DIRECT AND PERCENT HETEROTIC EFFECTS ON BODY WEIGHT AND REPRODUCTIVE TRAITS IN TWO BREEDS OF RABBIT

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ABSTRACT

This study was conducted to evaluate the effect of reciprocal crossing on body weight (BW) and reproductive characteristics of two breeds of rabbits, New Zealand white (NZW) and chinchilla (CHA) raised in tropics. Offspring from the crossing of NZW x CHA and CHA x NZW were studied for body weight (BW) and reproductive traits for twelve weeks. Reproductive traits studied were litter size at birth (LSB), litter size at weaning (LSW), Average birth weight (ABWT), Average weaning weight (AWWT), Gestation length (GSTL) and percent mortality. The heterotic values and their percentages were calculated in the two genetic groups using the linear contrast procedure. The direct and percent heterosis for reproductive traits were all positive for the two genetic groups except in gestation length and percent mortality which showed negative heterorosis (-1 and -3.2%; 3.19; 10.12% for gestation length and -7.19 and -19.07; -9.36 and -24.83% for percent mortality in CHA X NZW and NZW X CHA respectively). Body weight at different ages studied were positive for NZW x CHA offsprings while CHA x NZW offsprings had negative values for all these parameters measured indicating that CHA sired offsprings had no improvement for BW at various ages. It could therefore be concluded that rapid improvement in these traits (Reproductive and body weight) could be achieved by crossbreeding involving mating of New Zealand White male and Chinchilla does in the study area.

Key words: Rabbit, crossbreeding, heterosis, reproductive traits, body weight

Introduction

Production of rabbit has become very lucrative in recent times due to its numerous attributes. Some of which include high reproductive performance (Kabir *et al*., 2016), excellent mothering ability (Lukefahr and Cheeke, 1990), ability to adapt in different environmental conditions (Sam *et al*., 2020a), high genetic variability (Sam *et al.*, 2020b), low capital investment (Aduku and Olokosi, 1990). Rabbit meat contain very high protein 21-22% (Dale, 2002) and low in fat and cholesterol (Ekpo *et al.*, 2016) in addition rabbit has no religious taboo linked to its consumption.

Reproductive and growth traits are very important in rabbit production. Reproductive performance of rabbits determines the profitability and economic success of commercial rabbit breeding (Sam *et al.*, 2020a; Ekpo *et al*., 2018). Body weight and morphometric trait on the other hand is crucial because heavier body weights lead to greater economic of production in rabbit production (Fayeye, 2013). Estimation of morphometric traits in animals are very vital in estimating genetic parameters in animal breeding programs (Chineke, 2000; Sam *et al.*, 2020a). Body weight is an economic important trait in the commercial rabbit production and was found to be improved by crossing of local breeds with exotic standard breeds (Afifi *et al*., 2000; Piles *et al*., 2004). Similarly, crossbreeding is a major tool used by animal breeders to improve many traits in farm animals. Several researches have been conducted on breed complementation for reproductive and growth traits by crossing animals of different genotypes (Rashau and Marai, 2000, Iraqi *et al.*, 2008, Fayeye, 2013, Sam *et al.*, 2020a). Breed complementarity was achieved by crossing local white and local black rabbit to tap the non-additive genes for improving reproductive traits (Fayeye, 2013). Studies have shown that under field and experimental breeding situations, not every crossbreeding strategies produces desirable results (Nwachuckwu and Okoji, 2012). It is pertinent that breeders know what mating methods to employ and what breeding goals to expect (Dickerson, 1992). The needed information on which breed should be used as male or female in crossbreeding rabbit for commercial purpose is limited. Therefore, this study was undertaken to evaluate

the level of heterosis for body weight, reproductive and morphometric traits in main and reciprocal crossbreed of New Zealand and chinchilla breeds of rabbit.

Materials and Methods

Experimental site

This experiment was carried out at the Rabbitary Unit, Teaching and Research Farm, Akwa Ibom State University, Obio Akpa Campus. Obio Akpa is located between latitudes $5^0 17^1$N and $5^0 27^1$N and between longitudes $7^0 27^1$E and $7^0 58^1$E with an average annual rainfall which range from 3500 to 5000 mm. It has a hot-humid climate with temperature ranges of 21-26^0 C. The relative humidity is between 60 to 90% (Wikipedia, 2017).

Experimental animals and management

The experiment consisted of twenty New Zealand White (2 bucks and 18 does) and twenty Chinchilla breeds of rabbit (2 bucks and 18 does). The rabbits were purchased from reputable rabbit farms in Uyo metropolis, Akwa Ibom state, Nigeria. On arrival, the rabbits were allowed to acclimatize for two weeks to the environment before commencing the study. The animals were given ivomectin injection subcutaneously to treat both external and internal parasites that may affect their reproductive performance. They were also treated prophylactically with Amprolium 200 for one week against Coccidiosis given via drinking water. Multivitamins were also given to the rabbits to boost them up for the study. Every other care as applicable to international, national and University guidelines for the care and used of animals were followed (SAMRC, 2004).

During breeding one New Zealand White buck was used to mate with nine New Zealand White does and the second New Zealand buck was used to mate with nine Chinchilla does. While one Chinchilla buck was used to mate with nine Chinchilla does and the second Chinchilla buck was used to mate with nine New Zealand White does. At the end of the breeding period one hundred and twenty-six (126) kits produced from crosses comprising of NZW x NZW, CHA x CHA, NZW x CHA and CHA x NZW were produced. The rabbits were kept in 4 hutches each measuring 170 cm by 32 cm and consisting of 10 cells, each of which measured 34 cm x 30 cm x 28 cm such that one rabbit was accommodated in one cell. Identification marks were placed on the cells in which each rabbit was accommodated.

All the rabbits in their respective cells were fed with forages such as *Ipomea batata, Centrosema spp, Peuraria phaseoloides* and commercial concentrates feed was also given with drinking water ad-libitum. The commercial concentrate fed to the animals consisted of 18% CP, 2600 Kcal/kgME, and 8% CF as analyzed. Routine management operations were carried out on a daily basis. Pregnancy was detected by careful abdominal palpation on 14th and 21st days after mating, if confirmed pregnant, nest boxes were provided on 28th day of pregnancy.

Data collection

Measurement of Reproductive and Body weight Traits

Gestation length: This was measured by finding the interval between the date of last mating and date of kindling.

Litter size at birth: This was measured by direct counting of the kits immediately after kindling with still birth inclusive.

Litter size at weaning: This was the number of weaner's (young rabbits) in each litter at weaning time (6 weeks).

Birth weight: This was measured by transferring all the kits in a litter with gloved hands well rubbed on the body of the doe in question to the weighing scale. And the weight of the litter read off and divided by the total number of kits in the litter.

Body weight at weaning: This was measured by taking the weight of each kit in a litter at weaning time (6 weeks).

Weekly body weight: This was measured by weighing each kit in a litter on weekly basis for a period of twelve weeks using a measuring scale. All body weights were taken using a Sensitive weighing balance (S. Miller Digital Scientific Scale) and all measurements were recorded early in the morning before feeding.

Statistical Analysis

The design for this study was a completely randomised design with genetic group as major factor of interest. Direct and percentage heterosis were estimated using the linear contrast procedure as described by Dickerson (1992). The procedure is as follows:

1. Direct heterosis= Mean of crossbred – Mean of purebreds
2. Percentage heterosis = $\frac{\text{Direct heterosis}}{\text{Pure line}} \times 100$

Results and Discussion

Heterosis for body weight

The estimate of direct and percentage heterosis of main and reciprocal crossing of Body weights of New Zealand white and Chinchilla breeds of rabbit according to age is shown in Table 1. The results indicated that percent heterosis for body weight were positive in NZW X CH crossbreed kits at all the ages studied, (29.54, 29.28, 30.43, 26.46, 33.14 and 40.63 for 2, 4, 6, 7, 8, 10 and 12 weeks respectively). Direct heterosis and percent heterosis were negative for body weight in CH X NZW crossbred in all the ages studied, direct heterosis were -9.06, -95.46, -61.79, -96.33, -145.19 and -245.20 for weeks 2, 4, 6, 8, 10 and 12 respectively. The highest positive heterosis of 40.63% was recorded at week 12 followed by week 10 (33.14), exception of week 8 which recorded 26.46% heterosis increased gradually as the age of the rabbit increased. The observed differences in heterosis effect for body weight among breed crossed in this work is in consonance with earlier studies on New Zealand white local Egyptians rabbits and Nigerian local rabbits (Tag-El-Din *et al*., 1992; Rashwan *et al*., 1997 and Fayeye, 2013).

The negative direct heterosis and percent heterosis observed in the cross between CHA X NZW indicated that means of this crosses were lower than that of pure breeds. Therefore, crossing CHA X NZW does not improve body weight of these rabbits at different ages studied. However, the cross between NZW X CHA resulted in positive direct and percentage heterosis at all ages, this method of mating could be used for commercial production of rabbits. These results agreed with previous work by Ouyed and Brun (2008).

Table 1: Estimate of direct and percentage heterosis of main and reciprocal crossing of Body weights of New Zealand white and Chinchilla breeds of rabbit according to age

Age	CHA X NZW		NZW X CHA	
	Dir. Het	%Het	Dir. Het	%Het
0	0.03	0.045	0.98	1.48
2	-9.06	-5.83	45	29.54
4	-95.46	-26.36	106.03	29.28
6	-61.79	-13.55	138.03	30.43
8	-96.33	-16.75	152.21	26.46
10	-145.19	-20.57	233.9	33.14
12	-245.20	-28.49	349.6	40.63

Dir. Het-Direct heterosis, %Het-Percent heterosis

Reproductive Traits

Estimate for direct and percent heterosis for reproductive traits are shown in Table 2. The estimate for direct and percent heterotic effect for litter size at birth, litter size at weaning and average birthweight were positive in the two crossbred groups. CHA and NZW recorded 1.16, 0.52 and 0.03 direct heterosis for LSB, LSW and ABWT respectively, whereas the group percent heterosis were 25.77%, 14.77% and 0.045 for LSB, LSW and ABWT respectively. However, NZW and CHA crosses recorded higher direct and percent heterosis than CHA X NZW. The results showed that direct heterosis were 0.67, 1.46 and 0.98, while percent heterosis were 14.88%, 42.03% and 1.48% for LSB, LSW and ABWT respectively. The direct and percent heterosis for AWWT was negative for CHAXNZW progenies (-87.79 and -17.18% respectively), but positive for NZWXCHA progenies (118.72 and 24% respectively. The difference in heterotic effect for weaning weight between the two crossbred groups is in line with previous studies on New Zealand white, local Egyptian rabbits and Nigerian local rabbits (Tag-el din *et al*1992; Rashwan *et*

al., 1997; Fayeye, 2013). It was observed that NZW and CHA crosses had negative direct and percent heterosis for gestation length, which still indicates its superiority over the other genetic group. Results for heterosis for mortality were negative for the two crossbred genetic groups (NZW X CHA and CHA X NZW). The improvement in survivability of the crossbreds could be attributable to better mothering ability or maternal effects expressed by the two breeds. It may be desirable to experience negative heterosis for some traits such as mortality and gestation length which is an implication of higher parental or purebred performance as against crossbred performance.

Table 2: Estimate of direct and percentage heterosis of main and reciprocal crossing of reproduction traits of New Zealand white and Chinchilla breeds of rabbit

Parameter	CH X NZW		NZW x CH	
	Dir Het	% heterosis	Dir het	% het
LSB	1.16	25.77	0.67	14.88
LSW	0.52	14.77	1.46	42.03
ABWT	0.03	0.045	0.98	1.48
AWWT	-87.79	-17.18	118.72	24.95
GSTL	1.00	3.2	- 3.19	10.25
Mortality %	-7.19	-19.07	-9.36	-24.83

Conclusion

The study revealed strong crossbreeding effect on the NZW x CHA offspring as indicated by positive estimate of direct and percentage heterosis for LSW, ABWT, AWWT. GSTL and body weight at different ages studied. The study also showed negative direct and percent heterosis for CHA x NZW off springs in AWWT and body weight at all ages reflecting that there was no improvement for these traits following crossbreeding in the animals.

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