

SERUM BIOCHEMICAL PARAMETERS OF CAPTIVE LIONS (*PANTHERA LEO PERSICA*) OF CHHATTISGARH

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ABSTRACT

The present study was carried out to assess the biochemical profile of adult captive lions (*Panthera leo persica*) housed at three different zoos of Chhattisgarh viz. Maitri Bagh Zoo, Bhilai (MBZ); Nandanvan Zoo and Jungle Safari, Nava Raipur (NVJS) and Kanan Pedari Zoo, Bilaspur (KPZ). The blood samples were collected from 12 captive adult lions after physical restraint in squeeze cage. The study revealed that values of ALT in captive lions of MBZ were significantly ($P<0.05$) higher than both KPZ and NVJS whereas the values of ALT in captive lions of KPZ were significantly ($P<0.05$) higher than NVJS. Similarly, the values of ALP in captive lions of MBZ were significantly ($P<0.05$) higher than KPZ. The values of blood glucose, serum total protein, globulin and cholesterol in captive lions of NVJS were significantly ($P<0.05$) higher than MBZ and KPZ. The present study has provided baseline values for serum biochemical parameters in captive lions of Chhattisgarh.

Keywords: Biochemical profile, Captive lions, *Panthera leo persica*, Zoo

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Asiatic lion is the only surviving sub-species of lion in our country out of 8 globally known sub-species and is considered to be a vulnerable species in the Red List of IUCN and is placed under Schedule I in Wildlife Protection Act, 1972 (Bauer *et al.*, 2016). Earlier assessments of the conservation status of large carnivores presented an alarming situation due to low genetic diversity coupled with their low density, small population size and habitat fragmentation (Treves and Karanth, 2003). However, the Asiatic lion population has put forth a successful conservation story wherein this sub-species has recovered from the brink of extinction to a sustainable population. A steady increase in lion population has been reported since 2010 and it was estimated to be 523 individuals (Singh, 2017) during the 14th Asiatic Lion Census which has further increased to 650 wild lions in 2017 (Kaushik, 2017).

Evaluation of hematobiochemical parameters is very important to diagnose diseases, establish disease processes and monitor the progress of the disease in human as well as veterinary medicine. Various alterations in serum biochemical parameters is an important clinical diagnostic tool for understanding physiological or pathological deviation even in wild animals (Mishra *et al.*, 2019; Dinkar *et al.*, 2022). However, there must be adequate information about baseline data of biochemical values from clinically healthy subjects so that abnormality can be detected and its significance can be evaluated accordingly (Hanks, 1981). There is a paucity of literature over normal biochemical baseline reference values in Asiatic Lions

(*Panthera leo persica*) in India (Jani and Sabapara, 2010). Hence, the present study was envisaged to provide baseline values for serum biochemical parameters in captive lions of Chhattisgarh.

MATERIALS AND METHODS

Blood samples were collected as a part of routine annual health evaluation from a total of 12 captive lions for one occasion during the month of January, 2021 (n=4 adult lions aged between 4 to 8 years from each zoo). Clinically healthy lions were restrained in squeeze cage and about 6 ml of blood was collected aseptically from the tail vein using 22G scalp vein attached to 10 ml sterile disposable syringe. The blood sample was transferred into serum vacutainer and centrifuged at 3000 rpm for 15 minutes for separation of serum followed by storage of serum vials at -20° C until further analysis. The biochemical parameters were analyzed following the standard procedure using commercially available diagnostic kits (Bio Lab Diagnostics, Tarapur, Boisar, India) with the help of a semi-automated biochemical analyzer (DiaSIL-100, Systonics India Limited).

One Way Analysis of variance (ANOVA) was performed to compare the biochemical parameters of captive lions of 03 different zoos (Snedecor and Cochran, 1994). Probability less than 0.05 ($P<0.05$) was considered as statistically significant. All statistical analyses were performed with SPSS 16.0 for Windows (SPSS Inc. Chicago, IL USA).

RESULTS AND DISCUSSION

The Mean $\pm$ SE value of biochemical parameters in

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captive adult lions housed in 03 different zoos are presented in Table 1.

There was no significant ($p>0.05$) difference between the values of AST in captive lions of MBZ, NVJS and KPZ. The overall mean values (37.42 ± 2.13 IU/L) observed in our study are in close approximation with findings of Shanmugam *et al.* (2017). However, higher values of AST have been reported by Dunbar *et al.* (1997) and Dias *et al.* (2022) while AST values in captive lions under study are higher than those reported by Jani and Sabapara (2010). The values of AST are not considered to be very effective for detecting hepatic diseases in felines (Larsson *et al.*, 2017).

The values of ALT (IU/L) were significantly ($p<0.05$) higher in captive lions of MBZ as compared to KPZ and NVJS. However, the values of captive lions of KPZ were significantly higher ($p<0.05$) than the value of NVJS. The overall mean value of ALT in captive lions was 49 ± 1.96 IU/L and these values are within the normal range (10-50 IU/L) of feline biochemical values (Bentinck and French 1989). However, Dias *et al.* (2022) have documented higher ALT values (65.3 ± 13.0 IU/L) for wild cats housed in captivity at Conservation Centre, Ribeirao Preto. The tests of hepatic injury should be interrupted cautiously in felines since ALT values may vary according to the methods and instruments used (Duncan *et al.*, 1994).

The value of ALP (IU/L) in captive lions of MBZ was significantly higher ($p<0.05$) than the value of KPZ. However, the values of ALP in captive lions of MBZ were non-significantly ($p>0.05$) higher than the value of NVJS. The overall mean value of ALP (46.28 ± 1.19 IU/L) recorded during the present study is higher than those reported by Larsson *et al.* (2017) and Proverbio *et al.* (2021) while the values are lower than those reported by Maas *et al.* (2013) and Liu *et al.* (2021). The values of ALP may vary depending on the age and health status of animals. However, most of the animals were of adult age and hence, no such abnormal alterations outside reference values of ALP were recorded in our study.

The value of blood glucose (mg/dl) in captive lions of NVJS was significantly ($p<0.05$) higher than the values of MBZ and KPZ whereas the value of MBZ was non-significantly ($p>0.05$) higher as compared to KPZ. The overall mean value of blood glucose in the present study was 121.27 ± 5.33 mg/dl, which is in accordance with those reported by Larsson *et al.* (2017) and Shanmugam *et al.* (2017). However, the values of blood glucose in captive lions of 03 different zoos are lower than those reported by Dunbar *et al.* (1997) and Proverbio *et al.* (2021). The values of glucose are highly variable in captive lions and depend mostly on duration of the fasting period at the time of blood collection and some endocrine disturbance

(Larsson *et al.*, 2017).

The value of total protein (mg/dl) in captive lions of NVJS was significantly ($p<0.05$) higher as compared to MBZ and KPZ, whereas the value of TP in captive lions of MBZ was non-significantly ($p>0.05$) higher than the value of KPZ. The overall mean value of total protein in captive lions in present study was 8.2 ± 0.24 g/dl which is nearly close to the findings of TP values in wild cats as documented by Liu *et al.* (2021) and Dias *et al.* (2022). However, the values of total protein recorded in the present study are higher as compared to the normal feline values of 6.4 ± 1.88 g/dl (Bentick and French, 1989).

There was no significant ($p>0.05$) difference among the values of albumin (mg/dl) in captive lions of MBZ, NVJS and KPZ. The overall mean serum albumin value was 3.38 ± 0.17 g/dl, which is in accordance with those reported by Liu *et al.* (2021). However, the values of albumin in captive lions under study are slightly higher than those reported by Maas *et al.* (2013) and Dias *et al.* (2022). However, albumin levels were lower as compared to those reported by Shrivastav and Singh (2012) wherein they have reported albumin values in large carnivores to be 3.5 gm/dl.

The value of globulin (mg/dl) of captive lions of NVJS was significantly ($p<0.05$) higher than the values of MBZ and KPZ whereas the value of globulin in captive lions of MBZ was non-significantly ($p>0.05$) higher as compared to KPZ. The overall mean value of globulin in captive lions under study was 4.53 ± 0.20 g/dl is higher than those reported by Maas *et al.* (2013) and Shanmugam *et al.* (2017). However, the values of globulin in captive lions are lower than those reported by Jani and Sabapara (2010) and Dias *et al.* (2022). High globulin level as compared to level of albumin in our study indicates a favourable response of resistance of the body against diseases in wild carnivores (Shrivastav and Singh, 2012).

There was no significant ($p>0.05$) difference among the values of A/G ratio in captive lions of MBZ, NVJS and KPZ, respectively. The overall mean value of AG ratio was 0.75 ± 0.43 which is higher than the value stated by Jani and Sabapara (2010). However, Liu *et al.* (2021) have reported A/G ratio in captive Siberian tigers to be 0.87 ± 0.12 which is in accordance with findings of our study. In contrast a higher A/G ratio in lions as compared to our findings has been reported by Larsson *et al.* (2017).

There was no significant ($p>0.05$) difference among BUN (mg/dl) values of three zoos. In the present study, the overall mean BUN value was 29.35 ± 0.84 mg/dl which is slightly lower than those reported by Currier and Russeli (1982) and Dias *et al.* (2022). However, the overall mean

Table 1. Biochemical parameters in captive lions of three different zoos of Chhattisgarh (Mean ± S.E.)

Zoo	AST (IU/L)	ALT (IU/L)	ALP (IU/L)	Glucose (mg/dl)	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	A:G ratio	BUN (mg/dl)	Creatinine (mg/dl)	Cholesterol (mg/dl)
MBZ	33.35±3.85	54.07±0.88 ^a	47.32±2.03 ^a	124.1±8.51 ^{ab}	7.82±0.29 ^{ab}	3.25±0.29	4.3±0.31 ^{ab}	0.77±0.11	29.45±1.80	3.22±0.30	151.90±6.71 ^{ab}
NVJS	35.35±3.85	41.22±1.16 ^b	46.17±1.65 ^a	135.7±5.34 ^a	8.68±0.18 ^a	3.75±0.24	5.17±0.25 ^a	0.72±0.06	28.52±1.80	2.59±0.19	165.5±4.86 ^a
KPZ	43.56±0.54	51.72±2.96 ^a	42.35±0.54 ^b	104.07±6.48 ^b	7.48±0.32 ^b	3.16±0.34	4.12±0.26 ^b	0.76±0.07	30.1±0.67	2.97±0.42	141.5±3.08 ^b
Overall Mean	37.42±2.13	49±1.96	46.28±1.19	121.27±5.33	8.2±0.24	3.38±0.17	4.53±0.20	0.75±0.43	29.35±0.84	2.93±0.18	152.91±3.99
p Value	0.106	0.002	0.032	0.030	0.032	0.344	0.058	0.903	0.778	0.417	0.026

a, b- Values with different superscripts differ significantly ($p < 0.05$) between different zoos

value of BUN is higher than those reported by Maas *et al.* (2013) and Liu *et al.* (2021). Blood urea nitrogen levels in captive wild animals will rise within a normal range as the quality and quantity of protein ingested increases (Melton *et al.*, 1987).

The values of creatinine varied non-significantly ($p > 0.05$) in captive lions of three zoos. The creatinine value recorded in the present study (2.93 ± 0.18 mg/dl) were within the normal ranges for big cats as reported by Shrivastav and Singh (2012) and Proverbio *et al.* (2021). The overall mean creatinine value of captive lions is higher than that reported by Currier and Russeli (1982) and Shanmugam *et al.* (2017), while creatinine values in our study are lower than those reported by Larsson *et al.* (2017). Furthermore, the higher value of creatinine in big cats might be attributed solely to their obligatory meat-based diet (Miller *et al.*, 1999).

The value of blood cholesterol (mg/dl) was significantly ($p < 0.05$) higher in captive lions of NVJS as compared to MBZ and KPZ whereas the value of blood cholesterol in captive lions of MBZ was non-significantly ($p > 0.05$) higher than the value of KPZ. However, the overall mean value of blood cholesterol value is lower than those reported by Currier and Russeli *et al.* (1982). In captive lions, the overall mean blood cholesterol value was 152.91 ± 3.99 mg/dl which is in agreement with those reported by and Dias *et al.* (2022) and within the normal range for felines (41-225 mg/dl). However, the values of cholesterol in captive lions under study are much higher than values (96.48 ± 25.38 mg/dl) reported by Liu *et al.* (2021). The variations in cholesterol levels arise due to the level of lipoproteins in the blood which may occur either as a primary condition or secondary to the feeding of high-fat diet or starvation in wild animals (Larsson *et al.*, 2017).

CONCLUSION

The findings of the present study have provided a preliminary baseline data on biochemical parameters in captive lion which can prove to be useful in diagnostic investigations in captive lions. However, for a species-specific reference range to be developed for captive lions, future studies are warranted with some additional parameters and large sample sizes to evaluate other

differences between genders and age classes along with habitat evaluation to establish reliable relationships between these parameters.

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