RESEARCH ARTICLE

Correlative studies on the body weight, testis weight and plasma testosterone of *Pteropus giganteus giganteus* (Brunnich)

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ABSTRACT

In the present study correlation between the body and testis weight with that of mean plasma testosterone concentration was investigated from the pteropid bat, *Pteropus giganteus giganteus*. The cyclic variations in the body and testis weight were found to in consonance with the hormonal fluctuations. The total body and testis weight beginning to rise in July-August which is after 1-2 months after food availability (mango fruiting) in the local study area of this bat. And then, further reach to its peak level during Oct-Nov. which may be correlated with higher mean plasma concentration. Early rise in the body and testis weight which is complemented by the increase in plasma testosterone concentration may be due to initiation of spermatogenesis. Availability of food may act as stimulus for the onset of spermatogenesis.

Key words - Testis, plasma, testosterone, spermatogenesis, hormone.

INTRODUCTION

Many mammals are seasonal breeders and respond to annual climatic changes by adaptive alterations in physiological as well as in histoarchitechtural status in anticipation of the coming season. The switching on and off of reproductive functions during the annual breeding cycle of bats is the most striking example of such photoperiodically induced process. (Krutzsch and Crichton, 1990; Gopalkrishna and Badwaik., 1993; Begueliani, et al., 2009). Intraspecific variation has been reported, not just in the timing of reproduction, but also in the periodicity of reproduction in different environments and across the geographic range of the species (Vivier and Van der Merve, 1996). It is therefore often impossible to characterize a specific pattern of reproduction within species with a wide distribution (Bernard and Cumming, 1997).

The occurrence of varied reproductive patterns appears to be generally related to major differences in latitude. (Bernard and Cumming, 1997). A number of studies have addressed seasonal changes in structure and function of the male tract of pteropids (McGuckin and Blackshaw, 1987; 1991). After taking review of pertinent literature it was found that, reproductive pattern of *Pteropus giganteus giganteus* was not undertaken in the study area. It is a unique geographical site, characterized by heavy rainfall and extreme hot summer. This geographical situation and climatic condition in the local area prompt us to undertake reproductive investigation in this ecologically important but neglected pteropid bat.

MATERIALS AND METHODS

The specimens of *Pteropus giganteus giganteus* from roosting site of Mango trees from Bramhapuri forest range, Maharashtra, India. On the same day, these live animals, were bought to the laboratory and specimen anesthetized by petroleum ether and weighted on sensitive spring balance.

Male animal were dissected out to collect the testis from the scrotal sacs. Fixed in alcoholic Bouin's fluid for 24 hrs. Dehydrated in upgrade series of alcohol, infiltrated in paraffin wax and blocks were prepared. Sectioning carried out on rotory microtome for getting ribbon of 5μm thickness. Ribbons having sections of testis and epididymis were affixed on the slides. Staining of sections carried out with the help of double staining of haemotoxyline and eosin. Sections were cleared in xyline and mounted in DPX. Sections were photographed with the help of image capturing device of 'Labomed make' attached to the compound microscope. Microscopic measurements of different parameters were also taken with help of inbuilt software of image capturing device.

RESULTS AND DISCUSSION

The variations in the morphological parameters and plasma testosterone hormonal profile were used to assess the different periods during the annual reproductive cycle of *Pteropus giganteus giganteus* are shown in the Table.1. Table.2. shows correlation coefficient indices for body weight, testis weight and mean plasma testosterone concentration.

On the basis of presence of sperms in the seminiferous tubules and epididymis and mean plasma concentration of testosterone hormone the reproductive cycle was divided into four different periods, preparatory, breeding, post-breeding, and regressed. (Fig. 1 to Fig. 8) The adult testes of *Pteropus giganteus giganteus* shows great variations in their weight during different months annual reproductive cycle. The maximum weight of testis is found during Aug-Oct. (1.67gm ±0.42) which coincides with the mean body weight of the animal which is progressively increases to 750 gm (SEM ±0.83)(Table No.1). After this period the weight of the testis progressively decreases and the minimum weight found during the months of Feb. to April (1.03 gm ±0.36) which is reflected in the drop in the minimum mean body weight to 625 gm (SEM ±0.74) (Table.1).

In the Fig. 9, the annual variations in the mean body weight is correlated with the mean testis weight, which shows that increase in the mean testis weight reflected in the increase in the mean body weight of the animal. The testis of *Pteropus giganteus giganteus* exhibits marked seasonal changes during following periods of annual reproductive cycle as follows.

Table 1: Seasonal variations in body weight, testis weight and mean plasma testosterone

Sr. No.	Parameters	Preparatory (May-July)	SEM (n=5)	Breeding (Aug-Oct)	SEM (n=5)	Post-breeding (Nov-Jan)	SEM (n=5)	Regressed (Feb-April)	SEM (n=5)
1	Body wt.	675 gm	± .78	750 gm	± 0.83	735 gm	± 0.65	625 gm	± 0.74
2	Testis wt.	1.56 gm	±.39	1.67 gm	± 0.42	1.39 gm	± 0.31	1.03 gm	± 0.36
3	Testosterone	6.4 ng/ml	±.26	3.6 ng/ml	± 0.28	9.2 ng/ml	± 0.28	0.46 ng/ml	± 0.23

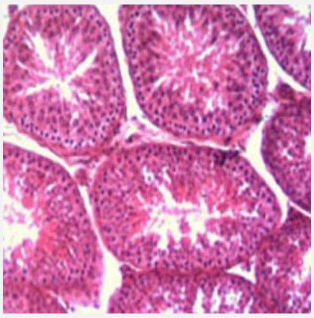


Fig. 1

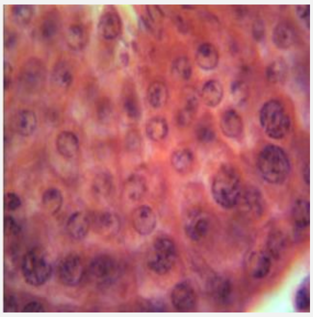
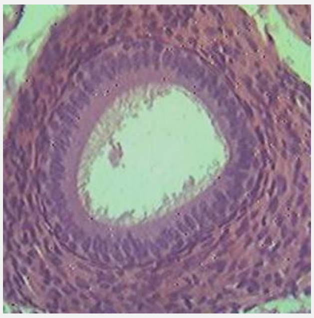


Fig. 2



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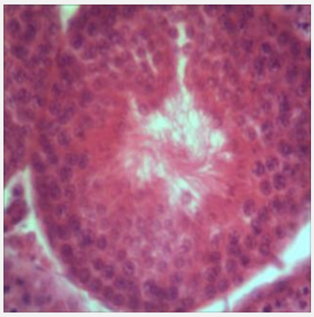


Fig. 4

Fig. 1: T. S. of testis showing seminiferous tubules and interstitium during the pre-breeding period of *Pteropus giganteus giganteus* (X100)

Fig. 2: T. S. of testis showing seminiferous epithelium having cohorts of spermatogenic cells displaying few spermatozoa towards lumen during the pre-breeding period of *Pteropus giganteus giganteus* (X1000)

Fig. 3: T. S. cauda epididymis showing pseudostratified epithelium surrounded by connective tissue having well developed stericocilia (STC) during the pre-breeding period of *Pteropus giganteus giganteus* (X400)

Fig: 4: T. S. of testis showing seminiferous tubule with epithelium having cohorts of spermatogenic cells and large number of spermatozoa projecting tails towards its lumen during the breeding period of *Pteropus giganteus giganteus* (X400).

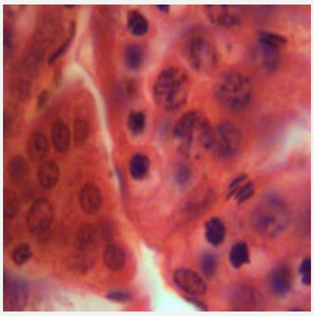


Fig. 5

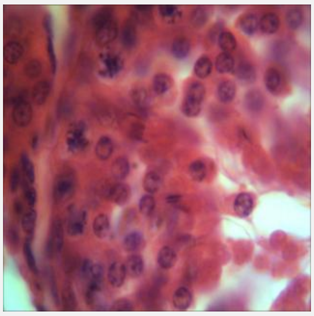


Fig. 6

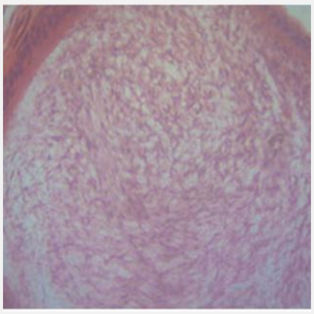


Fig. 7

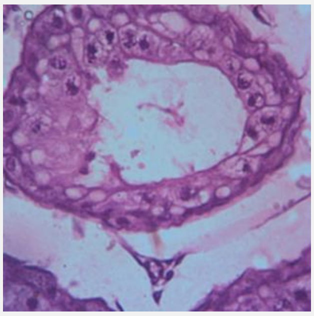


Fig. 8

Fig: 5: T. S. of testis showing seminiferous epithelium with spermatogenic cells and the Sertoli cells (SC) attached spermatozoa and cluster of Leydig cells (LC) in interstitium during the breeding period of *Pteropus giganteus giganteus* (X400)

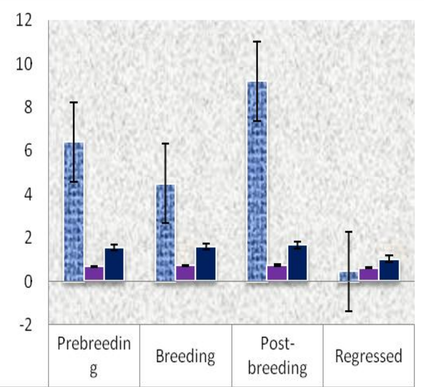
Fig. 6: T. S. of testis showing seminiferous epithelium with Sertoli cell and spermatogenic cells and few sperms (SPZ) released into the lumen also seen few residual bodies (RB) during the post-breeding period of *Pteropus giganteus giganteus* (X1000)

Fig. 7: T. S. cauda epididymis showing large number of spermatozoa entangled into the anastomizing network of well developed long stericocilia (STC) during the post-breeding period of *Pteropus giganteus giganteus* (X1000)

Fig. 8: T. S. of testis showing seminiferous epithelium with vacuoles and large empty lumen (L) separated by spacious interstitium having shrunken Leydig cells during the regressed period of *Pteropus giganteus giganteus* (X400).

Table 2: Correlation coefficient between body weight, testis weight and mean plasma testosterone.

Parameters	Body Wt	Testis Wt	Testosterone
Body Wt	1		
Testis Wt	0.893141	1	
Testosterone	0.790184	0.898001	1



	Prebreeding	Breeding	Post-breeding	Regressed
Mean plasma testosterone concentration in ng/ml	6.4	4.5	9.2	0.46
Mean body weight in Kg	0.675	0.735	0.75	0.625
Mean testis weight in gm	1.56	1.6	1.67	1.03

Fig. 9: Showing correlation between mean plasma testosterone concentration, mean body weight and testis weight

These results in the present investigation expressed in graphical and tabular presentations find its parallel in the similar studies conducted on the number of chiropteran species by many workers. (Bernard., 1986). Adult male grey-headed flying foxes (*Pteropus poliocephalous*) shows well-defined seasonal changes in reproductive parameters in wild (McGuckin and Blackshaw, 1987) and in captivity (McGuckin and Blackshaw, 1991). In some species fluctuation of body weight can indicate times of food abundance and scarcity (Bhasin et al., 1997).

According to McGuckin and Blackshaw (1991), assessment of changes in testicular weight in individuals provided information on the cyclic seasonal changes. The positive correlation between the body weight, testes weight and plasma testosterone concentration has been identified by Singh (1997); Singh and Krishna, (2000) in *Rousettus leschnaulti* which experiences two peaks of testosterone in a single testicular cycle (Sastry and Masram, 2007). The total weight of the body and testes of *Pteropus giganteus giganteus* in the present study beginning to rise in July-August which was about 1-2 months after the higher food availability (Mango fruiting) in the study area of this bat (Fig. 9). Then, the weight of the testes further increases during September and October and reaches to its peak level, these variations in the body weight and testis weight is positively correlated with the mean plasma concentration (Fig. 9). The data on steroid concentrations in blood plasma obtained during annual reproductive cycle shows large variations. The higher peak of mean plasma concentration of testosterone during mating period is due to increase in testicular production which is paralleled with similar findings by McGuckin and Blackshaw, 1987. In accordance with the earlier literature, since the biosynthesis of testosterone levels which is a key hormone in the maintenance of body mass and testicular weight, the changes in the testicular and body weights were correlated with the plasma testosterone concentration. (Choudhary and Sastry., 2011).

In the present study attempt has been made to correlate the body weight, testicular weight and testosterone values, since androgen is a potent stimulant of nitrogen retention (Bhasin et al., 1997), causes an increase in the body weight due to an increased serum concentration of potassium (Turner and Bagnara, 1976). In addition, testosterone also modulates growth and metabolism in several peripheral tissues that contain androgen receptors such as skeletal muscle (Sauerwein and Meyer, 1989). In muscular tissue, adrogens stimulate cell hypertrophy to glycolytic white musce cells possibly via reduction in glucocorticoid sensitivity (Sauerwein et al., 1991) and reduced proteolytic enzyme activities. (Blottner et al., 1996). The dramatic variations in plasma concentrations of steroid binding protein observed in the adult male little brown bats also confirm a seasonal variations of testosterone since the steroid binding proteins are the carriers of this hormone (Gustafson and Damassa, 1985; Gustafson, 1987). Physiologic increases or decreases in circulating steroid binding protein levels would be expected to influence the availability and therefore action of androgens (Gustafson and Damassa, 1985).

The data on mean plasma concentrations of *Pteropus giganteus giganteus* during breeding and post-breeding season suggest that the large increase in peripheral testosterone during the mating period is due, at least in part, to increased testicular production. Leydig cells appear fully active, histologically before the peak (October), suggesting that further stimulation occurs resulting in increased production of testosterone. Changes in stimulus could occur in response to many factors including environmental zeitgebers, female pheromones or stimulation of central nervous system associated with mating or territorial behavior (McGuckin and Blackshaw, 1991).

REFERENCES

Bernard RTF (1986) Seasonal changes in plasma testosterone concentrations and Leydig cell and accessory gland activity in the Cape horseshoe bat (*Rhinolophus capensis*). *J.Reprod.Fert.*, 78: 413-422.

Bernard RTF and Cumming GS (1997) African bats: Evolution of reproductive patterns and delays. *The Quarterly Review of Biology,* 72, 253–274.

Beguelini MR, Moreira PR, Faria KC, Marchesin SR, Morielle-Versute E (2009) Morphological characterization of the testicular cells and seminiferous epithelium cycle in six species of Neotropical bats, *J Morphol., 270(8):943-53.*

Bhasin S, Storer TW, Berman N, Yarasheski KE, Clevenger B, Phillips J, Lee WP, Bunnell TJ and Casaburi R (1997) Testosterone Replacement increases fat-free mass and muscle size in hypogonadal men*. J. Clin. Endocrinol. Metab*., 82(2): 407-413.

Blottner S, Hingst O and Meyer HD (1996) Seasonal spermatogenesis and testosterone production in soe deer (*Capreolus capreolus*). *J. Reprod. Fertil*. 108: 299-305.

Choudhury S and Sastry MS (2011) Correlative studies on circulatory serum testosterone and reproductive pattern in the male Indian leaf nosed bat, Hipposideros speoris (Schneider), The Ecoscan : special issue Vol. 1; 81-85.

Gopalkrishna AN Badwaik N (1993) Male reproductive cycle of in some Indian Bats. *J. Bom. Nat. His. Soc.,* 92 : 174.1814.

Gustafson AW Damassa DA (1985) Annual variations in plasma sex steroid-binding protein and testosterone concentrations in the adult male little brown bat: Relation to the asynchronous recrudescence of the testis and accessory reproductive organs. *Biology of Reproduction,* 33 (5): 1126-1137.

Gustafson AW (1987) Changes in Leydig cell activity during the annual testicular cycle of the bat *Myotis lucifugus lucifugus*: histology and lipid histochemistry*. Am .J. Anat.,* 178;312-325.

Krutzsch PH And Crichton EG (1990) Reproductive biology of bent- winged bat, *Minopterous schreibersii* (Vespertilionidae) in southeast south Australia*. Acta Anatomica,* 139, 109-125.

McGuckin MA Blackshaw AW (1987) Seasonal changes in spermatogenesis (including germ cell degeneration) and plasma testosterone concentration in the grey headed fruit bat, *Pteropus poliocephalus. Aust.J.Biol.Sci.,* 40:211-220.

McGuckin MA and Blackshaw AW (1991) Seasonal changes in testicular size, plasma testosterone concentrations and body weight in captiveflying foxes, *Pteropus poliocephalus* and *P. scapulatus. J. reprod. Fert.* 92 : 339-346.

Sauerwein H and Meyer HHD (1989) Androgen and estrogen receptors in bovine skeletal muscle - relation to steroid induced allometric muscle growth. *J. Anim. Sci*., 67: 206 - 212.

Sauerwein H, Dursch I and Meyer HHD (1991) Quantification of glucocorticoid receptors in bovine skeletal muscles; topographical distribution, sex effect and breed comparisons. J. Steroid Biochem. 39: 941-945.

Sastry MS and Masram A (2007) Correlative changes in the body weight, testis size and serum testosterone concentrations in the Indian flying fox, Rousettus leschenaultia (Desmerest): *Flora and Fauna*, 13(1) : 101-114.

Singh UP (1997) Reproductive biology of the male sheath-tailed bat, *Taphozous longimanus* (Emballonuridae) from India. *Biomedical and Environmental Sciences,* 10 (1): 14-26.

Singh UP Krishna A (2000) Seasonal changes in circulating testosterone and androstenedione concentration and their correlation with the anamolous reproductive pattern in the male Indian sheath tailed bat, *Taphozous longimanus. J. Exp. Zoo*., 287: 54-61.

Turner CD Bagnara, JT (1976) Endocrinology of testis. In:General Endocrinology. Eds. C. D. Turner and J.T. Bagnara VI. Edition W.B. Saunders Company. p. 427.

Vivier LM, Vander Merve (1996) Reproductive pattern in the male Angolan free tailed bat, *Tadarida (Mops) Condylura* (Microchiropterra : Molossidae) in the Eastern Transvaal, *South Africa. J. Zool. Lond.*, 239:465-476.