Phenotypic relationships between gestation length and preweaning litter traits in rabbits.

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Abstract

A total of 135 kittens from 22 kindlings were used to determine the relationship between gestation length (GL) and some preweaning litter traits alongside the weight of their 12 dams. Average daily gain at 21 days (ADG21), average litter weight at birth (ALWB), kindling to weaning viability (KWV), litter size at birth (LSB), litter size at 21 days (LS21), litter weight at 21 days (LW21), litter weight at birth (LWAB), and still birth number (SBN) when subjected to multiple regression analysis revealed non-significant t-test value with GL. However, Average litter weight at 21 days (ALW21) was highly significant ($P < 0.01$) suggesting that such can be used to predict GL. Weight of doe (WOD) was highly significant ($P < 0.01$) showing that such parameter is important for predicting GL. A high R^2 value was obtained indicating that the variability in GL is explained by the linearity of the preweaning litter traits and WOD. However the correlation coefficient R , (0.89) revealed a high degree of association between the preweaning litter traits in the rabbits and the weight of doe in a linear form. The F -value was significant at $P < 0.05$ indicating that WOD and the preweaning litter traits in rabbits have significant contribution to the variation in GL. The correlations among traits were positive and significant for majority of the traits, which include live birth number (LBN), ADG21, ALW21, KWV, LS21, and LW21. However SBN had negative correlation with other traits.

Key words: Phenotypic Correlation, Gestation Length, Preweaning Litter Traits, Rabbits.

Introduction

Inadequate supply of protein to meet the protein requirement of human beings has led to the use of intensive systems to optimise the output from livestock production. Concurrent with this approach is the search for other sources of animal protein and the rabbit has been thought of as being suitable in this regard (Odubote and Akinokun, 1991)

Preweaning litter traits are usually the indicators of the strength of the replacement stock of the farmer. Good selection of certain productive traits as well as use of good mating systems is prerequisites for genetic improvements in

rabbits. The preweaning litter traits such as the litter size and litter weight are usually regarded as the best estimate of number and weight of litters produced by does.

Gestation length has also been noted as an important factor affecting the number of animals produced as well as their viability. Nwagu *et al.* (2000) reported that a longer gestation period increased the litter weight at birth due to increased foetal growth.

The objective of this study was to determine whether there was phenotypic relationship between gestation and preweaning litter traits for selection of rabbits for increased rabbit

production. There is also need to estimate the correlation among the preweaning litter traits that would guide in the selection of rabbits for the production of greater rabbit meat.

Materials and Methods

The experiment was based on the primary data generated at the School of Agriculture and Agricultural Technology (SAAT) Teaching and Research Farm at the Federal University of Technology, Owerri. The records were generated from New Zealand White rabbits during the periods between June and November 2001.

The experiment started with sixteen mature New Zealand White rabbits comprising four stud bucks and twelve does. The bucks and does were obtained from different geographical regions (Owerri, Orlu, Mbaize and Zaria). This was done to eliminate or reduce inbreeding. There were limited records on their pedigree. The bucks' ages ranged from six to nine months, while the does' were six to eight months. They all had white coat colour and pink eyes. The weights of the bucks ranged from 1.83kg to 2.52kg while the does' weights ranged from 1.71kg to 2.79kg. The rabbits were fed commercial broiler starter mash in combination with wheat offal in equal weights *ad libitum*. Feeding was supplemented with forages and yam/ potato/ plantain peels. The animals were housed in individual hutches, the male hutches being larger than the females' to permit mating. The mating pattern was such that bucks served all the does and no buck served a doe twice before another buck. The kittens were kept in separate wooden nursery hutches until weaning.

Parameters measured were gestation length(GL), litter size at birth(LSB), live birth number(LBN), still birth number(SBN), litter weight at birth(LWAB), litter size at 21 days(LS21), litter weight at 21 days(LW21) and weight of doe(WOD). A total of 135 kittens were produced from 22 kindlings of which the live birth number was 119. The records of the weights of kittens and does were taken twice

daily in order to get an accurate average data on the parameters. This was taken with Kenwood Weighmaster which has one (1) gramme sensitivity. Observation of the parameters was recorded until the kittens were weaned on the 21st day *post partum*. Weights of kittens were taken as a group, while the weights of the does were taken before they were fed and before they suckled their kittens.

The SPSS statistical program (1987) was used for the analysis. The multiple regression model is presented below.

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_kX_k + e$$

Where Y- is the dependent variable

a- the intercept on the Y-axis.

b_1X_1 - regression coefficient b_1 of the independent variable X_1

b_kX_k - regression coefficient b_k of the independent variable X_k

e- is the residual.

The phenotypic correlation coefficient was estimated with the SPSS program. The kindling to weaning viability (KWV) estimated the survivability of kittens from birth to weaning. It took into consideration the mortality that occurred during the process of growth.

$$KWV = (LS21/LBN) \times 100$$

Where LS21 is the litter size at day 21, *post partum* and LBN is the live birth number. The average daily gain at 21 days estimated the rate of growth from birth to day 21, *post partum*. The formula is given by,

$$ADG21 = (LW21 - LWAB)/(21 \times LS21)$$

Where LW21 is the litter weight at day 21, LWAB is the litter weight at birth, and LS21 is the litter size at 21 days *post partum*.

Results and Discussion

Positive regression coefficients was obtained of 0.09 ± 0.028 for ALW21, 1.22 ± 0.079 for ALWAB, 0.09 ± 0.042 for KWV, 0.84 ± 0.782 for LS21, 0.01 ± 0.005 for LW21, and 7.34 ± 2.043 for WOD while negative values were obtained for ADG21 (-2.52 ± 0.890), LSB (-0.25 ± 0.589), LWAB (-0.03 ± 0.021) and SBN (-2.18 ± 0.936) for their regression coefficient were (Table 1). The

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the multiple coefficient of determination and multiple correlation coefficient were high.

Table 1: Multiple regression results of gestation length on preweaning litter traits and weight of doe.

Variables	t-value	coefficients + SE.
Constant		20.722 ± 4.042
ADG21	-2.833	-2.522 ± 0.890
ALW21	3.113**	0.088 ± 0.028
ALWAB	1.556	1.220 ± 0.079
KWV	-2.031	0.086 ± 0.042
LS21	1.074	0.840 ± 0.782
LSB	-0.423	-0.249 ± 0.589
LW21	0.352	0.009 ± 0.005
LWAB	-1.338	-0.029 ± 0.021
SBN	-2.333	-2.184 ± 0.936
WOD	3.592**	7.340 ± 2.043

Multiple coefficient of determination % R^2	78.6
Multiple correlation coefficient R	0.887
Number of observation	22
Degrees of freedom	21
F-calculated	4.046*
F-tabulated at 1%	4.54
F-tabulated at 5%	2.85

* $P < 0.05$, ** $P < 0.01$, NS – not significant.

The regression equation for table 1 is

$$Y = 20.72 - 2.52X_1 + 0.09X_2 + 1.22X_3 + 0.09X_4 + 0.84X_5 - 0.25X_6 + 0.01X_7 - 0.03X_8 - 2.18X_9 + 7.34X_{10}.$$

The coefficients of correlation between the preweaning litter traits as well as the weight of doe were significant. Positive significant results were obtained for ALW21 with GL and ADG21; ALWAB with ADG21 and ALW21; KWV with ADG21 and ALW21; LS21 with ADG21, ALW21, KWV and LBN. Other traits that showed positive correlation are LSB with LBN, LS21; LW21 with ADG21, ALW21, KWV, LBN, LS21; LWAB with GL, KWV, LBN, LS21, LSB and LW21. The following correlations were negative but significant: LBN with ALWAB; LSB with ALWAB; SBN with GL, ADG21, ALW21, KWV, LBN, LS21, LW21 and LWAB.

The highly significant partial correlation coefficient for ALW21 and WOD indicate that

prediction for gestation length can be based on these two parameters. ADG21, KWV, LSB, LWAB and SBN had non-significant negative coefficients, which indicate that prediction of the gestation length cannot be based on these parameters. ALWAB, LS21 and LW21 had positive non-significant values. A partial correlation coefficient of 0.088 for ALW21 means that a unit increase in ALW21 arose from an increase of 0.088 in the gestation length. This conforms with the report of Nwagu *et al* (2000) which indicated that higher birth weight may result from longer gestation length due to greater foetal growth from deposition of tissues from the mother. The average litter weight at 21 days is usually a reflection of the birth weight. This usually will be of great use to the farmer since higher average litter weight at birth increased the chance of survival of the animal and this yields more revenue to the farmer when the animal is sold.

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WOD also had a highly significant positive partial correlation coefficient ($P < 0.01$), indicating that the parameter can also be used as a predictor for gestation length. An increase of 1 kg in the weight of doe causes an increase of 1 units in the gestation length. WOD has an indirect effect on gestation length.

Crossbreeding, according to Fayeye and Ayorinde(2000), has been found to increase litter weights. It was reported that crossbred does had higher weights than the purebred. Thus, indirectly increasing the weight of doe increases the litter.

TABLE 2: Correlation among preweaning traits and WOD.

	GL	ADG 21	ALW 21	ALWA B	KWV	LBN	LS21	LSB	LW2 1	LWA B	SBN	W O D
GL												
ADG21	.401											
ALW21	.435*	.990**										
ALWA B	.406	.513*	.516*									
KWV	.342	.764**	.799**	.342								
LBN	.205	.108	.155	-.438*	.381							
LS21	.202	.458*	.508*	-.069	.836**	.742**						
LSB	-.142	-.271	-.239	-.644**	-.031	.829**	.490*					
LW21	.305	.712**	.752**	.176	.910**	.600**	.929**	.277				
LWAB	.413	.321	.392	.031	.612**	.839**	.808**	.542**	.785**			
SBN				-.105				-.101				
WOD	.559**	.565**	.603**		.721**	.640**	.647**		.686**	.749**		
	.411	.570**	.517*	.289	.394	.210	.332	.096	.480*	.306	-.241	

* $P < 0.05$, ** $P < 0.01$

The high value of the multiple correlation coefficients indicate that there is strong evidence that the preweaning litter traits and the WOD are highly associated with one another in a linear form. The high and significant correlation between ALW21 and GL shows that an increase in GL will bring about a moderate increase in ALW21. This may be accounted for by the

initial foetal deposition at longer periods leading to a heavier weight at birth (Nwagu *et al.*, 2000), and subsequently at weaning. Also the high and significant correlation between ALW21 and ADG21 suggests that kittens that have high mean litter weights are bound to have correspondingly high growth rates.

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Notably, low and non-significant correlation value between ALWAB and GL was observed. This corresponds with the result of Nwagu *et al.* (2000), which gave a lower but non significant value for the relationship. However, the significant relationship between ALWAB and ADG21 and between ALWAB and ALW21 indicate that a heavier weight average at birth will give moderate daily gain and increase in litter weight at 21 days. It was however observed that kittens with high viability increased in their daily weight and mean litter weight at 21 days as indicated by KWV which gave highly significant results with ADG21 and ALW21. Thus a farmer is expected to have heavier weaned kittens from a litter with high viability.

The correlation between LBN and ALWAB was negative and significant. This suggests that a high number of kittens alive at birth reduced the litter average weight and that a low LBN increased the mean weight of the kittens. LS21 was significantly correlated with ADG21 and ALW21. It was also significantly correlated with KWV and LBN, which indicates that there is greater likelihood of deriving more kittens at 21 days from a litter with larger number alive at birth and also with higher viability than one with a lower LBN.

A negative but non-significant correlation was obtained for GL and LSB. This conforms to the report of Patridge *et al.* (1981) that smaller litter sizes are invariably associated with an increase in gestation length. LSB and ALWAB had a highly significant but negative correlation coefficient indicating that a very low ALWAB will result from a large litter size at birth. Scholaut (1980) and Nwagu *et al.* (2000) reported similar results for the two traits. The highly significant correlation coefficient between LSB and LBN ($P < 0.01$) indicates that a large number is likely to be alive from a large litter size than from one with a small litter size. The correlation between LSB and LS21 was moderate and significant, which suggests that a large litter size at 21 days is more likely to come

from a large LSB. Khalil *et al.* (1987) obtained a similar result on Bauscat and Giza white rabbits.

LW21 gave very significant correlation ($P < 0.01$) with majority of the examined traits, which included ADG21, ALW21, KWV, LBN and LS21. The result shows that an increase in LW21 increased the average daily gain at 21 days and also increased the ALW21 in support of the result of Ndjon and Nwakalor (1998). A litter with high LW21 is expected to have high viability due to the relationship between high litter weight and ability to survive. Its relationship with LBN shows that the more there are live kittens at birth, the greater the likelihood of having higher litter weight at 21 days. However, the non-significant correlation obtained by Khalil *et al.* (1987) on the relationship between LS21 and LW21 on Bauscat and Giza white rabbit was contrary to the value obtained in this study. Such high correlation shows that the litter weight at 21 days was bound to increase from a large litter size at 21 days than from a small one.

The LWAB gave a non-significant correlation with GL, suggesting that longer GL will increase the LWAB. Nwagu *et al.* (2000) reported a much lower value. LWAB showed highly significant correlation with majority of other traits, which included KWV, LBN, LS21, LSB, LW21. It is obvious that a litter with high birth weight is expected to have high viability and subsequently high litter weight at day 21. The high correlation between LWAB and LBN arises because a litter with a large size of live kittens will have a corresponding increase in litter weight. Odubote and Akinokun (1991) found that litter size significantly influenced litter weight at all ages. Khalil *et al.* (1987) obtained a non significant value for Bauscat and Giza white rabbits, which contradicted the highly significant results obtained in this study. Nwagu *et al.* (2000) and Khalil *et al.* (1987) also reported highly significant correlation between LWAB and LSB.

The SBN gave negative correlation with all the traits examined. Most of the correlation coefficients were highly significant. SBN reduced with increasing GL this may have resulted from the fact that the longer gestation may have improved litters' viability by larger weight at birth. Its correlation with ADG21 and ALW21 implied that the higher the number of stillbirth, the lower the ability of the surviving kittens to have appreciable gain. This may have resulted from poor maternal environment. A larger proportion of SBN greatly reduced the number of kittens born alive and also the viability of the kittens at weaning. Its effect on the LS21 arose from the fact that an initial large size of stillbirth will subsequently result in a very low crop being weaned at 21 days. An initial unfavourable maternal environment that led to the increase in the stillbirth number may have resulted in the reduction of the LWAB and subsequently low LW21 of the surviving kittens.

The WOD was not significantly correlated with GL. The highly significant correlation ($P < 0.01$) of WOD with ADG21 and ALW21 shows that a high average daily gain should be expected from a doe of higher weight and subsequently high mean weight at 21 days. This may be due to higher milk production by such doe. This is seen from the report of Iyeghe-Erakpotobor *et al.* (2000) that crossbred does produce more milk than purebred ones. Such crossbred had higher weights. The WOD had non-significant correlation with ALWAB, KWV, LBN, LS21 and LSB. This shows that the environment has several roles to play in favour of these traits. WOD and LW21 had significant correlation, which may have resulted from higher milk production by such doe. A non-significant and negative value was obtained for WOD and SBN, indicating that a higher weight of doe resulted in reduced number of stillbirths. Feeding may also have contributed since Anderson and Melampey (1971) reported that feeding the doe with high portion of energy feed increased ovulation and subsequently litter size at birth. Furthermore, a heavier doe is most likely to have large size. Its size positively influenced the survival of kittens

since there will be large uterine horns which provide large implantation sites and more room for the foeti to develop.

Conclusion

Prewaning litter traits are important for optimum rabbit production. The consideration of these parameters and the subsequent selection of animals with the best traits lead to greater productive efficiency of the animals. This study has indicated the correlation among the various traits that would boost the farmer's selected stock and thereby has tried to fashion better alternatives and channels of achieving optimum protein supply through higher production of rabbits.

The average litter weight at 21 days and the weight of doe are two parameters that can be used to predict changes in gestation length. The phenotypic correlation among traits that can be used for the selection of animals were found to be significant for such fundamental traits as ADG21, ALW21, KWV, LBN, LS21, LW21 and LWAB. The study showed that emphasis should be placed on weaning traits, especially the weight since it had higher and more significant correlation with other traits. These criteria should be used in retaining stock for replacement. Cognisance should be taken on selecting stock with the least number of stillbirths. This is due to its significant negative correlation with other traits.

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