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## Seasonal impact of endocrine assessment in Musth elephants

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### Abstract

The study of musth condition in elephants is a key issue seeking to health management of wild animals. The present study is focused to provide basic information on the musth condition of captive elephants of Madhya Pradesh that may be helpful to elucidate the relationship of musth and seasonal changes on endocrine assessment. The study was conducted in adult, sub-adult, musth and non-musth elephants of different tiger reserves of Madhya Pradesh. Freshly voided fecal samples were collected and ELISA was performed to process the fecal samples for testosterone assessment. We observed the fecal testosterone in musth in winter season ( $2061.0 \pm 276.0$  ng/g) followed by summer ( $1714.0 \pm 141.0$  ng/g) and lowest in monsoon season ( $1221.0 \pm 119.0$  ng/g). The corresponding fecal testosterone concentration revealed in non-musth elephants with higher concentration in winter ( $1810.0 \pm 102.0$  ng/g) followed by summer ( $1324.0 \pm 135.0$  ng/g) and monsoon ( $842.6 \pm 078.2$  ng/g) season. Similarly fecal testosterone concentration was found significantly higher in adult elephants during winter season ( $1956.0 \pm 166.0$  ng/g) followed by summer ( $1551.0 \pm 103.0$  ng/g) and monsoon ( $963.5 \pm 080.6$  ng/g) season as compare to sub-adults, in which significantly higher concentration of testosterone levels observed in summer ( $651.5 \pm 30.2$  ng/g) followed by winter ( $473.9 \pm 27.5$  ng/g) and monsoon ( $380.9 \pm 32.1$  ng/g) season. The higher concentration of testosterone level in winter season revealed in the present study would have been considerable parameters in taking precautionary events in park areas where they are part of wildlife conservation.

**Keywords:** Endocrine, musth, captive elephants, testosterone, season

### Introduction

Wildlife health management is one of the essential components of biodiversity conservation as the wild animals act as habitat marker species to maintain the food chain of ecosystem (Shrivastav, 2015) [7]. After implementation of Wildlife (Protection) Act, 1972, National Parks and Tiger Reserves have been facilitated with captive elephants for assisting wildlife conservation tasks. Owing to habit and habitat of elephant's, they may be tamed in captivity. However their behavioral responses leading to gonadotropical hormones and their effect on elephant's nature have been studied in different part of the country and abroad whilst in Madhya Pradesh, it was yet not studied. The study of musth condition in elephants is a key issue seeking to health management of wild animals. The problematic elephants and their behavioral changes are characterized by endocrinal upsets and it occurs in both the species of Asian elephants (*Elephas maximus*) and African elephants (*Loxodonta Africana*). Adult male Asian elephants and both sexes of African elephants are periodically attaining the musth condition owing to elevation of androgen level in the blood (Swain *et al.*, 2003) [8]. Subsequently, musth conditions of male elephants have also been problematic as these elephants become aggressive and violent. In many stances, mahout, forest guards and veterinary doctors have been victimized during handling of musth elephants (The New Indian Express, August, 2020) [9].

The androgen level in blood usually increase considerably during the period of musth and is stated to be reason for the aggressive behavior particularly in musth elephants (Ajitkumar *et al.*, 2002) [1]. Sexual activity in adult male elephants is predominantly associated with their behavioral changes which could be the tool for assessment of pre musth conditions in terms of health management of captive elephants. Several studies have established a distinct musth-related elevation in androgen levels in captive and wild male African and Asian elephants (Ghosal *et al.*, 2013) [6].

The present study is focused to provide basic information on the musth condition of captive elephants of Madhya Pradesh that may be helpful to elucidate the relationship of musth and seasonal changes on endocrine assessment. In contrast, most of the studies reported on endocrine measurements in male Asian elephants are based on determination of hormone levels in serum (Brown *et al.*, 2007) [4]. However, assessment of hormonal correlation of musth in captive Asian bull elephants through non-invasive approach is essential to increase the feasibility of diagnosis for the endocrinal secretions assessment, as blood sampling would not be possible every time while attaining the musth conditions (Ganswindt *et al.*, 2010) [5]. In this aspect endocrinal hormones analysis in fecal samples is a reliable alternate as compare to serum hormones measurements (Ganswindt *et al.*, 2010) [5].

## Materials and Method

### Location

The study was conducted in different tiger reserves of Madhya Pradesh including Kanha, Bandhavgarh, Panna, Pench tiger reserves.

### Selection of animal

Based on the reproductive history available at different tiger reserves of Madhya Pradesh, sub-adult and adult male elephants (musth and non-musth) (20) were selected for the study.

### Collection of samples

For hormone analysis, approximately 50 g each dung samples (N=240) from sub-adult and adult male captive elephants during early in the morning and evening time preferring fresh voided dung were collected without adding preservative in a prescribed plastic (HIMEDIA-PW047) or glass container with maintaining cold chain during transportation and stored at -20 °C until analysis.

### Hormone analysis

Quantitative analyses of testosterone were estimated by processing of dung samples by using commercially available ELISA diagnostic kits (Testosterone Enzyme Immunoassay

Kit, DetectX, (Arbor Assays, Ann Arbor, Michigan USA).

### Statistical analysis of data

Statistical analysis of data was carried out by using standard statistical procedure and interpretations were based on the finding as suggested by Snedecor and Cochran (1967) [10].

### Result

Seasonal impact on endocrine hormone concentration studied were performed mostly in free ranging elephants whereas we have analysed these hormones in captive elephants of different tiger reserves of Madhya Pradesh to correlate the effect of environmental conditions on endocrine hormone concentration.

### Fecal testosterone in adult and sub-adult captive elephants

In the present study, we categorized age (adult and sub-adult) wise captive elephants and estimated fecal hormones which were collected during different seasons. Accordingly the fecal testosterone concentration was found significantly higher in adult elephants during winter season (1956.0±166.0 ng/g) followed by summer (1551.0±103.0 ng/g) and monsoon (963.5±080.6 ng/g) season as compare to sub-adults, in which significantly higher concentration of testosterone levels observed in summer (651.5±30.2 ng/g) followed by winter (473.9±27.5 ng/g) and monsoon (380.9±32.1 ng/g) season.

### Fecal testosterone in musth and non-musth captive elephants

Season wise fecal testosterone concentration in musth and non-musth captive elephants were analysed in the present study and found distinctly higher concentration of fecal testosterone in musth in winter season (2061.0±276.0 ng/g) followed by summer (1714.0±141.0 ng/g) and lowest in monsoon season (1221.0±119.0 ng/g). The corresponding fecal testosterone concentration revealed in non-musth elephants with higher concentration in winter (1810.0±102.0 ng/g) followed by summer (1324.0±135.0 ng/g) and monsoon (842.6±078.2 ng/g) season (table 1, fig. 1).

**Table 1:** Season wise fecal testosterone hormones of captive elephants

Season	Mean±SE			
	Testosterone (T) (ng/g)			
	Adult	Sub-adult	Musth	Non-musth
Monsoon	963.5 <sup>c</sup> ±080.6	380.9 <sup>c</sup> ±32.1	1221.0 <sup>c</sup> ±119.0	842.6 <sup>c</sup> ±078.2
Summer	1551.0 <sup>b</sup> ±103.0	651.5 <sup>a</sup> ±30.2	1714.0 <sup>b</sup> ±141.0	1324.0 <sup>b</sup> ±135.0
Winter	1956.0 <sup>a</sup> ±166.0	473.9 <sup>b</sup> ±27.5	2061.0 <sup>a</sup> ±276.0	1810.0 <sup>a</sup> ±102.0
P-value	0.000	0.000	0.000	0.004

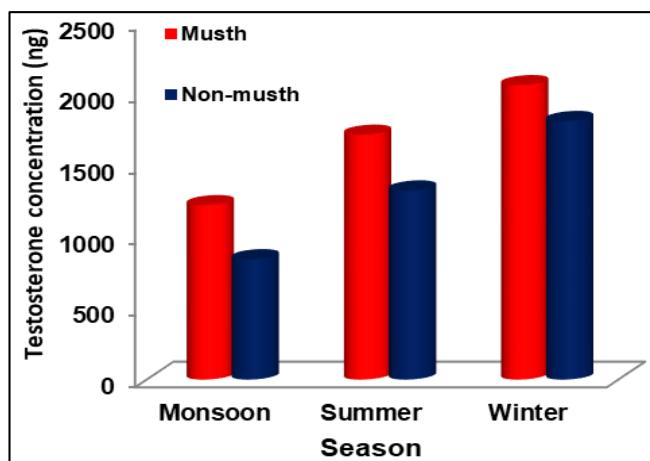


Fig 1: Testosterone concentration (ng/g) of musth and non-musth elephants

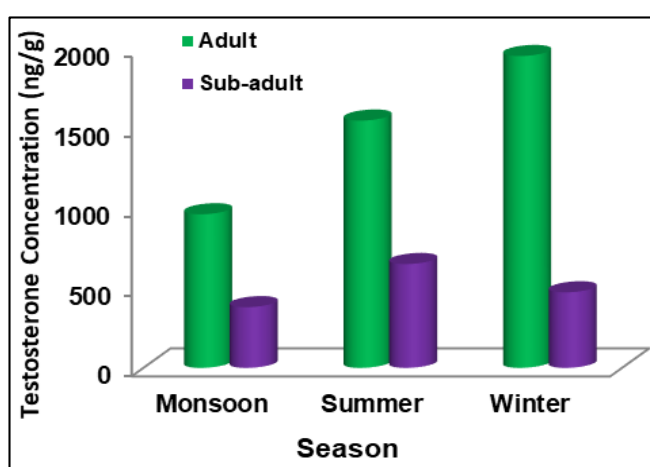


Fig 1: Testosterone concentration (ng/g) of adult and sub-adult elephants

## Discussion

Testosterone level found higher in winter season in adult elephants while sub-adults show higher testosterone concentration during summer season which can be influenced seasonal impact in relation to age and physical strength of elephants. Bolechova *et al.* (2020) [4] have studied the impact of environmental conditions (temperature and humidity) which plays leading role in elevation of endocrinal secretions as well as it also depend on age of puberty in Asian elephants. The findings of the present study definitely established there is a strong correlation between age and sex of the animals. In overall seasons, higher concentration of testosterone levels in adult elephants as compare to sub-adult shows the sex induced hormones concentration elevate during the attainment of maturity and these are associated with climatic conditions. As far as could be ascertaining from the perusal of literature we did not come across any literature were attempt has been made to investigate fecal testosterone levels in captive elephants with their seasonal impact. Hence, the findings have vital importance as the winter season is appropriate for breeding aspects with care and management of such elephants in captivity with standard operating procedure to provide facilities within the ambit of social background for avoiding unpleasant situation during musth condition of elephants. Andres *et al.* (2021) [2] defined that breeding season of elephant is not clear cut defined while it depends upon body condition, photoperiodic signaling environmental conditions,

inter and interspecific social interaction and their management in captivity. Hence they can reproduce throughout the whole year as a long day breeders. Thus seasonal impact on testosterone levels as encountered in the winter season in the present study needs more comprehensive study to draw the plausible reasons behind.

The present findings express that the winter season is most appropriate in which testosterone increases both in musth and non-musth elephants. The seasonal impact on elevation in different hormones levels observed in the same range when elephants show the temporal secretion and signs of aggression, urine dribbling most appropriately in winter season. In contrast Andres *et al.* (2021) [2] observed peak musth condition during june-october months with aggressive behaviour. The differences in season wise fecal testosterone concentration in the present study may be possibly due to changes in geographical condition and the habit and habitat of captive elephants with the surroundings which affect their mind set regarding mating preferences along with sharing in the nutritional intake, thus social impact among their team mates may be the tension building process (Ghoshal *et al.*, 2013) [6]. Furthermore, the higher concentration of testosterone level in winter season revealed in the present study would have been considerable parameters in taking precautionary events in park areas where they are part of wildlife conservation.

## Conclusion

The present study indicates that endocrine assessment of musth elephants on the basis of seasonal impact can be done by using non-invasive technique which could be used to guide the management of captive elephants.

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## References

1. Ajitkumar G, Ghosh A, Sreekumaran KN, Rajankutty K, Chandrasekharan K. Biometry of genitalia in a cow elephant. Kerala Journal Animal Reproduction. 2002;1(1):15-16.
2. Andres PJ, Caceres S, Crespo B, Silvan G, Illera JC. Non-invasive determination of annual fecal cortisol, androstenedione and testosterone variations in a herd of male Asian elephants (*Elephas maximus*) and their relation to some climatic variables. Animals. 2021;11:2723.
3. Bolechova PCM, Man DD, Galeffi C, Hofman S, Kappelhof J, Kfir G, *et al.* EAZA Best Practice Guidelines for Elephants, EAZA Executive Office: Amsterdam, Netherland, 2020, p. 1-214.
4. Brown JL, Somerville M, Riddle HS, Keele M, Duer CK, Freeman EW. Comparative endocrinology of testicular, adrenal and thyroid function in captive Asian and African elephant bulls. General and Comparative Endocrinology. 2007;151:153-162.
5. Ganswindt A, Muenscher S, Henley M, Henley S, Heistermann M. Endocrine correlates of musth and the impact of ecological and social factors in free-ranging African elephants (*Loxodonta africana*). Hormonal Behavior. 2010;57:506-514.

6. Ghosal R, Ganswindt A, Seshagiri PB, Sukumar R. Endocrine correlates of musth in free-ranging Asian elephants (*Elephas maximus*) determined by non-invasive faecal steroid hormone metabolite measurements. PLoS ONE, 2013;8:e84787.
7. Shrivastav AB, Singh KP, Rajput N, Rokde A, Agrawal S. Occurrence of *Bivitellobilharzia nairi* in elephant of Kanha Tiger Reserve. In: International symposium on ecology and health management of Asiatic elephants (*Elephas maximus*), New Delhi, 19-20, November 2016, Association of Indian Zoo and Wildlife Veterinarians, 2015, p. 306.
8. Swain D, Singh LAK. Musth in female Asian elephant. Zoos' Print Journal. 2003;18(9):1202.
9. The New Indian Express; c2020. Nation/2020/aug/14/tiger-tracker-elephant-mauls-forest-ranger-to-death-in-mp-reserve2183509.html
10. Snedecor GW, Cochran WG. Statistical Methods. Ames, Iowa: Iowa State University Press; c1967.