Nigerian Veterinary Journal
VOL:33 (3) 586-591
ARTICLE

Sex Hormonal Pattern of the Female African Giant Rat *(Cricetomys gambianus, Waterhouse)* at Different Stages of the Oestrous Cycle

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SUMMARY

Enzymeimmunoassay (EIA) system was used to measure the serum concentrations of follicle stimulating hormone (FSH), luteinising hormone (LH), estrogen, progesterone and prolactin in a total of thirty-five sexually matured female African giant rats (*cricetomys gambianus, Waterhouse*) at different stages of the oestrous cycle in order determine sex hormonal pattern. Exfoliative cytology of vaginal smears was used to classify the rats into different phases of the oestrous cycle. The results showed lack of LH surge at late proestrus/early estrus when estrogen had highest serum concentration of 88.7 ± 0.14ng/ml ~~and,~~ estrogen and progesterone had inversely related cyclic pattern. Progesterone serum concentration (96.8 ± 11.21ng/ml) was significantly high ($p<0.05$) at late metestrus/early diestrus but was at its basal level at late diestrus/early estrus. Prolactin serum concentration (20.7 ± 2.92ng/ml) decreased significantly ($p>0.05$) at late diestrus/early proestrus and was at its peak during mid estrus. Prolactin serum concentration displayed inverse relationship with the FSH whereas it exhibited synergism with estrogen serum concentration. The hormonal pattern suggested that probably ovulation occured at late diestrus/early proestrus and perhaps female African giant rat was a spontaneous ovulator.

KEY WORDS: African giant rat, Oestrous cycle, Sex hormones

INTRODUCTION

The cricetomys rodents are traditionally hunted as food in most parts of Africa (Den Hartog and De Vos, 1973; Ajayi and Olawoye, 1974). Attempts to breed these rodents on a large scale have not been successful because detailed knowledge of their reproductive biology is still scanty and sometimes incorrect. Oke (1985) investigated the effect of season on the reproductive organs of the male African giant rats and reported them as not being seasonal breeders whereas Joo and Myers (2004) reported Gambian rats as being seasonal breeders, usually breeding in the summer.

In addition, while Ajayi (1975) described four regular smear stages for oestrous cycle in female African giant rat, Oke and Oke (1999) found four mid-smear stages as well as three intermediate smear stages whereas Malekani *et al.,* (2002) reported only two phases of estrus and anoestrus in a breeding colony of Cricetomys gambianus kept under semi-controlled physical environment. Therefore, this paper, an aspect of series of researches aimed at elucidating the reproductive biology of the female African giant rat, describes its sex hormonal pattern at different stages of the oestrous cycle.

MATERIALS AND METHODS

Animals

Serum samples were collected from thirty-five sexually matured female African giant rats in this study. All the animals were captured alive in Ibadan, Oyo state, Nigeria, housed singly in cages in the Giant Rat Colony of the Experimental Animal unit of the Faculty of Veterinary Medicine, University of Ibadan, Ibadan and were allowed to acclimatize before blood collection.

The animals were fed on a diet of mouse cubes (21% protein, 3.5% fat, 6% fibres, 0.8% calcium, 0.8% phosphorous) from Ladokun Feeds Nigeria Limited, Ibadan, Nigeria. Supplements of palm kernel fruits, pawpaw and yam as well as cassava tubers, fresh and partially dry maize were given. Water was provided *ad libitum*.

Experimental Design

Seven groups of rats in different stages of the oestrous cycle were identified by analysis of exfoliative cytology of vaginal smears as described by Oke and Oke (1999). The groups, each containing five rats, were named as; Mid Proestrus (MP), Late Proestrus/Early Estrus (LP/EE), Mid Estrus (ME) groups as well as Mid Metestrus (MM), Late Metestrus/Early Diestrus LM/ED, Mid Diestrus (MD) and Late Diestrus/Early Proestrus (LD/EP) groups.

Hormone assay

Enzymeimmunoassay (EIA) system was used to measure the concentrations of Follicle stimulating hormone (FSH), Luteinising hormone (LH), Estrogen, Progesterone and Prolactin in the serum samples obtained at different stages of oestrous cycle. The assay was of an immunometric (sandwich) design. Three main stages were involved for the assay of FSH, LH, Estrogen and Prolactin. These include, immuno-extraction, labelled antibody reaction and colour development. The stages were followed as described by Immunometric (UK) Ltd (Unit 8, The Quadrangle 49, Atlanta Street, London, SW6 6TU United Kingdom).

The progesterone EIA was a direct 2-step assay of a limited reagent (competitive) design with no pre-extraction of samples. The concentration range covered by the standard was approximately 0 -100 nmol/L with minimum detectable dose of approximately 2.0 nmol/L. The stages followed were as described by Immunometric (UK) Ltd (280 Munster Road, London SW6 6BQ).

Statistical Analysis

All data obtained were expressed as means with the standard errors. The data were subjected to the pooled variance "t" test for comparison between and within groups. Also, Duncan Multiple range test (1995) was used to evaluate variations in parameters measured between and within the groups of different seasons. $P<0.05$ were considered significant at 95% confidence limit (Maed and Curnow, 1983).

RESULTS

Hormonal Observations

The mean serum concentrations of LH, FSH, estrogen, progesterone and prolactin at different stages of oestrous cycle are shown in TABLE I while the means of the groups according to Duncan Multiple range test are as shown in TABLE II.

Luteinising hormone (LH)

LH was observed to have mean serum concentration of 0.1 ± 0.01 ng/ml throughout the oestrous cycle in the sexually matured female African giant rat. No LH surge was observed during the

oestrous cycle (TABLE I).

Follicle stimulating hormone (FSH)
At mid-proestrus, late proestrus/early estrus, mid-estrus and mid-metestrus, FSH had constant mean serum concentration of 0.2 ± 0.03 ng/ml which later dropped to 0.1 ± 0.01 ng/ml at late metestrus/early diestrus and mid-diestrus. Thereafter, serum concentration of FSH rose to 0.2 ± 0.01 ng/ml at late diestrus/early proestrus (TABLE I). TABLE II shows that there were no significant differences ($p>0.05$) in the serum concentration of FSH throughout the oestrous cycle.

Estrogen
TABLE I shows that the serum concentration of estrogen had a peak value at late proestrus/early estrus and started to decline at mid-estrus until it reached a basal level at late metestrus/early diestrus. Thereafter, it rose sharply at mid-diestrus and declined steadily at late diestrus/early proestrus. TABLE II shows that the mean serum concentration of estrogen decreased significantly ($p>0.05$) at late metestrus/early diestrus when compared to other stages of the oestrous cycle.

Progesterone
TABLE I shows that the serum concentration of progesterone was increasing steadily from mid-proestrus until it reached a peak value of 96.8 ± 11.21 ng/ml at late metestrus/early diestrus. The serum concentration started to decline slowly from mid-diestrus until it reached basal level of 17.3 ± 1.93 ng/ml at late diestrus/early proestrus. TABLE II shows that the serum concentration of progesterone was significantly high ($p<0.05$) at late metestrus/early diestrus and mid-diestrus whereas there were no significant differences ($p>0.05$) in the value of progesterone in other stages of oestrous cycle.

Prolactin
The mean serum concentration of prolactin was undulating steadily throughout the oestrous cycle. Prolactin had the highest mean serum concentration of 72.8 ± 9.54 ng/ml at mid-estrus and the least value of 20.7 ± 2.92 ng/ml at late diestrus/early proestrus (TABLE I). TABLE II shows that the mean serum concentration of prolactin decreased significantly ($p>0.05$) at late diestrus/early proestrus.

DISCUSSION
Literature is replete with information on the endocrine events that lead to ovulation in several species of animals (Hafez, 1970; Peters and McNatty, 1980) but hormonal pattern of the sexually matured female African giant rat during oestrous cycle is being reported for the first time in this study. Although it is generally accepted that an increase in oestradiol is responsible for the induction of the preovulatory surge of LH during the follicular phase of the normal oestrous cycle (Baird and McNeilly, 1981; Tortonese *et al.*, 1990), no LH surge was observed at late proestrus/early estrus when estrogen serum concentration was at its peak level in this study. The pattern of LH and FSH secretions observed in this study show a peculiar trend and could probably suggest that the female African giant rat is perhaps a spontaneous ovulator. In some species of animals such as the rat, mouse, hamster, guinea pig, or monkey, the increased release of LH has been reported to occur in waves following an intrinsic biological rhythm. Ovulations recur at regular intervals and are independent of external environment. Species with intrinsic rhythm of LH release are known as spontaneous ovulators (Everett, 1961; Hafez, 1970).

Going by the reports of several authors (Weiss, 1983; Erickson, 1995; Erickson, 1997; Wilson and Foster, 1998; Fawcett and Jensh, 2002; Eurell and Frappier, 2006) that the estrus is characterized by high estrogen secretion from preovulatory (Graafian) follicles at the ovarian level, findings in this study are suggesting that perhaps ovulation takes place during late proestrus/early estrus stage of the oestrous cycle in the female African giant rats

Progesterone has been shown to be the principal secretory product of corpus luteum and responsible for progestational effects. It has also been shown to be the principal hormone of luteal phase that promotes glandular development of the mammary gland, increase body temperature and induces decidualization of the endometrium (Wilson and Foster, 1998; Fawcett and Jensh, 2002). During folliculogenesis, the granulosa cells have been reported to reduce their production of oestradiol at the end of follicular phase while increasing amount of progesterone is secreted during the luteal phase (Erickson, 1995; Erickson, 1997; Fawcett and Jensh, 2002). Therefore, going by the observations in this study that the serum concentration of progesterone was at its peak and significantly high at late metestrus/early diestrus as well as mid diestrus but was at its basal level at late proestrus/early estrus, the progesterone profile in the female African giant rat is in agreement with other species of animals earlier reported (Hafez, 1970; Eurell and Frappier, 2006).

Results of this study shows that the serum concentration of prolactin in the female African giant rat exhibits inverse relationship with the FSH serum concentration whereas it displays synergism with estrogen serum concentration. This is in agreement with earlier reports in some species of animals that high prolactin levels tend to suppress ovulatory cycle by inhibiting the secretions of both FSH and gonadotropin-releasing hormone (GnRH) while large doses of estrogen probably stimulate prolactin secretion by anti-dopanergic effect (Fox and Laird, 1970; Weiss, 1983; Wilson and Foster, 1998). In conclusion, the hormonal pattern suggests that probably ovulation occur at late diestrus/early proestrus and perhaps female African giant rat was a spontaneous ovulator.

TABLE I. Mean serum concentrations (ng/ml) of the reproductive hormones in female African giant rat at different stages of the oestrous cycle.

Reproductiv Hormones	MP	LP/EE	ME	MM	LM/ED	MD	LD/EP
LH	0.1 ± 0.01	0.1 ± 0.02	0.1 ± 0.01	0.1 ± 0.01	0.1 ± 0.01	0.1 ± 0.02	0.1 ± 0.01
FSH	0.2 ± 0.01	0.2 ± 0.03	0.2 ± 0.01	0.2 ± 0.02	0.1 ± 0.01	0.1 ± 0.01	0.2 ± 0.01
Estrogen	86.8±0.1	88.7±0.0	87.2±0.3	66.1±0.1	17.8±0.3	78.3±0.1	56.5±0.2
Progesteron	17.6 ± 1.03	10.8 ± 1.04	21.7 ± 2.71	40.0 ± 3.95	96.8 ± 11.21	95.9 ± 10.08	17.3 ± 1.93
Prolactin	54.2 ± 8.21	65.2 ± 7.34	72.8 ± 9.54	49.2 ± 4.10	50.9 ± 7.16	59.7 ± 6.27	20.7 ± 2.92

Values are given as Mean ± s.e.

TABLE II. Means of groups for serum concentrations (ng/ml) of the reproductive hormones in female African giant rat at different stages of the oestrous cycle.

Reproductive Hormones	MP	LP/EE	ME	MM	LM/ED	MD	LD/EP
LH	0.0873[a]	0.0978[a]	0.0917[a]	0.0894[a]	0.0944[a]	0.0899[a]	0.0987[a]
FSH	0.1351[a]	0.1084[a]	0.1112[a]	0.1088[a]	0.0987[a]	0.0991[a]	0.1081[a]
Estrogen	0.4472[a]	0.6194[a]	0.5437[a]	0.2189[a]	0.1188[b]	0.3188[a]	0.2339[a]
Progesterone	0.1353[a]	0.1206[a]	0.1411[a]	0.2329[a]	0.5197[b]	0.5193[b]	0.1323[a]
Prolactin	0.2474[a]	0.2879[a]	0.3175[a]	0.2114[a]	0.2995[a]	0.3238[a]	0.1120[b]

Values with different superscripts in the same horizontal row are significantly different from one another at $P<0.05$ according to Duncan Multiple Range Test (1995). n=5

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