




EFFECT OF PHOTOPERIOD ON ESTRUS CYCLE AND REPRODUCTIVE ORGANS IN FEMALE AFRICAN GIANT RAT (*Cricetomys Gambianus*: Waterhouse)

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ABSTRACT

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African giant rat is a prolific animal in its wild condition. Therefore, in captivity, the decrease in productive performances may be due to photoperiod under which they are submitted. This research was carried out to evaluate whether photoperiod affects estrus cycle and reproductive organs in female African giant rat (AGR). Twenty-eight matured female AGR were randomly assigned to four lighting conditions (Light / Dark): 0 L/ 24 D, 12 L/ 12 D, 18 L/ 06 D and 24 L/ 0 D. Animals were individually housed and had free access to food and water. Daily, vaginal smears were taken and observed under a microscope to determine estrus cycle length. After four weeks, twelve animals were sacrificed and sexual organs were collected and weighted. Results showed that in AGR, the length of estrus cycle ranged between 5.5 and 6.4 days. However, this estrus cycle duration showed an upward ($p>0.05$) trend with a decreasing photoperiod. The weight of ovary and uterus was significantly ($p<0.05$) low in animals continuous enlightened compared to other treatment groups. Uterus length have dropped by 13.94%, 17.81 % and 9.50 % in animals exposed to 12 h, 18 h and 24 h of light per day respectively compared to those bred in dark condition. Regarding above results, AGR has a regular estrus cycle and the variation of photoperiod does not have effect on the duration of estrus cycle but it is detrimental for reproductive organs.

Contribution/Originality: This research was carried out to evaluate whether photoperiod affects estrus cycle and reproductive organs in female African giant rat (AGR).

1. INTRODUCTION

African giant rat (AGR) is a source of meat, nutritional protein and income for farmers (Ajayi, 1977; Malekani, Westlin, Paulus, & Potgieter, 2002). Meat can be considered as a prime food for humans since it serves to produce energy. The greatest nutritional benefits of meat are the quality and quantity of amino acids, irons, essential fatty acids and vitamin B complex it provides. AGR meat has a relatively higher protein content than beef, pork and mutton and then, it can be used as alternative meat source (Ojo, Adesokan, Nchor, & Oduntan, 2016). African giant rat constitutes one of the rodents most hunted for consumption in the tropical region where it is still present (Asibey & Addo, 2000). For sustainable supply, it is necessary to breed them. Unfortunately, in some breeding, this

animal shows slow reproductive performances which could be due to photoperiod under which they are submitted since that, in wild, AGR is nocturnal. Photoperiod has many effects on reproductive parameters and thus several studies have shown that increase photoperiod is detrimental for reproductive organs and estrus cycle. Li et al. (2019) showed that mouse exposed to light undergo a drop of ovary development. It has shown that females Syrian hamster became acyclic after 6 weeks of exposure to a short day (Bridges, Tamarkin, & Goldman, 1976). In subtropical goat subjected to short photoperiod regime (Delgadillo et al., 2004) reported the lengthening of sexual activity. A disappearance of heat signs has shown in Panda (*Ailuropoda melanoleuca*) exposed to constant light (Tay et al., 2018). In male AGR, (Ali, Onyeanus, Ayo, Salami, & Hambolu, 2017; Kenfack et al., 2020) observed that long photoperiod induces a reduction in testicular weight and testosterone level. However, available literature review shows that, effects of photoperiod on reproductive organs and estrus cycle in female African giant rat have not yet investigated.

2. MATERIAL AND METHODS

2.1. Study Site and Period

This study was carried out during dry season at the Teaching and Research Farm of the University of Dschang. The farm is situated at 5°26' longitude North and 10°26' latitude East. The Altitude is 1500 m in Sudano-guinean ecological zone. Average pluviometry, temperature, hygrometry and daylight was 2000 mm, 24°C, 85 % and 12 hours respectively.

2.2. Experimental Animals and Housing

Twenty-eight matured females African giant rat (850 ± 63 g) were randomly assigned to four treatments (Light / Dark; L/D): 0 L/ 24 D, 12 L/ 12 D, 18 L/ 06 D and 24 L/ 0 D. Concretely 0 L/ 24 D means 0 hour of light and 24 hours of dark; 12 L/ 12 D shows that, animal is treated under 12 hours of light and 12 hours of dark, etc.

Animals were individually housed and enlightened with white light provided by fluorescent tube (power: 18 W). Except photoperiod, all animals were kept under the same hygienic and managerial conditions.

2.3. Feeding

Diet used in this trial was constituted by composed diet supplemented with sweet potatoes and ripe banana. Animals had free access to food and water. Bromatological characteristics of provender were: metabolizable energy: 2700 Kcal/kg de MS, crude protein: 21%, lipids: 3.5 %, cellulose: 6 %, calcium: 0.8 % and phosphorus: 0.8 %.

2.4. Data Collection and Studied Parameters

2.4.1. Evaluation of Estrus Cycle Duration

During four weeks, vaginal smears were taken daily between 07: 00 and 08 :00 a.m. according to method used by Marcondes, Bianchi, and Tanno (2002). 10 µL of physiological solution (NaCl 0.9 %) were inserted into the rat vagina with a pipette and vaginal secretion was collected. One drop of vaginal fluid was placed on a glass slides and colored with methylene blue. These glass slides containing vaginal smears were observed under a light microscope (OLYMPUS BX51), at magnification 100. The estrus cycle phase was determinate by the proportion of the smear cells. (i) during proestrus vaginal smears are dominated by nucleated epithelial cells, (ii) estrus: vaginal smears get cornified cells, (iii) metoestrus shows that cornified cells of vaginal smear are infiltrated by leucocytes, and (iv) dioestrus: vaginal smears are almost fill by the leucocytes (Aydin, Sur, Ozaydin, & Dinc, 2011; Marcondes et al., 2002; Oke & Oke, 1999). The length of one estrus cycle was considered by the duration between two consecutives same estrus cycle phase.

2.5. Determination of Sexual Organ Weights

Three rats per treatment were sacrificed, uterus and ovaries were removed, measured and weighted using a ruler and balance (capacity 160 g and 10⁻³g of sensibility) respectively.

2.6. Histology of Ovary

Once ovary was removed, they were preserved in labelled bottles, containing 10 % of formalin solution for fixation. In laboratory, ovary was dehydrated through a series of graded ethanol solutions (50 – 100 %) and embedded in paraffin. Then, paraffin sections (5 µm) were cut and stained with haematoxylin-eosin. The sections were observed using optical microscope (Leica DM 750) at magnification 100.

2.7. Statistical Analysis

Data obtained were submitted to one-way ANOVA to appreciate the effects of photoperiod on studied parameters. Duncan's test was used to separate means when a significant difference exists. Significant threshold was fixed at 0.05 and results were expressed as means ± standard deviation.

3. RESULTS

Table 1 shows the effect of photoperiod on the duration of estrus cycle in African giant rat (AGR). It appears that, in AGR, estrus cycle seems to be regular. The decrease of photoperiod induced an upward trend in estrus cycle duration. But, any significant ($p > 0.05$) difference was observed among treatments.

Table-1. Effect of photoperiod on the duration of estrus cycle in African giant rat.

Duration of estrus cycle (days)	Photoperiods				p
	24 L/ 0 D	18 L/ 06 D	12 L/ 12 D	00 L/24 D	
First cycle	5.60 ± 0.55	5.75 ± 0.96	6.60 ± 2.30	6.60 ± 1.81	0.66
Second cycle	5.40 ± 0.55	6.00 ± 0.81	6.20 ± 1.30	5.60 ± 0.55	0.48
Third cycle	5.40 ± 0.55	5.83 ± 0.58	6.00 ± 1.73	7.00 ± 2.00	0.35
Means	5.47 ± 0.38	5.83 ± 0.25	6.27 ± 1.48	6.40 ± 1.23	0.50

Note: There is no significant difference between means ($p > 0.05$); p: Probability.

Effect of photoperiod on the ovary weight is illustrated in Figure 1. Results showed that, the reduction of photoperiod induced a significant ($p < 0.05$) increase of ovary weight. The higher value was obtained in animals submitted to natural photoperiod (12 L/12 D). No apparent abnormalities were observed on the ovary morphology whatever the duration of light under which animals were submitted. However, histology of ovary showed the presence of entrapped oocyte in animals continuously enlightened (Figure 2).

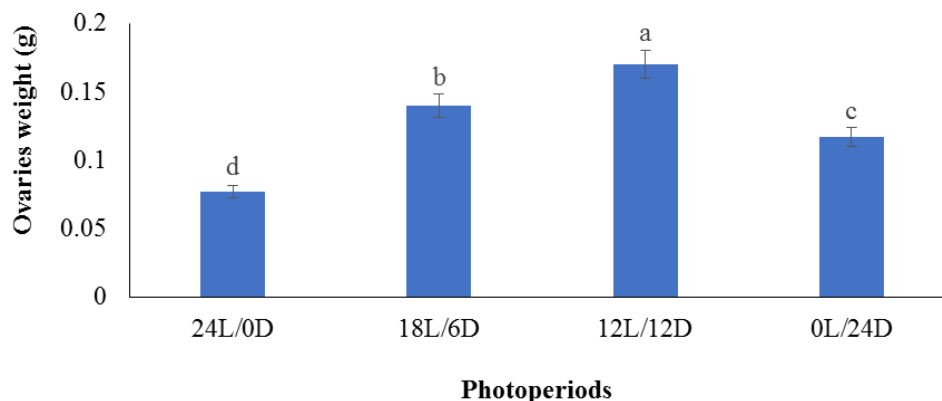


Figure-1. Effect of photoperiod on the weight of ovary in African giant rat.

Note: ^{a,b,c,d}; bars having different letters are significantly different ($p < 0.05$).

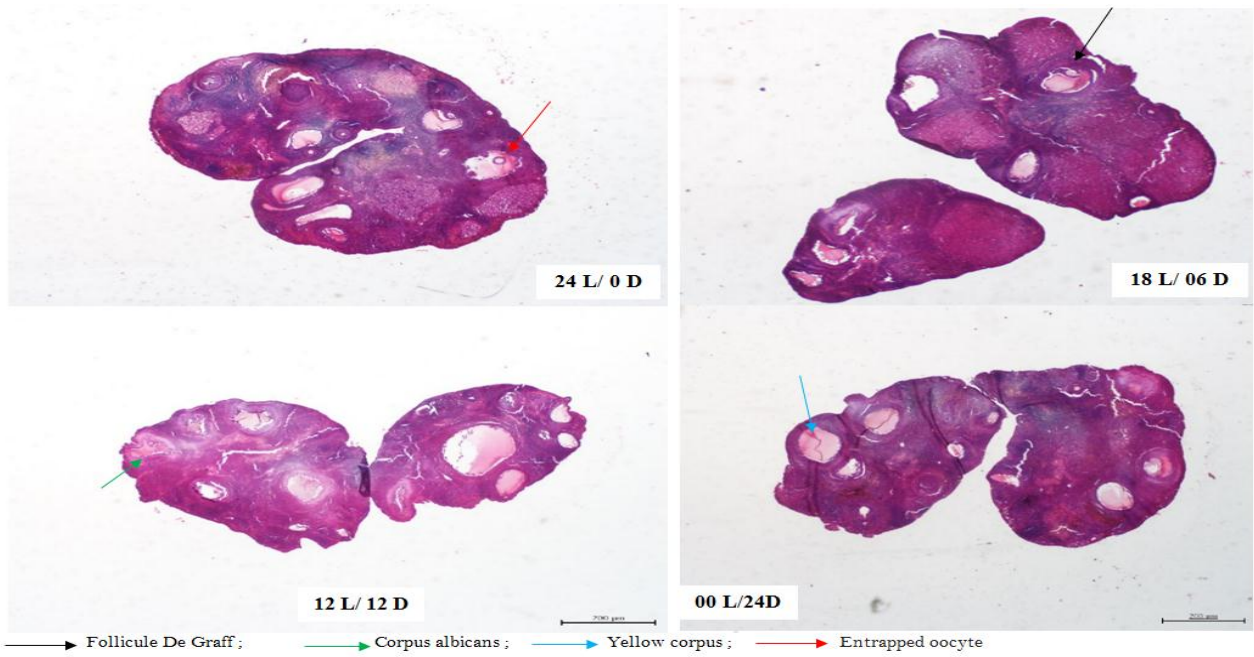


Figure-2. Effect of photoperiod on the histology of ovary in African giant rat (HE x 100).

Figure 3 presents the effect of photoperiod on uterus weight and length of African giant rat. Thus, the weight of uterus was significantly ($p < 0.05$) low in animals continuous enlightened compared to other experimental groups (Figure 3 A). Concerning uterus length, a decrease tendency was observed with increasing photoperiod (Figure 3 B). Well as there was not significant ($p > 0.05$) difference among treatments, animals kept under 18 hours of light per day recorded a lower value compared to that of animals in darkness.

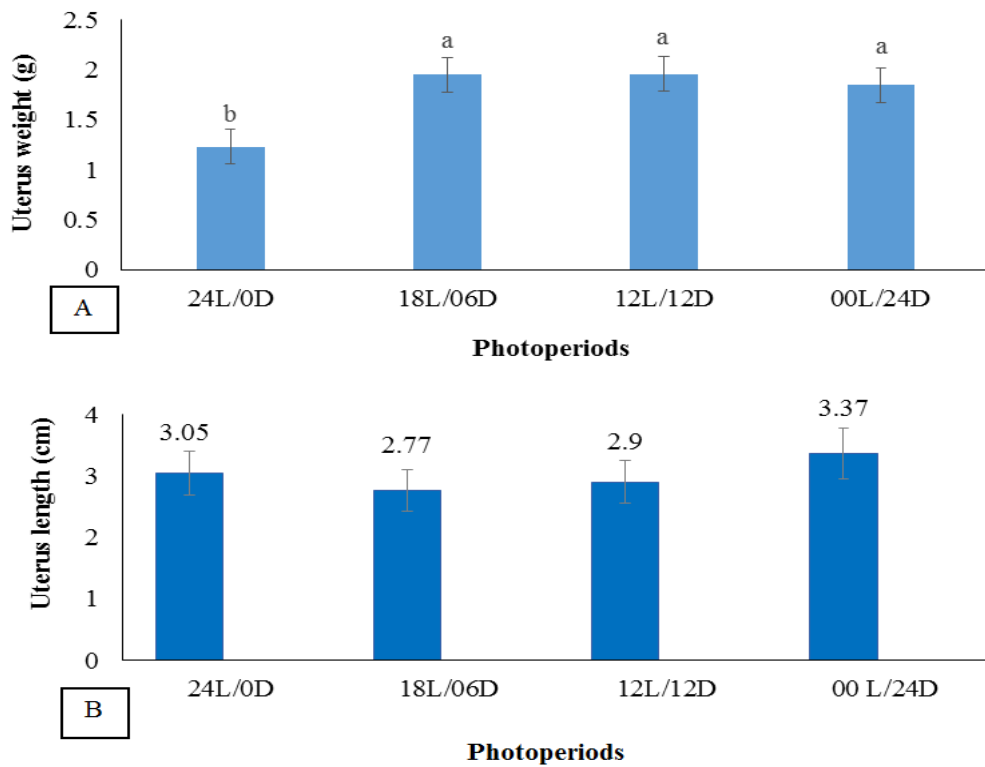


Figure-3. Effect of photoperiod on uterus weight (A) and length (B) of African giant rat. Note: ^{a,b}; bars having the same letters aren't significantly different ($p > 0.05$).

4. DISCUSSION

In mammals, many factors affect the duration of estrus cycle such as exogenous factors especially photoperiod (Delgadillo et al., 2004; Tay et al., 2018). In this study, results showed that, photoperiod variation did not have effect on the duration of estrus cycle in African giant rat (AGR). This result could be due to the fact that, AGR used in this study was adult and thus they would need much time before to express their photo sensibility. The finding obtained in our study is in disagreement with that reported by Nayeli, Marcela, and Pilar (2017), who observed a lengthening of diestrus phase in *Meriones unguiculatus* submitted to short photoperiod. More-over, Bridges et al. (1976) showed that, Syrian hamster became acyclic after 6 weeks of exposure to short photoperiod. The opposite results observed between these works and mine could be due to difference in animal species.

Ovary plays an important role in reproductive live of the female. It controls estrus cycle and sexual hormone production (Gayrard, 2007). In AGR submitted to long light exposure, a decrease of ovary weight has been noticed. This finding obtained is in agreement with that of Li et al. (2019) who showed a decrease of ovary weight in mouse exposed to long photoperiod. Concordance results could be due to the fact that, mouse and African giant rat had similar live mode. Indeed, the both are nocturnal animals. The decrease of ovary weight in animals subjected to long photoperiod could come to the fact that, photoperiod lengthening induced low gonadotropins release and thus the decrease in ovary weight, knowing that the development of ovary depends on the secretion of gonadotropin hormones. More-over, this explanation could justify the presence of De Graff follicle with an entrapped oocyte (impair ovulation) in animals exposed to 24 hours of light per day. This observation is in accordance with that obtained by Steger, Peluso, Mitchell, and Hafez (1975) in laboratory rat exposed to continuous light. This finding may be explained by the absence of LH pic or insufficient surcharge of this hormone to induce normal ovulation. Indeed, melatonin plays important role in ovulation process (Tamura et al., 2012). Thereby, increase photoperiod involves low melatonin secretion knowing relationship between photoperiod, melatonin and LH secretion (Viguie, Caraty, Locatelli, & Malpoux, 1995).

The development of uterus is under control of sexual hormone such as estrogen. In this work, the length of uterus dropped with an increase photoperiod. Once more, animals continuous enlightened recorded a significant low uterus weight compared to animals bred in darkness. This finding seems to strengthen above explanation according to which long or continuous photoperiod induces a decrease in gonadotropin secretion and thus inhibit sexual hormones production. Since that sexual hormones secretion require the gonad stimulation by these gonadotropins hormones.

5. CONCLUSION

AGR has a regular estrus cycle and the variation of photoperiod does not have effect on the duration of estrus cycle but it is detrimental for reproductive organs.

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