inputs.

Availability of rabbit meat will depend on their growth. The lifetime interrelation between an individual's inherent impulses to grow and mature in all body parts and the environment in which the impulses are expressed can be expressed with growth models (Orheruata *et al*., 2010). The live body weight and linear body measurements contribute significantly to the lifetime performance of the animal (Chineke, 2005).

Thus, this study is aimed at reporting the age – weight relationship of the different rabbit genotypes at weekly intervals to determine the significant effect of different genotype on rabbit body weights.

MATERIALS AND METHOD

The experiment was carried out at the rabbit experimental unit of the Teaching and Research Farm of the Federal University of Technology, Akure, Nigeria. Akure is situated on 350.52m above sea level at latitude 7^0 25'N and at longitude 5^0 19'E. The vegetation of the area is that of the rainforest characterized by hot and humid climate. The mean annual rainfall is about 1500mm and the rain period is bimodal with a short break in August with mean annual relative humidity of 75% and mean temperature of 26 - 28^{o}C.

Animal breeding and Management

The animals used were litters from pure and mixed strains of crosses of New Zealand white, Rex, Dutch, California white and locally adapted breeds of rabbits. A foundation population of 40 growing rabbits was used for this study. The 40 growing rabbits consisted of 6 does and 2 bucks each of New Zealand white, Dutch Belted, California white, Rex and locally adapted breeds.

The breeding stock (bucks and does) were housed in individual hutches with separate feeders and drinkers. The house is typically of concrete floor and metallic roof. It has open-sided wire mesh with dwarf wall made of zinc to ensure adequate ventilation. Each rabbit was provided with a stainless steel feeder hung at a reasonable height to prevent feed spillage and stainless steel bowls for water. Daily observation of the rabbits and other routine management practices were carefully carried out.

At sexual maturity, each doe was transferred to the buck's cage for mating. Each doe was palpated 10 days thereafter to detect pregnancy. Does that failed to conceive were returned to the same mating buck for re – breeding. On the 25th day after the fruitful conception, nest boxes were placed in the breeding does cages in preparation for kindling. Litters were weaned at 28 day post-kindling. A commercial pelleted ration containing 16.23% CP, 10.27% CF and 2280 ME was provided in the morning and forage in the evening. Fresh clean water was provided at all time. Hutches of bucks were cleaned and disinfected regularly while that of does and nest boxes at each kindling. All genetic groups of rabbits were subjected to the same environmental, medication and managerial conditions. The mating procedure is shown in Table 1.

Table 1 Mating Procedure

Sire Genotype	Dam genotype	Kit genotypes	No of Kits
NZW	NZW	NZW x NZW	23
RX	RX	RX x RX	20
DT	DT	DT x DT	21
CF	CF	CF x CF	17
LAB	LAB	LAB x LAB	21
NZW	RX	NZW x RX	18
DT	CF	DT x CF	23
LAB	NZW	LAB x NZW	18
CF	RX	CF x RX	22
DT	LAB	DT x LAB	18
RX	NZW	RX x NZW	22
CF	DT	CF x DT	19
NZW	LAB	NZW x LAB	19
RX	CF	RX x CF	15
LAB	DT	LAB x DT	24

N.B : NZW, New Zealand White ; RX, Rex; DT, Dutch; CF, California; LAB, Local Breeds; m , male ; f, female.
No of Sire = 2 ; No of Dam = 6 ; No of litters = 3.

DATA COLLECTION

Three hundred individual weekly body weights of rabbit kittens from 1-20 weeks of age were obtained using a weighing balance of 10kg capacity with 0.01kg accuracy.

The data were analysed using the General Linear Model Procedure of the Statistical Analysis Systems Institute (SAS,1999) to identify the significant effect of genotype on the observed body weights of the different rabbit genetic groups.

RABBIT GENETIC GROUPS

Pure bred rabbit genetic group

New Zealand White	-	NZW
Rex	-	RX
Dutch	-	DT
California	-	CF
Local	-	LAB

Cross bred genetic group

New Zealand white (male) by Rex (female)	-	NZW_m x RX_f
Dutch (male) by California (female)	-	DT_m x CF_f
Local (male) by New Zealand (female)	-	LAB_m x NZW_f
California (male) by Rex (female)	-	CF_m x RX_f
Dutch (male) by Local (female)	-	DT_m x LAB_f

Reciprocal cross genetic group

Rex (male) by New Zealand white (female)	-	RX_m x NZW_f
California (male) by Dutch (female)	-	CF_m x DT_f
New Zealand (male) by Local (female)	-	NZW_m x LAB_f
Rex (male) by California (female)	-	RX_m x CF_f
Local (male) by Dutch (female)	-	LAB_m x DT_f

RESULTS

Least squares means with standard errors of body weights (BDW) for the different rabbit genetic groups (Pure, cross and reciprocal) at weeks 1 – 20 are summarized in Tables 2 – 4.

Least squares means of body weights at weeks 1 – 20 among the pure bred rabbit genetic group

The analysis of variance indicated that genotype had significant ($P < 0.05$) effect on body weights among the different rabbit genotypes and the least square means showed that there was significant difference($P<0.05$) among the body weights of the different rabbit genotypes at different ages (Table 2).

The LAB and NZW recorded the highest least squares mean of 128.65 $\pm$ 8.64g and 128.00 $\pm$ 5.66g respectively while the REX recorded the lowest least squares mean value of 113.40 ± 7.44g at week 1.

At week 2, the LAB and NZW maintained the lead with the CF breed recording the lowest least squares mean value, at week 3 and 4, the DUTCH breed recorded the lowest least squares mean value. The least squares mean values at week 5 for all the breeds were not significantly (P>0.05) different from each other.

At weeks 6 and 7 of age, the LAB recorded the highest least squares mean values with the DT and CF recording the lowest values respectively. From weeks 8 – 20, the NZW maintained the highest least squares mean values though not significantly (P< 0.05) different from LAB at weeks 8 and 13, RX at weeks 11, 13, 14 and 17 while the DT and CF recorded the lowest least squares means interchangeably.

Least squares means of body weights at weeks 1 – 20 among the cross bred rabbit genetic group

The analysis of variance indicated that genotype had significant (P< 0.05) effect on body weights among the different rabbit genotypes and the least squares means values in Table 3 showed that there was significant difference (P<0.05) among the body weights of the different rabbit genotypes in this genetic group at different ages.

The CF_m x RX_f recorded the highest least squares means of 142.10 ± 10.43g though not significantly (P< 0.05) different to NZW_m x RX_f at weeks 1, it maintained the lead from week 2 through to week 5 (Table 3). The NZW_m x RX_f ranked highest at weeks 6, 18 and 19 while the LAB_m x NZW_f recorded highest least squares mean values at weeks 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17 . The DT_m x CF_f recorded the lowest body weight least squares means at weeks at all the different ages observed (Table 3).

Least squares means of body weights at weeks 1 – 20 among the Reciprocal cross rabbit genetic group

The analysis of variance showed that there were significant differences (P< 0.05) among the body weights and least square means (Table 4) of the different reciprocally bred rabbit breeds.

The RX_m x NZW_f recorded the highest body weight least squares means at almost all the weeks though not significantly different (P> 0.05) from RX_m x CF_f at weeks 7 and 9. CF_m x DT_f and RX_m x CF_f recorded the highest least squares means at week 8 while the LAB_m x DT_f recorded the lowest values at almost all the weeks.

Table 2: Least square means of weekly body weights (g) of pure bred rabbit genetic group at different ages

	NZW	RX	DT	CF	LAB
Age (weeks)	Mean SE	Mean SE	Mean SE	Mean SE	Mean SE
1	128.00 ± 5.66^{a}	113.40 ± 7.44^{c}	118.05 ± 12.30^{bc}	120.65 ± 9.16^{b}	128.65 ± 8.64^{a}
2	173.95 ± 8.05^{a}	168.70 ± 9.10^{b}	164.95 ± 15.50^{bc}	163.45 ± 12.33^{e}	181.15 ± 9.36^{a}
3	226.40 ± 10.18^{a}	217.85 ± 11.33^{b}	203.95 ± 16.93^{c}	213.75 ± 14.75^{b}	227.85 ± 9.44^{a}
4	268.95 ± 11.75^{a}	259.15 ± 14.71^{b}	245.55 ± 19.95^{c}	251.35 ± 16.39^{c}	267.75 ± 12.31^{a}
5	390.25 ± 3.38^{a}	397.00 ± 0.00^{a}	397.00 ± 0.00^{a}	397.00 ± 0.00^{a}	397.00 ± 0.00^{a}
6	376.00 ± 20.05^{ab}	371.40 ± 24.05^{b}	347.00 ± 29.62^{c}	348.40 ± 26.64^{c}	381.35 ± 18.98^{a}
7	424.60 ± 23.79^{b}	417.65 ± 28.71^{bc}	393.50 ± 34.80^{d}	389.10 ± 30.25^{d}	435.70 ± 23.19^{a}
8	488.50 ± 27.32^{a}	465.65 ± 33.67^{b}	441.30 ± 41.58^{c}	440.35 ± 34.75^{c}	489.30 ± 27.56^{a}
9	568.55 ± 28.81^{a}	541.70 ± 35.33^{b}	524.75 ± 42.47^{c}	522.35 ± 36.20^{c}	561.15 ± 30.65^{b}
10	626.65 ± 34.71^{a}	613.40 ± 38.17^{b}	591.90 ± 44.66^{c}	589.30 ± 38.60^{c}	611.10 ± 34.72^{b}
11	700.10 ± 36.26^{a}	695.30 ± 36.71^{ab}	683.45 ± 44.91^{d}	681.50 ± 40.30^{d}	691.20 ± 35.17^{bc}
12	779.90 ± 38.79^{a}	771.15 ± 40.49^{b}	756.80 ± 47.15^{c}	756.25 ± 42.75^{c}	766.65 ± 38.75^{b}
13	867.50 ± 40.43^{a}	866.70 ± 40.66^{a}	851.80 ± 46.26^{b}	852.80 ± 45.62^{b}	865.65 ± 38.34^{a}
14	1004.65 ± 38.26^{a}	1002.00 ± 43.16^{a}	959.55 ± 47.65^{c}	969.45 ± 42.09^{c}	990.85 ± 36.73^{b}
15	1202.75 ± 25.32^{a}	1191.75 ± 29.45^{b}	1149.95 ± 36.67^{d}	1162.90 ± 30.47^{c}	1185.85 ± 24.69^{b}
16	1366.45 ± 18.80^{a}	1348.60 ± 23.42^{b}	1311.90 ± 30.03^{c}	1320.60 ± 25.67^{c}	1354.95 ± 18.99^{b}
17	1520.05 ± 11.12^{a}	1511.85 ± 13.46^{a}	1475.40 ± 23.57^{d}	1481.85 ± 18.54^{d}	1499.20 ± 12.27^{c}
18	1682.15 ± 9.07^{a}	1659.85 ± 14.02^{b}	$1622.6\ 0 \pm 22.52^{c}$	1625.85 ± 19.02^{c}	1665.90 ± 13.20^{b}
19	1807.05 ± 10.28^{a}	1788.65 ± 14.25^{b}	1751.70 ± 19.59^{e}	1758.30 ± 14.94^{c}	1789.35 ± 11.99^{c}
20	1952.25 ± 13.41^{a}	1932.05 ± 17.27^{b}	1875.80 ± 24.49^{d}	1888.45 ± 19.85^{e}	1936.80 ± 17.16^{b}

Means with different superscripts in the same column (within variable groups) are significantly (P< 0.05) different.

N.B ; NZW- New Zealand white ; RX- Rex; DT – Dutch, CF – California, LAB – Local breed.

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Table 3: Least squares means of weekly body weights (g) of cross bred rabbit genetic group at different ages

	NZW_m x RX_f	DT_m x CF_f	LAB_m x NZW_f	CF_m x RX_f	DT_m x LAB_f
Age (weeks)	Mean SE	Mean SE	Mean SE	Mean SE	Mean SE
1	139.90 ± 3.46^{a}	125.15 ± 3.97^{d}	133.20 ± 4.86^{b}	142.10 ± 10.43^{a}	130.20 ± 5.66^{c}
2	186.30 ± 4.03^{b}	172.95 ± 4.97^{d}	184.15 ± 6.75^{b}	195.65 ± 11.84^{a}	180.40 ± 5.72^{bc}
3	233.25 ± 4.81^{b}	218.10 ± 5.14^{d}	232.05 ± 8.16^{b}	246.35 ± 12.53^{a}	225.80 ± 6.56^{cd}
4	292.30 ± 6.54^{b}	263.05 ± 6.87^{d}	287.05 ± 10.51^{b}	305.25 ± 16.33^{a}	279.40 ± 8.65^{c}
5	357.80 ± 10.07^{b}	332.60 ± 12.54^{d}	349.50 ± 13.90^{c}	368.25 ± 17.36^{a}	345.75 ± 11.33^{c}
6	406.35 ± 12.80^{a}	381.65 ± 16.06^{c}	404.10 ± 17.24^{a}	402.90 ± 19.66^{a}	391.00 ± 13.77^{b}
7	457.10 ± 15.68^{b}	435.15 ± 19.11^{d}	462.25 ± 21.21^{a}	459.50 ± 22.50^{b}	445.15 ± 17.52^{c}
8	512.25 ± 19.84^{b}	491.50 ± 23.57^{d}	522.85 ± 26.10^{a}	518.55 ± 25.50^{ab}	501.95 ± 22.04^{c}
9	593.60 ± 22.40^{b}	575.70 ± 25.65^{d}	605.95 ± 28.79^{a}	599.60 ± 27.36^{b}	585.40 ± 24.31^{c}
10	691.55 ± 21.86^{b}	671.90 ± 24.90^{d}	700.85 ± 28.23^{a}	693.90 ± 27.35^{ab}	680.35 ± 23.84^{c}
11	758.75 ± 22.72^{b}	742.80 ± 26.61^{c}	778.55 ± 29.68^{a}	774.90 ± 27.90^{a}	759.45 ± 24.63^{b}
12	849.05 ± 24.62^{b}	835.35 ± 27.20^{c}	866.90 ± 31.45^{a}	849.85 ± 26.67^{b}	845.35 ± 26.21^{bc}
13	953.35 ± 27.87^{b}	940.10 ± 26.57^{c}	965.20 ± 31.32^{a}	959.45 ± 25.82^{a}	951.20 ± 25.90^{b}
14	1049.70 ± 27.65^{c}	1034.90 ± 29.61^{d}	1072.30 ± 33.08^{a}	1057.05 ± 30.03^{b}	1047.10 ± 28.43^{c}
15	1212.70 ± 18.23^{a}	1187.90 ± 23.66^{c}	1218.60 ± 26.96^{a}	1206.10 ± 22.79^{b}	1201.30 ± 21.78^{b}
16	1322.65 ± 18.47^{a}	1299.75 ± 23.28^{c}	1328.50 ± 26.39^{a}	1322.40 ± 21.88^{a}	1312.95 ± 21.13^{b}
17	1428.05 ± 14.55^{b}	1406.40 ± 21.23^{c}	1436.50 ± 25.78^{a}	1436.70 ± 20.93^{a}	1422.60 ± 19.37^{b}
18	1582.50 ± 15.53^{a}	1567.00 ± 18.26^{c}	1576.65 ± 21.63^{b}	1576.30 ± 17.76^{a}	1567.50 ± 17.19^{c}
19	1722.00 ± 13.93^{a}	1693.80 ± 18.73^{d}	1715.55 ± 26.13^{b}	1700.10 ± 19.94^{cd}	1701.45 ± 16.57^{c}
20	1816.30 ± 12.14^{b}	1790.90 ± 17.79^{d}	1832.15 ± 20.63^{a}	1813.10 ± 23.14^{b}	1804.10 ± 15.86^{c}

Means with different superscripts in the same column (within variable groups) are significantly ($P<0.05$) different.
N.B ; NZW- New Zealand white ; RX- Rex; DT – Dutch, CF – California, LAB – Local breed, m – male, f – female

Table 4: Least squares means of weekly body weights (g) of reciprocal crosses at different ages

	RX_m x NZW_f	CF_m x DT_f	NZW_m x LAB_f	RX_m x CF_f	LAB_m x DT_f
Age (weeks)	Mean SE	Mean SE	Mean SE	Mean SE	Mean SE
1	171.10 ± 7.90^{a}	139.75 ± 3.79^{b}	115.50 ± 5.08^{c}	143.10 ± 6.17^{b}	105.90 ± 7.69^{d}
2	225.60 ± 9.63^{a}	192.20 ± 4.91^{b}	170.45 ± 5.70^{c}	192.95 ± 7.29^{b}	153.25 ± 10.88^{d}
3	279.60 ± 10.54^{a}	258.15 ± 6.56^{b}	215.75 ± 6.01^{c}	252.90 ± 9.43^{b}	198.85 ± 13.34^{d}
4	331.45 ± 12.63^{a}	308.25 ± 4.73^{b}	253.25 ± 6.99^{c}	307.45 ± 9.00^{b}	225.30 ± 16.76^{d}
5	376.85 ± 15.41^{a}	361.40 ± 8.64^{b}	310.85 ± 11.63^{c}	366.30 ± 9.65^{b}	286.40 ± 19.48^{d}
6	423.20 ± 18.36^{a}	409.20 ± 11.50^{b}	362.50 ± 15.32^{d}	393.20 ± 13.49^{c}	331.80 ± 25.38^{e}
7	463.85 ± 21.86^{a}	454.20 ± 14.89^{b}	402.15 ± 18.43^{c}	462.60 ± 15.16^{a}	382.80 ± 25.32^{d}
8	509.85 ± 26.19^{b}	511.05 ± 18.91^{a}	452.85 ± 23.99^{c}	513.00 ± 19.14^{a}	443.60 ± 34.47^{c}
9	575.60 ± 30.11^{a}	576.10 ± 23.30^{a}	534.35 ± 25.47^{b}	571.60 ± 22.95^{a}	518.45 ± 34.95^{c}
10	632.00 ± 33.44^{a}	616.60 ± 29.83^{b}	588.80 ± 29.36^{c}	614.70 ± 28.96^{b}	580.75 ± 35.77^{c}
11	703.70 ± 32.65^{a}	694.10 ± 30.18^{b}	670.45 ± 30.45^{c}	693.15 ± 30.52^{b}	668.80 ± 35.58^{c}
12	783.15 ± 37.03^{a}	770.10 ± 33.06^{b}	747.10 ± 33.62^{c}	771.15 ± 32.76^{b}	744.90 ± 37.71^{c}
13	874.50 ± 37.60^{a}	867.35 ± 33.78^{b}	829.90 ± 33.65^{c}	869.55 ± 34.82^{ab}	836.90 ± 39.63^{c}
14	1015.15 ± 36.87^{a}	999.80 ± 31.89^{b}	965.10 ± 31.93^{c}	1007.50 ± 32.36^{b}	961.45 ± 37.46^{c}
15	1212.90 ± 22.18^{a}	1190.55 ± 18.57^{b}	1156.40 ± 18.72^{c}	1199.40 ± 21.43^{ab}	1153.35 ± 25.38^{c}
16	1391.05 ± 16.37^{a}	1365.50 ± 13.75^{b}	1317.55 ± 11.80^{c}	1369.75 ± 18.49^{b}	1312.65 ± 22.20^{c}
17	1540.80 ± 9.65^{a}	1503.60 ± 11.56^{b}	1469.05 ± 7.00^{c}	1508.40 ± 18.00^{b}	1469.20 ± 16.17^{c}
18	1704.45 ± 10.00^{a}	1687.70 ± 10.23^{b}	1634.40 ± 10.63^{c}	1686.40 ± 15.89^{b}	1609.80 ± 22.49^{d}
19	1831.25 ± 9.27^{a}	1813.10 ± 11.97^{c}	1761.10 ± 13.00^{d}	1821.00 ± 17.96^{b}	1749.05 ± 17.30^{d}
20	1986.15 ± 13.70^{a}	1958.55 ± 11.78^{b}	1908.75 ± 17.73^{c}	1956.40 ± 19.51^{b}	1859.35 ± 26.60^{d}

Means with different superscripts in the same column (within variable groups) are significantly ($P< 0.05$) different.
N.B ; NZW- New Zealand white ; RX- Rex; DT – Dutch, CF – California, LAB – Local breed, m – male, f – female

DISCUSSION

Generally, the result showed that the NZW and the LAB from the pure rabbit genetic group were superior when compared to other breeds at all ages. This result corroborate with the results of Chineke *et al* (2000), who reported superior performance of NZW over other rabbit breeds used in his study. Prayaga and Eady (2003) also reported similar result. Lower values recorded for the Dutch and CF rabbit breeds in this study opposed the report of Obike and Obi (2010), who recorded a higher value for the Dutch breed.

In the cross bred, crosses involving NZW (m) and LAB (f) recorded the best performance as compared to other rabbit crosses, this fact could be partly attributed to the possession of major genes that improved growth performance in the two rabbit breeds. Crossing did not only take advantage of traits with considerable non-additive genetic variations (i.e. dominance and epistasis), but also exploited differences in additive effects (i.e. differences in average performance between populations as a deviation from the overall mean) between populations (Ahmed, 2003).

In the reciprocal cross bred, crosses involving RX (m) and NZW (f) were superior over other genotypes of the genetic group at almost all the ages. The cross bred and reciprocal cross bred genetic group showed superiority over the pure bred at the pre – weaning ages, this result was in line with the reports of Odubote and Somade (1992) and Chineke *et al* (2002) that pre - weaning growth characteristics of crossbred rabbits were significantly higher than those of purebreds. These authors attributed the higher performance of crossbreds to heterosis, indicative of preponderance of non-additive genes for these growth traits.

CONCLUSION

In conclusion, from this study, the performance of Local and New Zealand White breeds of rabbit was better when compared to other genotypes in the pure rabbit genetic group, the CF_m x RX_f proved superior at pre – weaning ages and the LAB_m x NZW_f gave the best performance at post – weaning ages among the cross bred genetic group, while the RX_m x NZW_f was better when compared to other genotypes among the reciprocally bred rabbit genetic group.

The LAB and NZW breeds of rabbit should be considered for improved breeding, crosses between these breeds and with other rabbit breeds will improve production efficiency of rabbit breeds with less production efficiency. Therefore, the two genotypes could be considered as choice genotypes for improvement of growth of rabbits. The improvement and sustainability of rabbit production will depend on how best selection is made as regards choice of genotypes and how well the breeding programme is planned. Breeders need to exploit the preponderance of additive genes in the rabbit population to bring about improvement in the growth traits.

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