JORMAR 3(1) 2006, 12 - 20 ISSN: 1597-3204

Ejaculate characteristics and artificial insemination in rabbits (*Oryctolagus cuniculus*) following ovulation induction using teaser bucks

Zahraddeen*, D., Butswat, I.S.R. and Mbap, S.T.
Animal Production Programme, School of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi, Nigeria

Abstract
Series of experiments were conducted at the Abubakar Tafawa Balewa University Farm, Bauchi, Nigeria to investigate the reproductive performance of local and exotic rabbits. For the local and exotic rabbits, the mean (± S.E) gel-free volume, gel volume, progressive motility, sperm concentration, total sperm per ejaculate, % live spermatozoa and % abnormal spermatozoa were 0.61 ± 0.02 vs 0.80 ± 0.01ml; 0.37 ± 0.02 vs 0.48± 0.01ml; 65.42± 0.68 vs 71.83 ± 0.70; 74.47 ± 0.50 vs 101.00± 0.34 x 10^6; 45.66± 1.45 vs 80.75± 1.68 x 10^9; 73.95± 0.86 vs 85.48 ± 1.00% and 17.23 ± 0.23 vs 13.84± 0.21% respectively, and were significantly (P< 0.05) different between the breeds. The results also showed that kindling rate (11.80 vs 14.71), number of young born (14.0 vs 22.0) and mean litter size (3.5 vs 4.4) for local and exotic rabbits respectively, and did not differ significantly between the two breeds. The Dutch rabbits are superior to the local ones in terms of their reproductive performance, and could be used to upgrade the local breeds. It is also suggested that when conducting AI in rabbits, appropriate method of ovulation induction should be opted for in order to achieve maximum conception rate.

Key words: *Rabbits, ejaculate characteristics, ovulation induction and teaser bucks.*

INTRODUCTION

Rabbits offer an avenue for rapid transformation in animal protein production. This is because of the possibility of high turnover rate in its production. Substantial parts of rabbit feed can be provided from herbage crops and weeds.

**Corresponding author*

Less land is required for rabbit production: the housing and other facilities are simpler and cheaper, and most importantly, rabbits have a shorter generation interval than many farm animals [1].

Artificial insemination (AI) has been used to increase the efficiency of controlled mating of farm animals in various parts of the world [2]. Method of controlled mating plays a very minor role in Nigeria. The development of AI in the country has

been very slow. Few reports are available, for example in cattle [3,4, 5,6], in sheep [7,8,9,10], in pigs (2) and in poultry [11,12]. The constraint to adoption of AI in Bauchi (Nigeria) has been identified by Butswat and Choji [13]. These workers recommended that the majority of the populace needs to be educated more on the significance and practice of AI or infrastructural facilities developed in an integral manner with essential manpower, financial input and built-in educational and training programmes, for bringing about the attitudinal change in the potential adaptors of AI.

Semen characteristics of rabbit breeds for some parts of the country have been reported in literature [14,15]. It is imperative to understand and improve the reproductive performance of rabbits in this country in order to form a basis for the development of rapid AI programme. It is also necessary that the programme should always include the local breeds since they possess some innate resistance to certain local diseases in addition to adaptability to prevailing climatic conditions. This study was designed to investigate the reproductive performance of Dutch-belted and local rabbits, following ovulation induction using teaser bucks.

MATERIALS AND METHODS

Location and climate

The study was carried out at Abubakar Tafawa Balewa University Farm, Bauchi, Nigeria. Bauchi is located on the northeastern part of the country and has a tropical climate. It is on latitude 10^0 27^1 North, longitude 9^0 49^1 East and at altitude of 690.2 metres above sea level [16].

The weather data in Bauchi reveals that the average rainfall starts with a mean of about 15.5mm in March to reach a peak in August (320.9mm) and decline to 0.54mm by November. The hours of sunshine indicate highest visibility in February (8.6h) and lowest in August (4.9h). April is the hottest month with mean minimum and maximum temperatures of 13.8^0C and 37.5^0C respectively. The mean relative humidity tends to follow the rainfall pattern, being highest (78.0%) in the peak of the rainy season (August) and least (20.5%) in the peak of the dry season (January) [17].

Experimental rabbits

The study was conducted over a period of nine months; from April-December 2000, using Dutch-belted (exotic) and local rabbits. The average ages, body weights and body conditions scores were 9.75 $\pm$ 0.16 vs 10.25$\pm$ 0.16 months, 4.23$\pm$ 0.11 vs 3.78$\pm$ 0.09kg and 3.50$\pm$ 0.28 vs 2.50 $\pm$ 0.28 for the Dutch-belted and local rabbits respectively. Body weight and body condition score did not change significantly throughout the period of the experiment.

Four bucks of proven fertility from each breed were randomly selected for semen production in the study. A total of 24 local does, with previous records of kindling were also randomly selected for the fertility studies.

The Dutch-belted rabbits were sourced from Bauchi State Agricultural Development Programme (BSADP), while the local rabbits were purchased from households who practised the small scale traditional system of management, where rabbits are fed on natural pasture with little or no supplementation. Veterinary

care was practically non-existent in most cases.

The description of the Dutch breed has earlier been reported [18]. The breed weighs 2.5-3.5kg at maturity and the body colour is black with belted white. The breed is one of the commonest among the exotic rabbits found in the study area; few others were available. The resultant indiscriminate mating among these exotic breeds has produced what is called the local breeds or mongrels. They are not well defined, but characterized by different fur colours, smaller body size and body weight, smaller litter size at birth and weaning, smaller birth and weaning weight than the exotic rabbits.

Animal care

The rabbits were maintained individually in hutches measuring 0.56 x 0.41m. The hutches were housed in a shed roofed with asbestos and having windows for ventillation. They were fed a diet containing 18% crude protein [19]. Tridax (*Tridax procumbens*) was also fed during the rainy season. Fresh drinking water was given *ad libitum*. Routine veterinary care was also rendered. The rabbits were kept for a period of three weeks for acclimatization.

Semen collection

The bucks were first trained for three weeks for semen collection after which semen samples were harvested using a modified small ruminant artificial vagina (AV). These bucks were made to ejaculate twice weekly, with alternations between mornings (7:00am) and afternoons (3:00pm). Non-gravid mature teaser does were used interchangeably to effect stimulation of the bucks.

Data collection

Data for this study were generated from experiments conducted sequentially over the nine-month period. The desired parameters from each of these experiments were recorded.

Semen characteristics measurements

Semen characteristics namely gel-free volume, gel volume, progressive motility, sperm concentration, live sperm count and abnormal spermatozoa were determined using the methods described by Hill [20] and Zenjamis [21]. After each collection, samples were immediately transported to the laboratory for immediate evaluation.

Fertility trial

A total of four bucks from each breed, and 24 local does were randomly allocated to treatment groups and used in the fertility trial. All does were maintained individually in hutches, out of sight of the bucks for 18 days before being inseminated.

The does were inseminated with fresh semen following intense sexual excitement by teaser (without having any coitus) during the morning in an attempt to induce ovulation 10 hours later. The number of spermatozoa per milliliter of fresh semen was determined as described by Parks *et al* [22] and Chen *et al* [23].

The ejaculates were pooled after each ejaculate has been determined to contain at least 70% motile spermatozoa. The inseminate volume was calculated to deliver 10×10^6 motile sperm cells per doe. The does were to proceed to pregnancy without further interference. The kits were examined and counted shortly after kindling.

Data analysis

The data generated from this study were subjected to analysis of variance and chi-square method of statistical analysis [24] using breed as factor, while simple percentages were used on other relevant measurements.

RESULTS

Data showing the ejaculate characteristics of local and exotic rabbits are shown in Table 2. Gel free volume, gel volume, progressive motility, sperm concentration, total sperm per ejaculate, % live spermatozoa and % abnormal spermatozoa were significantly ($P<0.05$) different between the breeds. The respective values being 0.61 ± 0.02 vs 0.80 ± 0.01ml, 0.37 ± 0.02 vs 0.48 ± 0.01ml, 65.42 ± 0.68 vs $71.83 \pm 0.70\%$, 74.47 ± 0.50 vs $101.00 \pm 0.34 \times 10^6$, 45.66 ± 1.45 vs $80.75 \pm 1.68 \times 10^9$, 73.95 ± 0.86 vs $85.48 \pm 1.00\%$ and 17.23 ± 0.23 vs $13.84 \pm 0.21\%$ for local and exotic rabbits respectively.

Semen characteristics prior to insemination in the two breeds are presented in Table 3. The results showed that sperm motility, % live spermatozoa and % abnormal spermatozoa were 73.3 vs 76.7%, 76.7 vs 83.3 and 23.3 vs 13.5 for local and exotic rabbits respectively.

The fertility results from does bred artificially with fresh semen from local and exotic rabbits, following ovulation induction using teaser breeds, are depicted in Table 4. The results showed that kindling rate 11.80 vs 14.71, number of young born 14.0 vs 22.0, and mean litter size 3.5 vs 4.4, for local and exotic rabbits respectively, and did not differ significantly between the two breeds.

DISCUSSION

The seminal traits observed in this study fall within the limits reported by Herbert [14]. The exotic rabbits were superior ($P<0.05$) to the local ones. This finding is supported by a later report [15], which showed that this difference could probably be due to the higher secretory activities of the accessory sex glands, which are well-grown and developed in one breed than the other breed of rabbits. Similarly, Khalifa [26] attributed the difference to genetic traits as well as pre and post-natal growth and development. The nutrition and management conditions to which animals are subjected during the formative stages of gestation and during post-natal growth affect their performance in later life.

The present investigation on fertility study revealed that the mean litter size for the local and exotic rabbits were 3.5 and 4.4 respectively. This is in close agreement with the values (3.5 and 4.8) shown in previous reports [23, 26], when does were inseminated 10 hours to the expected time of ovulation. The results, however, contrast with the findings of Gregoire *et al* [25], who obtained a much higher value (8.2) using the same exotic breed. Other parturition records followed similar trend in both breeds as previously reported [27].

Despite the high quality of semen produced by exotic rabbits, the kindling rate was not significantly ($P>0.05$) higher than the local rabbits. This was similarly observed by Chen *et al.* [23], when they compared the fertility of fresh and frozen semen.

Table 1: **Composition of the experimental diet**

Ingredient	Composition (%)
Energy (kcal/kg)	2,700
Protein	18
Calcium	1.1
Phosphorus	0.8
Lysine	0.75
Methionine	0.60
Meth+Cystine	0.60

Source: Aduku [19]

Table 2: **Semen characteristics in local and exotic rabbits**

Seminal traits	Local	Exotic
n	4	4
Gel free volume (ml)	0.66 ± 0.02^{b}	0.80 ± 0.01^{a}
Gel volume (ml)	0.37 ± 0.02^{b}	0.48 ± 0.01^{a}
Progressive motility(%)	65.42 ± 0.68^{b}	71.83 ± 0.70^{a}
Sperm conc. (x 10^{6})	74.47 ± 0.52^{b}	101.00 ± 0.34^{a}
Total sperm per ejaculate (x 10^{9})	45.66 ± 1.45^{b}	80.75 ± 1.68^{a}
%Live spermatozoa	73.95 ± 0.86^{b}	85.48 ± 1.00^{a}
% Abnormal spermatozoa	17.23 ± 0.23^{a}	13.84 ± 0.21^{b}

Mean± S.E
All were significant ($P<0.05$)
n = number of bucks

Table 3: **Semen characteristics of rabbits prior to insemination**

Breed	No. of Insemination	Spermatozoa motility (%)	%live Spermatozoa	%Abnormal Spermatozoa	Insemination Dose ($x10^6$)
Local	1	70	80	30	10.0
	2	80	70	20	10.0
	3	70	80	20	10.0
Mean		73.3	76.7	23.3	10.0
Exotic	1	70	80	20	10.0
	2	80	90	10	10.0
	3	80	80	10	10.0
Mean		76.7	83.3	13.5	10.0

Table 4: **Fertility of rabbits following ovulation induction using teaser bucks**

	Number of Insemination							
	1st (July-Aug.)		**2nd (Sept-Oct.)**		**3rd (Nov-Dec)**		**Overall**	
	Local	**Exotic**	**Local**	**Exotic**	**Local**	**Exotic**	**Local**	**Exotic**
No. of does pregnant per total does	2/11	1/11	0/11	1/11	2/12	3/12	4/34	5/34
No. of young born	6	5	0	3	8	14	14	22
Mean litter size per pregnant does	3.0	5.0	0.0	3.0	4.0	4.7	3.5	4.4
Kindling rate	18.18	9.09	0.00	9.09	16.7	25.00	11.80	14.71

Values in the overall column are not significantly different at ($P<0.05$)

However, the low fertility exhibited in both breeds is probably attributed to the ineffectiveness of the ovulation induction method employed in this study. A kindling rate of 65 and 75% when ovulation in the does was induced using mating with asectomized bucks [25]. A much higher value of 100% kindling rate was recorded by Chen *et al* [23], when does were hormonally treated with Buserin 10 hours to the expected time of ovulation.

CONCLUSION

The difference in reproductive potential between these two breeds suggests that the exotic rabbits could be used to upgrade the local rabbits in breeding programmes. However, when conducting AI in rabbits appropriate method of ovulation induction should be opted for in order to achieve maximum conception rate.

REFERENCES

1. Akin, A. (1976) .The livestock sub-sector in the Third National Development Plan. *Nigerian Journal of Animal Production*, 33 (1): 10-17

2. Dede, T.I., Steinbach, J. (1977). Artificial insemination of pigs in Nigeria: A preliminary report. *Nigerian Journal of Animal Production*, 4 (2): 101-108.

3. Nwakalor, L. N., Orji, B. I., Igboeli, G. (1979). Sexual behaviour in Muturu, N'dama and Holstein Friesian bulls in a humid tropical environment. *World Review of Animal Production*, 15: 35-46.

4. Kumi-Diaka, J. M., Nagatnam, V., Rwuaan, J. S. (1981). Seasonal and age-related changes in semen quality and testicular morphology of bulls in a tropical environment. *Veterinary Records*, 108: 13-15

5. Orji, B. I., Igboeli, G., Nwakalor, L. N. (1984). Semen characteristics of Muturu bulls (*Bos brachyceros*). *Theriogenology*, 22: 197-203.

6. Seconi, V.O., Kumi-Diaka, J., Saror, D. I., Njoku, C. O., Olurunju, S. A. S. (1988). Seasonal and monthly variations in the incidence of morphological abnormalities in bovine spermatozoa in Shika, Northern Nigeria. *AnimalReproductive Science*, 17: 61-67

7. Osinowo, O. A., Bale, J. O., Eduvie, L.O. (1982). Semen quality of Yankasa rams. *Tropical Animal Health and Production*, 14: 189-193

8. Butswat, I. S. R., Osinowo, O. A., Dim, N. I. (1990). Fertility test for ram semen preserved at ambient temperatures by discontinuous flow dialysis. *Theriogenology*, 34:795-799

9. Barje, P. P., Osinowo, O. A., Dim, N. I. (1992). Effect of type of diluents and length of storage on the survival of chilled ram spermatozoa. Paper presented at the 17th Annual Conference of the Nigerian Society for Animal Production held at, Sheraton Hotel, Abuja, 23-27 March.

10. Barje, P. P., Osinowo, O. A., Dim, N. I. (1994). Effect of diluents, storage and Depth of insemination on the fertility of chilled ram spermatozoa, *Nigerian Journal of Animal Production,* 21:42-46

11. Ibe, S. N., Obi, J. C. (1986). Effect of dosage of undiluted semen and frequencies of insemination on fertility of chicken eggs. Proceedings of the 11th Conference of the Nigerian Society for Animal Production. 59-63pp.

12. Rose, I. D. (2000). Semen characteristics, fertility and hatchability in some breed s of cocks. M.Sc Thesis, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

13. Butswat, I.S. R., Choji, G. F. (1995). Constraints to adoption of artificial insemination techniques in livestock production in Bauchi L.G.A. *Nigerian Journal of Animal Production,* 22 (1): 28-31

14 Herbert, U. (1993). Growth and reproductive characteristics of rabbits fed on leucaena (*Leuceana leucocephala* lam) and Gliridia (*Griliciolia sepium* jacq) foliage. A Ph.D Thesis. University of Ibadan, Nigeria. 374p.

15. Herbert, U., Acha, C. O. (1995). Preliminary observations on seminal characteristics of rabbits raised in two locations in Southeastern Nigeria. *Nigerian Journal of Animal Production,* 22 (2): 108-112.

16. Kowal, J. M., Knabe, D. T. (1972). An agroclimatological atlas of Northern Nigeria with explanatory notes. Ahmadu Bello University Press, Zaria, Nigeria.

17. Nigerian Federal Office of Statistics (1979). Annual Abstract of Statistics, Lagos, Nigeria.

18. Cheeke, P. R., Patton, N. M., Templeton, G. S. (1982). Rabbits Production. The Interstate Printers and Publishers, Inc. Danville, Illinois.

19. Aduku, A. O. (1993). Notes on the feedstuff analysis. Department of Animal Science, Ahmadu Bello University, Samaru, Zaria, Nigeria.

20. Hill, H. J (1956). Morphology of bovine semen and its relative importance in evaluation of breeding soundness. Animal Reproduction lab. Colo. State University, Fort Collins.

21. Zenjamis, R. (1970). Diagnostic and therapeutic techniques in animal production. Williams and Wilkine Company, Baltimore. 2nd edition.

22. Parks, J. E., Ehrenwal, D. E., Foote, R. H. (1985). Counting mammalian spermatozoa in biological fluid containing matter. *Journal of Dairy Science,* 68: 2329-2336.

23. Chen, Y., Yang, X., Foote, R. H. (1989). Time breeding of rabbits with fresh and frozen thawed semen and evidence of acrosome alteration following freezing and thawing. *Animal Reproduction Science,* 18: 35-41.

24. Humburg, M. (1977). Statistical Analysis for Decision making, 2nd Edition, Hacourt Brace, New York. 810 pp.

25. Gregoire, A. T., Bratton, R.W., Foote, R. H. (1958). Sperm output of rabbits ejaculated either once a week or once a day for 43 days. *Journal of Animal Science*, 19: 243-258.

26. Khalifa, R. M. (1994). Mating frequency and artificial insemination in rabbits using vasectomized bucks. *World Rabbits Science*, 1: 1-5

27. El-Gaafary, M. N. (1994). Quality and fertility of cooled rabbits semen supplemented with cyclic AMP stimulators. *Animal Reproduction Science*, 84 (3 & 4): 307-313.