

REPRODUCTIVE RESPONSE OF PREPUBERTAL FEMALE RABBIT TO PHOTOPERIOD AND/OR MALE PRESENCE

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SUMMARY : A study was undertaken to determine, in tropical breeding conditions, the effect of male presence and/or photoperiod on age at puberty attainment, oestrous behaviour and breeding performance in prepubertal female rabbits. The study involved 3 treatment groups of seven does each, designated as A, B and C. Group A, rabbits were exposed to both extended light (+6 hours) and male presence. Group B, does were subjected to extended light only, whereas those in group C were treated to male presence only. Group D rabbits which were not subjected to any of the two treatment factors (photoperiod and male presence) served as the control group.

The data obtained indicated that the does subjected to either one or both treatment factors attained puberty earlier (142.4 ± 2.0 days) than the control group (167.1 ± 5.0 days). Weight at puberty was also significantly ($P < 0.05$) lighter (1.34 ± 0.04 kg) in the does exposed to male presence and/or photoperiod than the control group (1.50 ± 0.06 kg). Oestrous behaviour in terms of mean frequency and

"intensity" of oestrus as well as length of the cycle were significantly ($P < 0.05$) improved in the treatment groups than the control. The duration of oestrus (heat) was however shorter among the treatment groups. With respect to breeding performance, kindling rate was much higher among the treatment does (66.03 ± 2.8 %) than the control (50.00 ± 3.1 %). However, differences in gestation length, litter size and litter weight were not statistically significant ($P > 0.05$). Pseudopregnancy in proportion of non fertile matings was significantly ($P < 0.05$) higher among the treatment groups (50.1 ± 2.3 %) than the control (33.33 ± 3.5 %).

It was concluded that the exposure of young female rabbits to male presence and/or photoperiod may serve as a useful and relatively inexpensive management tool in improving rabbit production in the tropics since the technique has the potential to induce early puberty, amplify behaviour oestrus and improve kindling rates.

RESUME : *Effet de la photopériode et/ou de la présence du mâle sur l'entrée en production de lapines prépubères.*

Cette étude a pour but d'évaluer l'influence de la présence du mâle et/ou de l'éclairage sur l'âge à la puberté, le comportement oestral et les performances d'élevage de lapines prépubères, dans des conditions d'élevage tropical. Quatre groupes de 7 lapines ont suivis le traitement suivant : A - 6 heures supplémentaires d'exposition à la lumière et présence du mâle. B - 6 heures supplémentaires d'exposition à la lumière. C - présence du mâle. D - groupe témoin (aucun traitement). Les résultats obtenus indiquent que les lapines soumises soit à l'un des deux traitements ou aux deux combinés, atteignent plus tôt l'âge de la puberté (142.4 ± 2.04 jours) que celles du groupe témoin (167.1 ± 5.0 jours). Le poids à la puberté est significativement ($P < 0.05$) inférieur dans les 3 lots expérimentaux (1.34 ± 0.04 kg) par rapport au lot témoin (1.50 ± 0.06 kg). Le comportement oestral évalué en termes de fréquence moyenne et

d'intensité de l'oestrus ainsi que la longueur du cycle sont significativement améliorés dans les groupes expérimentaux ($P < 0.05$). En outre la durée de l'oestrus étaient plus courte dans ces groupes. Compte tenu des performances d'élevage, le taux de mise bas est plus élevé dans les lots expérimentaux (66.03 ± 2.8 %) que dans le lot témoin (50.0 ± 3.1 %). En outre, les différences de durée de gestation, de taille et de poids des portées n'étaient pas significatives ($P > 0.05$). Par rapport aux saillies fécondes., le nombre de pseudogestations était significativement plus élevé ($P < 0.05$) dans les groupes expérimentaux (50.1 ± 2.3 %) que dans le groupe témoin (33.33 ± 3.5 %). On peut conclure que l'exposition des jeunes lapines à la présence du mâle et/ou à un éclairage prolongé peut être un moyen utile et relativement peu onéreux d'améliorer la production cunicole tropicale puisque cette technique permet de favoriser une puberté précoce, d'amplifier le comportement oestral et d'améliorer les taux de mise bas.

INTRODUCTION

The low animal protein intake in several developing countries, particularly Nigeria, has been blamed partly on over-population and partly on over-reliance on large-size but slow-growing farm species with prolonged production cycles (IBEAUCHI and

FAJUYITAN, 1986). There is therefore the need to gradually shift emphasis from these large, capital-intensive species to those with relatively low feed/input costs and short production cycles such as the rabbit. Apart from its well reputed prolificacy, the rabbit has several other advantages over many other farm species including its high quality meat with

higher protein and much lower fat/cholesterol contents (FIELDING, 1991).

In spite of these advantages, large-scale rabbit production has been hesitant and somewhat hampered in Nigeria and several other less developed countries because of the dearth of relevant information on the rabbit's complex sexual behaviour (no well defined cyclic oestrus) and the attendant problem of controlled mating. It is known that the doe's oestrous behaviour and breeding pattern are all influenced by a wide range of external stimuli (PAUFLER, 1985 ; FIELDING, 1991). This study was thus undertaken to determine whether exposure of prepubertal females to male presence and/or photoperiod could have any beneficial influence on puberty attainment, oestrous behaviour and breeding performance.

MATERIALS AND METHODS

Location and environment of the study

This study was conducted at a University Teaching and Research farm in Port Harcourt, a coastal town in the southernmost part of Nigeria. The town is located within the tropical rain forest belt ; the environment is hot and humid with mean daily maximum and minimum temperatures of 21-33°C and 20-23°C respectively. Although a relatively photostable environment with 12 hours of diurnal light all year round, the high cloud cover tends to diminish the sunshine hours to as low as 1.5 hours (sometimes) to 6 hours daily. Precipitation is quite high (1,700-4,500 mm annually) with correspondingly high relative humidity of 50-90 %, depending on the season of the year. There are two seasons (rainy and dry), and in some years the rains fall every month of the year. Unlike some parts of Nigeria, the dry season is usually short (3 months or less).

Animals and housing

Twenty-eight, 3-month old, female rabbits and four mature and fertile bucks of New Zealand White breed weighing 3.8 kg (mean adult weight of this strain) were used in the study. The female rabbits were randomly assigned into four groups of seven and housed in standard-type single tier hutches of 2 compartments each. The males were housed separately from the females in another room except when needed. All the rabbits in the study received similar conditions of management and husbandry including regular washing, disinfection of feeding/drinking troughs, and prophylactic administration of coccidiostat. Water and feed were offered *ad libitum*. The feed consisted of mostly grass (*Panicum maximum*) and legumes (*Centrosema pubescens*) supplemented with commercial grower's mash (20 %).

Treatments and experimental design

The study entailed three treatment groups (A, B, C) and a control group (D) each consisting of seven females. Treatment A involved the combined exposure of the females to both extended light (6 hours additional lightning from 6 p.m. to 12 midnight) and male presence. In treatment B, the females were subjected to extended light only (i.e. artificial light from 6 p.m. to 12 midnight), whereas the treatment factor in treatment C was male presence only. Treatment D served as the control, as the females in this group were subjected to neither extended light nor male presence. Extended lighting was ensured by the use of two cool, large (2 m) white fluorescent electric bulbs (FTL 40W Cool "Daylight 6500°K"). A natural lighting regimen of about 108.0 lux/m² was determined in the rabbitry rooms prior to and throughout the experimental period. The average temperature of the rooms was about 26°C maximum and 21°C minimum. Exposure of the females to males was done by surrounding a male hutch with hutches housing the females. The arrangement pattern of the female hutches was such that they were all equidistant (0.5 m) from the male hutch. The males were used on a weekly rotational basis in order to avoid habituation effects.

Experimental procedure

Both the treatment groups and the control group were observed thrice a day for signs of oestrus (i.e. 7 a.m. - 10 a.m. ; 5 p.m. - 7 p.m. ; 10 p.m. - 12 midnight respectively). Detection of oestrus was based on three vital signs namely : 1 - increased vascularisation and swelling of the vulva, 2 - exposition of the rear quarters, 3 - arching of the back (lordosis) and frequent micturition. Other supporting signs were stretching of the ears, rubbing of the chin on feed trough or waterer, and aggressive restlessness. The combined observation of the three vital signs (HAFEZ, 1960) and any other secondary signs particularly towards the end of a one-week monitoring period was considered as "intensive heat" and attracted an arbitrary score of 5. The manifestation of any two vital signs with/without other signs was interpreted as "less intense heat" and was assigned a score of 3 whereas one vital sign with/without secondary signs was recorded as "mild heat" with a score of 1. Every silent heat was scored as 0. Intensity of oestrus (%) was scored as the mean observed "degree" of intensity over the possible maximum intensity multiplied by 100. Attainment of puberty was determined on the basis of, at least, 2 of the vital signs of oestrus i.e. a score of 3. These signs indeed correspond to the ability of the does to submit to mating.

Data collection on treatment effects on age at puberty and oestrus behaviour lasted 16 weeks. Subsequently, at 7 months, all animals in both the control and the treatment groups were bred (following

Table 1 : Effect of extended light and/or male presence on age and body weight at puberty and on oestrous behaviour.

Experimental group (Additional lighting) (Male presence)	A yes yes	B yes no	C no yes	D control
Age at puberty (days)	139.1 ± 2.4 ^b	144.3 ± 1.4 ^b	143.7 ± 2.3 ^b	167.1 ± 5.0 ^a
Initial weight at 90 days (kg)	0.74 ± 0.09	0.94 ± 0.04	0.92 ± 0.09	0.97 ± 0.09
Weight at puberty (kg)	1.35 ± 0.02 ^b	1.34 ± 0.04 ^b	1.33 ± 0.05 ^b	1.50 ± 0.06 ^a
Mean frequency of oestrus (%)	97.24 ± 0.03 ^a	86.83 ± 0.19 ^b	96.43 ± 0.4 ^a	73.10 ± 0.06 ^c
Mean intensity of oestrus (%)	76.7 ± 1.5 ^a	69.6 ± 1.8 ^b	73.3 ± 2.1 ^a	57.1 ± 3.0 ^c
Mean duration of oestrus (hours)	6.24 ± 0.25 ^a	7.18 ± 0.30 ^b	6.39 ± 0.26 ^a	7.46 ± 0.26 ^b
Mean length of the oestrous cycle	5.69 ± 0.09 ^a	5.84 ± 0.08 ^a	5.80 ± 0.10 ^a	7.01 ± 0.16 ^b

a, b, c means bearing different superscripts within a row are significantly different ($P < 0.05$)

oestrus manifestation and under the same lighting conditions earlier described) in order to test the validity of the oestrus signs observed. Kindling rate is the number of matings accomplished over the total number of pregnancies carried to term (delivery) by the same female individuals (does). It also afforded comparative evaluation of gestation length, litter size and litter weight, between the control and the treatment groups. The various data obtained on individual and group treatment means were compared based on the standard least significant differences (LSD) method of pairwise comparison (5 % level of significance) (STEEL and TORRIE, 1981). This was preceded by analysis of variance.

RESULTS

Comparative evaluation of the treatment effects on the onset of age at puberty indicated a significant difference ($P < 0.05$) between the treatment groups (142.4 ± 4.6 days) and the control (167.1 ± 5.0 days)

(Table 1). The treatment groups (A, B, C) showed no significant differences between themselves but the group A does subjected to both male presence and extended light attained puberty earlier. Attainment of puberty was determined on the basis of first observable signs of oestrus with a score of 3. Mean body weight at puberty was significantly ($P < 0.05$) lower in the treatment groups (1.34 ± 0.04 kg) than in the control group (1.50 ± 0.06 kg).

Data on the effects of male presence and/or extended light on oestrous behaviour are also presented in Table 1. There was a significant difference ($P < 0.05$) between the treated does (93.50 ± 0.08 %) and the control does (73.10 ± 0.06 %) in terms of mean frequency of oestrus. A similar difference ($P < 0.05$) in mean intensity of oestrus was also observed between the treated does (73.2 ± 2.2 %) and the control does (57.1 ± 3.0 %). Mean duration of oestrus and mean length of the oestrous cycle were much shorter ($P < 0.05$) among the treatment groups (A, B, C) than in the control group (D).

Table 2 : Breeding and body weight response of nulliparous female rabbits to extended light and/or male presence.

Experimental group (Additional lighting) (Male presence)	A yes yes	B yes no	C no yes	D control
No of kindling	5	3	5	5
Mean kindling rate (%)*	71.4 ± 2.0 ^a	66.7 ± 2.5 ^b	60.0 ± 4.0 ^b	50.0 ± 3.1 ^c
Mean gestation length (days)	31.40 ± 0.06	31.75 ± 0.40	31.67 ± 0.30	31.67 ± 0.40
Mean litter size	6.16 ± 2.0	6.28 ± 3.1	5.01 ± 2.2	6.11 ± 2.0
Mean litter weight	0.49 ± 0.11	0.40 ± 0.20	0.47 ± 0.17	0.46 ± 0.23
% pseudopregnancy**	42.8 ± 1.8 ^a	42.9 ± 2.8 ^a	64.7 ± 2.4 ^b	33.3 ± 3.5 ^c
Mean body weight at breeding (kg)	1.98 ± 0.43	2.11 ± 0.32	2.20 ± 0.33	2.90 ± 0.40
Mean adult weight (kg)	3.10 ± 0.20	3.19 ± 0.28	3.16 ± 0.31	3.88 ± 0.29

a, b, c means bearing different superscripts are significantly different ($P < 0.05$).

* expressed as No of kindlings over No of matings

** expressed in proportion to all sterile matings including possible embryonic resorption and stimulation-induced pseudopregnancy.

A total of 18 does (representing 64.3 %) out of the 28 does bred in the study, kindled. The effect of the individual treatments on breeding performance in the four groups of does is summarised in Table 2. There were significant treatment differences ($P < 0.05$) in kindling rates between the treatment group (62.8 ± 2.8 %) and the control (50.0 ± 3.1 %), and even within the treated group (A, B, C). The treatment factors did not seem to differentially influence gestation length, litter size and litter weight but a significant difference ($P < 0.05$) was observed in regard to pseudopregnancy both within the treatment groups, and between the treatment does (50.1 ± 2.3 %) and those of the control (33.3 ± 3.5 %).

DISCUSSION

Although some research has been done on the possible individual roles of male-female interrelationships and photoperiod on the reproductive potential of several farm species such as the pig (PATTERSON *et al.*, 1989 ; HUGHES *et al.*, 1990), cattle (HANSEN *et al.*, 1989 ; KINDER, 1991), and sheep (PLATT *et al.*, 1983), corresponding studies on the rabbit are lacking in available literature. In the present study, it was observed that the male presence and light supplementation collectively (treatment A) and individually (treatments B and C) played a significant role in the onset of puberty in prepubertal does. It is noteworthy that the collective treatment factors of male presence and light extension (treatment A) were the most potent in inducing early puberty attainment. Similar stimulatory effects have been observed individually in various other farm species (EASTHAM and COLE, 1987 ; HUGHES *et al.*, 1990 ; FIELDING, 1991) and the rabbit (KAMWANJA and HAUSER, 1983 ; BEREPUBO and DEE-UE, 1988). So far, no scientific literature has been precise on the critical age at which these stimulatory effects would be most effective. However, the age of 3-4 months suggested by KAMWANJA and HAUSER (1983) which was adopted in the present study appears to be the optimum age since no adverse affect could be noted. The does in the treatment group were lighter in body weight at puberty than those in control group. This is understandable since the control does were much older at puberty. This observation is consistent with those of KAMWANJA and HAUSER (1983), BURNETT *et al.*, (1988) and EASTHAM *et al.* (1986) who reported similar weight differences in favour of the control does and gilts respectively.

Observations on oestrous behaviour in the present study suggested that does that were exposed to the individual and combined effect of light extension and male presence (groups A, B, C) exhibited shorter oestrous cycles and reduced duration of oestrus but had a higher frequency and intensity of behavioural oestrus

than the control. This observation is of practical importance and indeed desirable since the former could mean a greater number of litters (more rabbits) within a given breeding period whilst the latter might result in a more accurate and effective recognition of oestrus. The significance of this finding is the inherent prospect of controlled breeding and greater reproductive efficiency in large-scale rabbit production. It is also interesting to note that the average length of the oestrous cycle observed among the does in this study agrees with the presumed 5-7 day cycle reported previously by other researchers (CUDNOSVASKII, 1957 ; BROOKS and COLE, 1970 ; PAUFLER, 1985).

The lack of any significant difference in gestation length, litter size and litter weight between the treatment groups and the control seems to suggest that these parameters might not necessarily be influenced by the two treatment factors adopted. This observation is consistent with the findings of KAMWANJA and HAUSER (1983) and BEKENEV *et al.* (1977) that photoperiod does not affect number of ovulations.

Based on the observations made in this study, it is obvious that the combined use of supplemental light and male-female interaction could be encouraged as a routine animal management tool in improving rabbit production, particularly in the less developed countries of the tropics. However, the real sequence of interactive events which create the complex stimulatory effects on the female reproductive functions still remains to be thoroughly elucidated. The effects from light supplementation have been attributed to pineal fuction whereas those emanating from male-female interaction have been ascribed to certain exteroceptive cues including olfactory, visual, auditory and tactile stimuli (KIRWOOD *et al.*, 1981 ; KINDER, 1991). It is for this reason that the does in the treatment groups were allowed olfactory auditory, visual and "partial" tactile contact in the course of this study. The exact nature of the transmission of these cues during the buck-doe interaction is also not known. However, available evidence tends to favour the hypothesis of male pheromones (EASTHAM and COLE, 1987 ; HUGHES *et al.*, 1990). These chemical substances are known to cause the acceleration of female sexual maturation, induction of oestrus and precocious attainment of morphological and physiological development associated with reproduction.

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