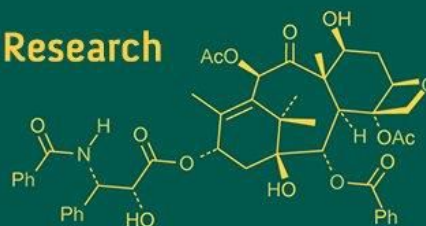
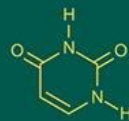
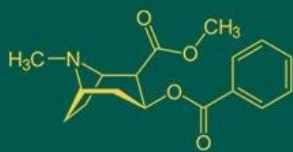


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Haematological and blood biochemical values in chemically restrained healthy male Nilgais (*Boselaphus tragocamelus*) in a Zoo environment

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Abstract

The haematological and blood biochemical values of eight chemically restrained full grown adult male Nilgai (*Boselaphus tragocamelus*) were analysed statistically to establish baseline parameters. The mean and SD values are haematological parameters were: Haemoglobin 11.48 ± 1.39 g/dL, Haematocrit $34.98 \pm 3.81\%$, Red Blood Cell count 6.20 ± 0.50 million/cmm, Mean Corpuscular Volume 56.73 ± 2.54 fl, Mean Corpuscular Haemoglobin 18.48 ± 1.25 pg, Mean Corpuscular Haemoglobin Concentration 32.93 ± 3.47 g/dL, Platelet count 263578.25 ± 56933.24 cells/cmm, White Blood Cell count 4561.88 ± 1586.19 cells/cmm. The differential leukocyte count included Neutrophils $54.60 \pm 6.07\%$, Lymphocytes $31.71 \pm 5.15\%$, Monocytes $3.69 \pm 1.60\%$, Eosinophils $2.60 \pm 1.14\%$, and Basophils $7.40 \pm 3.48\%$. The mean and SD values for blood biochemical parameters were: Urea 31.13 ± 10.51 mg/dL, Blood Urea Nitrogen (BUN) 15.26 ± 5.32 mg/dL, Creatinine 1.68 ± 0.18 mg/dL, Uric acid 1.90 ± 0.35 mg/dL, Total protein 6.38 ± 0.63 g/dL, Albumin 3.16 ± 0.77 g/dL, Globulins 2.85 ± 0.57 g/dL, Albumin-Globulin ratio 1.29 ± 0.26 . Enzyme activity levels measured included Alkaline Phosphatase 83.25 ± 23.76 U/L, Aspartate Transaminase 123.38 ± 50.36 U/L, Alanine Transaminase 43.00 ± 5.26 U/L, and Gamma-Glutamyl Transferase 13.39 ± 1.53 U/L. Bilirubin levels were recorded as Total Bilirubin 0.11 ± 0.05 mg/dL, Direct Bilirubin 0.05 ± 0.02 mg/dL, Indirect Bilirubin 0.06 ± 0.04 mg/dL and serum Calcium was 8.29 ± 0.26 mg/dL. These values provide essential baseline data for interpreting blood profile and optimizing health care management in captive Nilgai populations.

Keywords: Nilgai, haematology, biochemical

Introduction

Nilgai (*Boselaphus tragocamelus*), largest antelope of Asia, are found in surplus numbers in many wildlife facilities in India, often requiring veterinary intervention. The clinical interpretation of laboratory data on blood components is an effective and reliable method to assess the health and nutritional status of individual animals, as well as to represent the overall condition of the herd. This is particularly relevant in captive ruminants, where physical restraint poses significant challenges. Therefore, establishing reference values for the blood parameters of this species is crucial.

Studies on baseline values of haematological and blood biochemical values of captive nilgai in the Indian region are scarce. Gehlot and Vyas (2021) [7] reported haematological parameters in different age groups of both sex of rescued free ranging chinkara, nilgai and blackbuck in the Indian region. Basic haematological and blood biochemistry values of nilgais aged 1 to 12 years in captivity at the Barcelona Zoo were documented by Peinado *et al.* (1999a, b) [11, 12].

The normal hematologic values in wild animals can vary significantly throughout their lives due to fluctuating environmental conditions. Within the same species, captive and free-ranging populations may exhibit markedly distinct hematologic profiles (Beechler *et al.*, 2009) [3]. These values are influenced by various factors, including sex, diet, age, immobilizing agents, handling conditions, and environmental factors (Peinado *et al.*, 1999b) [12]. Consequently, it is recommended that reference values for blood components be established using uniform procedures, ensuring that all individuals included in a study are sampled under consistent management conditions (Rosef *et al.*, 2004) [14].

This study aimed to statistically evaluate the recorded haemato-biochemical parameters of healthy adult male Nilgais housed at Gadag Zoo, Gadag, Karnataka, India.

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The objective was to establish reference ranges for male Nilgais in a zoo environment specific to this region, contributing to enhanced health management practices in captivity.

Materials and Methods

The study was conducted using recorded data of eight healthy adult male nilgais housed at the Gadag zoo, Gadag, Karnataka. The blood profile was part of patient monitoring during elective vasectomy surgery under chemical restraint using xylazine-ketamine combination. The data related to signalment, restraint procedure and blood profile were collected for the study.

The data of haematological parameters and blood biochemical parameters were tabulated separately. The values were statistically analyzed in Microsoft Excel version 2021 to obtain mean value and standard deviation.

Haematological parameters studied are haemoglobin, haematocrit, red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelet count, white blood cell count (WBC), differential WBC count (neutrophils, lymphocytes, monocytes, eosinophils, basophils).

The blood biochemical parameters studied are urea, blood urea nitrogen, creatinine, uric acid, total protein, albumin, globulins, albumin-globulin ratio, alkaline phosphatase, aspartate transaminase, alanine transaminase, gamma-glutamyl transferase, total bilirubin, direct bilirubin, indirect bilirubin, and calcium.

Results and Discussion

The study involved eight fully grown adult male nilgai. The animals were housed in a single enclosure alongside females and juveniles under uniform husbandry and dietary conditions. There were no records of recent history of illness in the individual animals or in the herd. The restraint and blood sample collection were performed in the morning hours before feeding, during March, 2023.

All animals were chemically restrained using a combination of xylazine hydrochloride and ketamine hydrochloride, administered by a remote drug delivery system for induction, followed by intravenous administration of Ketamine for maintenance of anaesthesia. Average total dose for sufficient immobilization was 200mg of xylazine hydrochloride and 400mg of ketamine hydrochloride. The animals were free from injuries and clinically healthy upon physical examination following restraint. Actual body weight was 203.63±11.70 kg (range 185 kg to 215 kg). Chemical restraint is essential for stress-free handling of wild ruminants and Xylazine-ketamine combination often used for restraining captive nilgai (Sharma *et al.*, 1997; Arora, 1998; Kumar, 2006) [17, 2, 9]. Regarding body weight of the animals, Kumar (2006) [9] and Machado *et al.* (2014) [10] reported similar values for captive and free-ranging nilgai, respectively.

Table 1 summarizes the mean, standard deviation, and range of haematological parameters observed in the present study. The range of most parameters was comparatively narrower and fell within published reference values for nilgai (Peinado *et al.*, 1999a; Gehlot & Vyas, 2021) [11, 7] as well as other bovine species such as gaur, gayal, African buffalo, and American bison (Srivastav *et al.*, 2014; Beechler *et al.*, 2009; Perumal *et al.*, 2013) [18, 3, 13].

RBC values were lower, whereas MCV and MCHC were higher compared to findings reported by Peinado *et al.* (1999a) [11] and Gehlot & Vyas (2021) [7]. Similarly, platelet counts were also comparatively lower. Factors such as the capture of wild animals, increased ambient temperatures, and aging can significantly impact RBC levels, MCV, and MCHC (Abaigar, 1993) [1].

WBC counts were within the normal range; however, neutrophil values were higher compared to lymphocytes. The neutrophil levels observed in this study were higher than those reported by Peinado *et al.* (1999a) [11] and Gehlot & Vyas (2021) [7]. An increased neutrophil-to-lymphocyte ratio has also been documented in semi-captive spotted deer (Sahoo & Arora, 2002) [15]. Physiological responses to excitement, handling, reproductive cycles, and seasonal changes trigger the release of epinephrine. This surge in epinephrine mobilizes neutrophils that are marginated within small blood vessels, causing them to enter larger vessels as blood flow increases (Gehlot & Vyas, 2021) [7].

Basophil values were elevated in all nilgai examined in the present study. Basophilia in ruminants is commonly observed in response to allergies and parasitic infections (Tornquist & Rigas, 2010) [19]. Subclinical parasitic infections are prevalent among wild animals across India, and Nilgai have been reported to harbour *Avitellina centripunctata*, *Strongyle* spp., *Moniezia* spp., *Trichuris* spp., and *Coccidia* spp. (Kamdi *et al.*, 2014; Brown *et al.*, 1984) [8, 4]. Further studies are needed to assess basophil counts in captive Nilgai.

Table 2 summarizes the blood biochemical parameters observed in the present study. A comparison with the values reported by Peinado *et al.* (1999b) [12] for nilgai indicates that our creatinine, alkaline phosphatase, and total bilirubin levels were significantly lower, whereas AST, ALT, and GGT levels were higher. While elevated AST levels are typically indicative of physical trauma, they can also increase due to stress, which is commonly associated with the restraining of wild animals and is often difficult to avoid (Chapple *et al.*, 1991) [5].

The total protein and albumin levels observed were within the published reference ranges for nilgai and gaur (Peinado *et al.*, 1999b; Srivastav *et al.*, 2014) [12, 18]. However, the albumin-globulin ratio was at the lower end of the compared range. A lower albumin-globulin ratio suggests an increased globulin fraction in older animals, which is attributed to a more mature immune system in adults due to prolonged exposure to acute and chronic inflammatory conditions and parasitic infections over time (Vestweber *et al.*, 1991) [20].

The range of ALP and AST values was broader, with ALP levels significantly lower than those reported by Peinado *et al.* (1999b) [12]. Alkaline phosphatase is an enzyme associated with osteoblastic activity and skeletal development, which explains its higher levels in younger animals compared to adults.

The variability in data from wild animals is often significant due to small sample sizes, which can hinder statistical analysis. In addition to the stress of handling, factors such as environmental conditions, physiological status, circadian rhythms, and management practices contribute to variations in blood parameter outcomes (Sankar *et al.*, 2001; Gad & Shyama, 2009) [16, 6]. Hence, reference intervals for blood parameters are typically established based on clinically healthy animal populations (Beechler *et al.*, 2009) [3].

Table 1: Values of haematology parameters in healthy adult male nilgais in a zoo condition.

Parameters	Average $\pm$ SD (n = 8)	Range of values observed
Haemoglobin (g/dL)	11.48 $\pm$ 1.39	9.60-13.90
Haematocrit (%)	34.98 $\pm$ 3.81	29.10-41.10
RBC (millions/cmm)	6.20 $\pm$ 0.50	5.31-6.79
MCV (fl)	56.73 $\pm$ 2.54	53.60-60.50
MCH (pg)	18.48 $\pm$ 1.25	16.10-20.50
MCHC (g/dL)	32.93 $\pm$ 3.47	26.22-37.89
Platelet count cells/ccm)	263578.25 $\pm$ 56933.24	202000.00-378000.00
WBC (cells/ccm)	4561.88 $\pm$ 1586.19	2760.00-7930.00
Neutrophils (%)	54.60 $\pm$ 6.07	43.50-62.00
Lymphocytes (%)	31.71 $\pm$ 5.15	24.70-41.90
Monocytes (%)	3.69 $\pm$ 1.60	1.70-6.90
Eosinophils (%)	2.60 $\pm$ 1.14	1.10-4.30
Basophils (%)	7.40 $\pm$ 3.48	3.60-14.00

Table 2: Values of blood biochemical parameters in healthy adult male nilgais in a zoo condition

Parameters	Average $\pm$ SD (n = 8)	Range of values observed
Urea (mg/dL)	31.13 $\pm$ 10.51	12.00-44.00
Blood urea nitrogen (mg/dL)	15.26 $\pm$ 5.32	5.60-21.00
Creatinine (mg/dL)	1.68 $\pm$ 0.18	1.40-1.90
Uric acid (mg/dL)	1.90 $\pm$ 0.35	1.40-2.30
Total protein (g/dL)	6.38 $\pm$ 0.63	5.20-7.20
Albumin (g/dL)	3.16 $\pm$ 0.77	1.40-3.90
Globulins (g/dL)	2.85 $\pm$ 0.57	2.00-4.00
Albumin-Globulin ratio	1.29 $\pm$ 0.26	0.80-1.60
Alkaline phosphatase (U/L)	83.25 $\pm$ 23.76	40.00-115.00
Aspartate transaminase (U/L)	123.38 $\pm$ 50.36	63.00-200.00
Alanine transaminase (U/L)	43.00 $\pm$ 5.26	36.00-54.00
Gamma-glutamyl transferase (U/L)	13.39 $\pm$ 1.53	10.70-15.40
Total bilirubin (mg/dL)	0.11 $\pm$ 0.05	0.05-0.21
Direct bilirubin (mg/dL)	0.05 $\pm$ 0.02	0.01-0.07
Indirect bilirubin (mg/dL)	0.06 $\pm$ 0.04	0.00-0.14
Calcium (mg/dL)	8.29 $\pm$ 0.26	7.90-8.60

Conclusions

In the present study, the management, environment and handling of eight male nilgai during blood sample collection procedure were similar that provided standardised conditions for more reliable statistical evaluation of values of haematological and blood biochemical parameters. The reference intervals recorded in this study will be useful for evaluating hematologic values of captive nilgais in the future.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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