Influence of breed-type and parity order on pre-weaning litter traits of rabbits raised in derived savanna zone of Nigeria

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Abstract

Pre-weaning litter traits such as litter size and weight at birth and weaning are of economic importance for profitable expansion of the rabbit industry. This study investigated the influence of breed-type and parity order on pre-weaning litter traits of three rabbit breeds raised in Nigeria. Data were obtained on purebred progenies, from three parities, of does belonging to Chinchilla, Dutch and New Zealand white breeds. Does were first mated at 9-11 months of age. Traits evaluated include litter size and weight at birth and weaning (56 days of age) and pre-weaning mortality rate. Highly significant breed-type and parity order effects ($p < 0.001$) were found in litter size and weight at birth and weaning. The Chinchilla had 12.58% and 11.54% more kits at birth than the Dutch and New Zealand white breeds respectively. More kits ($p < 0.01$) were also weaned by the Chinchilla. On average, litters from Chinchilla were heavier (42.74 ± 1.28 g and 390.51 ± 5.14 g at birth and weaning respectively) than those from Dutch and New Zealand white. Litter size and weight at birth and weaning were highest in the first parity ($p < 0.001$). Pre-weaning mortality rate ranged from 19.47-22.99% but was not affected by breed-type or parity order. The use of Chinchilla breed and selection criterion based on first parity litter traits is recommended for genetic and economic improvement of rabbits in Nigeria.

Keywords: breed, litter size, litter weight, parity, pre-weaning mortality, rabbits

Introduction

Rabbit production represents one of the cheapest and sustainable livestock enterprises that can be used to ameliorate low animal protein consumption as well as alleviate poverty with the present dwindling economy of the nation. Possession of remarkable reproductive and economic attributes such as attaining maturity at an early age, shorter gestation period and generation interval, high fecundity and prolificacy, efficient utilization of fibrous agricultural by-

products and forages, as well as excellent meat quality makes its production profitable for smallholder subsistence/integrated farming notable in developing countries (McCroskey, 2000; Obike and Ibe, 2010). Generally, the productive efficiency of rabbits is measured by the number of young raised to weaning or slaughter per unit time (Isaac *et al.*, 2010). Rashwan and Marai (2000) noted that increase in economic returns from rabbit production is associated with increase in litter size and reduction in mortality. Thus litter traits such as litter size

Influence of breed-type and parity order on pre-weaning litter traits of rabbits

at birth and weaning and litter weight at birth and weaning are of economic importance for profitable expansion of the rabbit industry (Odeyinka *et al.*, 2008). Szendr (2008) asserted that these traits are influenced by several genetic, physiological and environmental factors. Breed and parity order are often considered as pertinent factors which may affect productivity and appraisal of any commercial rabbit production (Oseni *et al.*, 1997). Though litter traits at first parity are mostly used as selection criterion in genetic improvement of rabbits, Eugene *et al.* (1980) opined that litter traits in subsequent parities from the first should also form part of the selection criterion for long term improvement. This study aimed at investigating the effect of breed-type and parity order on litter traits of three common rabbit breeds raised in Nigeria.

Materials and methods

Study area

This study was conducted at the Rabbit Unit of the Teaching and Research Farm of Department of Animal Science, Ebonyi State University, Abakaliki, Nigeria between 2012 and 2013. Abakaliki lies in latitude 06°45 N and longitude 08°65 E in the derived savanna zone of South-East, Nigeria.

Management and breeding of experimental animals

Twenty seven does and nine bucks from three breeds, Chinchilla (9 does x 3bucks), Dutch (9 does x 3bucks) and New Zealand White (9 does x 3bucks), maintained in the Rabbit Unit of the Department were used for the study. All rabbit breeds were housed in an asbestos roofed, dwarf walled house. Temperature within the building during the study period ranged from at 25°C-35°C. All animals were identified by ear notching and kept individually in battery cages (two feet

above floor level) with each cell measuring 40x50x30cm. Two weeks before commencing the study, all the rabbits were given prophylactic treatment against ecto and endo parasites. The does were first mated using natural mating at 9-11 months of age. For breeding purposes, bucks were transferred to wooden breeding hutches a week before using them for service. Does were served in the morning by introducing them to the bucks. They were returned to their cages after service. The mating system was pure breeding. Pregnancy diagnosis was done 14 days post service by palpating the horn of the uterus to feel for implanted embryo. Does' without successful fertilization or indicating false pregnancy were reintroduced to the bucks for mating. Does diagnosed to be pregnant were transferred from the battery cage to wooden nest boxes prepared for kindling (using grass straw as bedding material) from the 26th day of mating. After kindling, the does were allowed to nurse their kits for 56days. Kits were properly identified at birth by ear notching.

The does were fed according to their physiological status during the study period. They were fed concentrate and forages throughout the study period. Concentrate was fed in the mornings at 140g feed/doe/day and 320g feed/doe/day to pregnant and lactating does respectively. Does were flushed after weaning for 7days before serving them. The proximate composition of the pelleted concentrate was 17.63%CP, 15.30%CF, 4.80%EE, 5.1% ash and with 2610Kcal kg⁻¹ME. Different forages (*Panicum maximum* and *Centrosema pubescens*) were given in the evenings as supplements. Creep feed (0.07g/g body weight/day) was introduced to the kits from 28days of age till they were weaned at 56 days of age. Clean portable water was provided *ad libitum*. All the

rabbits were treated and medicated similarly and raised under the same management conditions.

Traits measured

Data were collected according to parity order from the different breeds on the following traits:

- Litter size at birth: This was recorded after kindling as numbers of kits kindled at birth per doe.
- Litter weight at birth: This was obtained after kindling and measurement was done using a sensitive electronic weighing balance of 1000g capacity with 0.001g precision. The litter weight at birth was the total weight of all the kits in a litter at birth.
- Litter weight at weaning: Each kit was weighed at weaning using the sensitive electronic weighing balance and the sum total of the individual weights of the kits recorded.
- Litter size at weaning: this was recorded as number of kits alive at weaning/per doe.

Statistical Analysis

Analysis of variance was performed using GLM-multivariate procedure of IBM SPSS (2013). Only main effects of breed-type

and parity order were considered. Main effect mean differences were tested by least significance difference and considered to be significant at probability level less than 5% ($p < 0.05$). The linear additive model adopted was as follows:

$$y_{ijk} = \mu + B_i + P_j + \epsilon_{ijk}$$

y_{ijk} = Number of observation/records

μ = Population mean

B_i = Effect of breed-type ($i=1-3$, Chinchilla, Dutch, New Zealand white).

P_j = Effect of parity ($j=1, 2, 3$)

ϵ_{ijk} = Randomized Experimental error.

Results and discussion

Effect of breed-type on litter traits

Litter size and litter weight are of paramount economic consequence in rabbit production. Table 1 presents the least square means ($\pm$ SEM) of pre-weaning litter traits of the three breed-types studied. Significant breed-type effect existed between the Chinchilla and the other two breeds (Dutch and New Zealand white). Such difference was not observed between Dutch and New Zealand white. Our findings revealed a disparity among breed-types for litter size at birth and weaning, with the Chinchilla breed showing more superiority. Litter size at birth of Chinchilla breed was 12.58% and 11.54% more than those of Dutch and New Zealand white breeds respectively.

Table 1: Least square means ($\pm$ SEM) of pre-weaning litter traits of the three breed-types

Litter Traits	Breed			P-value
	Chinchilla	Dutch	New Zealand white	
LS at birth(kits)	5.72 $\pm$ 0.14 ^a	5.00 $\pm$ 0.13 ^b	5.13 $\pm$ 0.13 ^b	0.000
LS at weaning(kits)	4.50 $\pm$ 0.08 ^a	3.94 $\pm$ 0.10 ^b	3.83 $\pm$ 0.11 ^b	0.000
LW at birth(g)	271.14 $\pm$ 8.65 ^a	229.36 $\pm$ 7.40 ^b	227.44 $\pm$ 5.54 ^b	0.000
LW at weaning (g)	2362.80 $\pm$ 60.88 ^a	1757.70 $\pm$ 53.75 ^b	1690.56 $\pm$ 45.91 ^b	0.000
Pre-weaning mortality (%)	20.66 $\pm$ 1.45	19.72 $\pm$ 1.81	22.99 $\pm$ 1.83	0.314

^{ab}Means on the same row followed by different superscripts are significantly different $p < 0.05$

LS at birth – Litter size at birth, LS at weaning - Litter size at weaning, LW at birth - Litter weight at birth, LW at weaning - Litter weight at weaning

Influence of breed-type and parity order on pre-weaning litter traits of rabbits

Furthermore, the Chinchilla does weaned 0.56 - 0.67 kits more than both Dutch and New Zealand white does. This affirms the report of Addass *et al.* (2010) among selected breeds of rabbits in Bauchi, Nigeria. Khalil (1993) and Iyeghe-Erakpotobor *et al.* (2001) however, reported more number of kits at birth for New Zealand white breed. Apart from genetic factors, variations in litter size different at stages of development have been associated with the maternal reproductive traits such as ovulation rate, uterine capacity and embryonic or fetal survival rates (Christenson *et al.*, 2000; Argente *et al.*, 2003), nutrition (McNitt and Moody, 1988), season of breeding (Sood *et al.*, 2006; Pasupathi *et al.*, 2014), and breeding methods (Heba-T-Allah *et al.*, 2016). Highly significant strong and positive phenotypic and genetic correlations have been reported to exist between litter size at birth and litter size at weaning (Orumunyi *et al.*, 2006).

There was significant breed-type effect on litters weight at birth and weaning. On average, litter from Chinchilla weighed heavier (42.74 ± 1.28 g at birth and 390.51 ± 5.14 g at weaning) than litters from Dutch and New Zealand white. The superiority of the Chinchilla in litter weight (at birth and weaning) is consistent with the findings of Obike and Ibe (2010). Variation in litter weight at birth due to breed-type effect as indicated by our result is in agreement with the findings of Hassanien and Balomy (2011) who obtained significant breed effect in medium size rabbits (Rex, California, New Zealand white, and Baladired). Lower litter birth weight in the New Zealand breed is also supported by the results of Addass *et al.* (2010). Chineke (2005) found no breed effect on litter weight at birth between New Zealand white and Chinchilla breeds,

whereas Iyeghe-Erakpotobor *et al.* (2001) in contrast, reported higher litter birth weight for New Zealand white rabbits than Chinchilla breeds. Mgheni *et al.* (1982) found that litter weight at birth directly influenced daily weight gain and body weight. Interaction of different variables such as fertility rate, maternal behavior, milk production ability, pre-weaning growth characteristics and survival rate are known to influence litter weight in rabbits (Lukefahr *et al.*, 1990; Garcia and Baselga, 2002).

Our findings showed that there was a loss of 1.25, 1.06 and 1.30 kits by the Chinchilla, Dutch and New Zealand white breeds respectively prior to weaning. The pre-weaning mortality rate ranged from 19.72-22.99%. Though the pre-weaning mortality rate appeared to be higher in the New Zealand white, no breed-type discrepancy was found. Ahmed and Marai (1998) also indicated no significant genetic variation on pre-weaning mortality rate. However, some authors have reported significant breed effect on pre-mortality rates in rabbits (Abdel-Azeem *et al.*, 2007; Hassanien and Baiomy, 2011; Nwakpu *et al.*, 2015). Apart from genetic effect, certain non-genetic factors such as those due to maternal influence (Nandakumar and Thomas, 1999; Ahmed *et al.*, 2005), litter size and weight birth (Poigner *et al.*, 2005), daily weight gain (Johnson *et al.*, 1988) have been reported to influence pre-weaning mortality rate in rabbits. Afifi and Khali (1991) opined that pre-weaning mortality rate can be reduced through genetic improvement involving cross breeding.

Effect of parity on litter traits

As depicted in Table 2, parity order had a highly significant ($p < 0.001$) effect on litter size and litter weight at birth and weaning. Unexpectedly, the number of kits kindled at first parity was greater than those in the

second and third parity. A similar trend was observed in litter size at weaning. Apori *et al.* (2015) reported that parity order significantly influenced litter size, although such variation appeared to occur from the fifth parity. The finding of Singh *et al.* (2007) that does in their first parity had

about 0.5kits more than subsequent parities in a population of White giant rabbits in India supports our result. Hassanien and Baiomy (2011) also observed that parity order had non-significant effect on litter size at birth and weaning in different breeds of rabbits.

Table 2: Pre-weaning litter traits of rabbits (least square means $\pm$ SEM) as influenced by parity order

Litter Traits	Parity 1	Parity 2	Parity 3	P-value
LS at birth	5.56 $\pm$ 0.14 ^a	5.17 $\pm$ 0.15 ^{ab}	5.06 $\pm$ 0.14 ^b	0.009
LS at weaning	4.33 $\pm$ 0.10 ^a	4.06 $\pm$ 0.09 ^b	3.89 $\pm$ 0.11 ^b	0.002
LW at birth(g)	255.52 $\pm$ 7.74 ^a	241.65 $\pm$ 8.13 ^a	230.80 $\pm$ 7.17 ^b	0.032
LW at weaning (g)	2080.96 $\pm$ 69.58 ^a	1943.45 $\pm$ 62.58 ^b	1826.65 $\pm$ 68.44 ^b	0.014
Pre-weaning Mortality (%)	20.87 $\pm$ 1.65	19.47 $\pm$ 1.99	22.43 $\pm$ 1.43	0.453

^{ab}Means on the same row followed by different superscripts are significantly different $p < 0.05$

LS at birth – Litter size at birth, LS at weaning - Litter size at weaning, LW at birth - Litter weight at birth, LW at weaning - Litter weight at weaning

Litter weight at birth for the three parities studied was within the range of 240.30 - 269.10g obtained by Sivakumar *et al.* (2013) over six parities in Soviet Chinchilla and White giant rabbits, and 255g by Fayeye and Ayorinde (2008) in a mixed-breed rabbit population in Nigeria. El-Magahawry (1993) reported that parity had no effect on birth weight of rabbits, while an inconsistent trend was observed by Chineke (2005). According to Afifi and Kadry (1984) and Khalil and Afifi (2000) variations in litter traits at birth due to parity order could be attributed to changes in the physiological efficiency of the doe such as those associated with ovulation and implantation rate, and intra uterine capacity/environment during gestation which could influence embryo survivability and provision of nourishment essential for proper pre-natal development.

Generally, there was limited effect of parity on pre-weaning mortality rate. Though pre-weaning mortality was apparently higher in the third parity, the observed increase was not significantly different from observations recorded in the first and

second parity. Zotte and Paci (2013) obtained similar result in a mixture of crosses of several medium-large size breeds of rabbits. Our result is within pre-weaning mortality range of 19.02 $\pm$ 2.59 – 24.26 $\pm$ 3.70 obtained by Heba-T-Allah *et al.* (2016) in New Zealand white and Hyplus rabbits. This result agrees with the report of Tuma *et al.* (2010) which indicated that number of dead kits prior to weaning was not influenced by parity order. Variations in pre-weaning mortality rate due to parity have been attributed to litter size and weight at birth (Poigner *et al.*, 2000), management system (Laxmi *et al.*, 2009; Gerencse *et al.*, 2011), season of birth (Kumar *et al.*, 2001), nutrition (Latuet *et al.*, 2017), mating systems (Oke and Iheanacho, 2011; Olowofeso *et al.*, 2012) and body size and age of the dam (Rebollar *et al.*, 2009).

Conclusion

Pre-weaning litter traits in this study were influenced by breed-type and parity order. The performance of the Chinchilla breed was superior to the Dutch and New Zealand white breed in all traits except pre-weaning

Influence of breed-type and parity order on pre-weaning litter traits of rabbits

mortality rate. Litter size and weight at birth and weaning were best at first parity. Our findings suggest, therefore, that pre-weaning litter traits are economic traits that ought to be considered when planning rabbit production, and that selection criterion based on first parity litter traits could be adopted in genetic and economic improvement of rabbits in Nigeria.

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