(ISSN: 0973-7049(P))

The Bioscan AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES 21(4): S.I (4),1032-1036, 2026 www.thebioscan.com

Haematological Profile of Khariar Cattle of Odisha: Baseline Leucocyte, Erythrocyte and Platelet Values

Avinash Palli[1]*, Shaz Murthuza M[2], Sai Kumar G[3], Likitha N[4], and Divya Sri B[5]

[1*]Assistant Professor, Department of Veterinary Physiology and Biochemistry, School of Veterinary and Animal Sciences, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha - 761211, India.

[2]Assistant Professor, Department of Veterinary Physiology and Biochemistry, School of Veterinary and Animal Sciences, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha - 761211, India.

[3] Assistant Professor, Department of Veterinary Microbiology, School of Veterinary and Animal Sciences, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha - 761211, India.

[4] Assistant Professor, Department of Veterinary Medicine. School of Veterinary and Animal Sciences, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha - 761211, India.

[5]Assistant Professor, Department of Veterinary Physiology and Biochemistry, School of Veterinary and Animal Sciences, Centurion University of Technology and Management, Paralakhemundi, Gajapati, Odisha - 761211, India.

Corresponding author: Avinash Palli

Email: avinash.palli@cutm.ac.in

DOI: https://doi.org/10.63001/tbs.2026.v21.i04.S.I(4).pp1032-1036

Keywords:
Khariar cattle, Haematology, Indigenous cattle, Erythrocyte indices, Platelet indices.

Article Info

Received:14.10.2026

Accepted: 02.11.2026

Published: 12.11.2026

Abstract

Khariar is a small, hardy draught breed of western Odisha for which no blood profile has been published. Blood from 36 clinically healthy Khariar cattle (cows, bulls and calves) was analysed for 24 complete blood count variables. Total leucocyte count averaged 10.48 ± 2.56 × 10^3/µL, and lymphocytes formed 63.63 ± 10.93% of leucocytes; the granulocyte-to-lymphocyte ratio was 0.43 ± 0.31. Erythrocyte count, haemoglobin and haematocrit averaged 6.51 ± 0.95 × 10^6/µL, 15.34 ± 2.00 g/dL and 34.16 ± 5.22%, with a mean corpuscular volume of 52.60 ± 4.61 fL. Platelet count averaged 236.80 ± 54.12 × 10^3/µL and mean platelet volume 5.36 ± 0.45 fL. Leucocyte, erythrocyte and platelet counts fell within published bovine ranges and close to values for other Indian zebu breeds. Haemoglobin and the derived mean corpuscular haemoglobin concentration (15.34 ± 2 g/dL and 44.29 ± 1.29 g/dL), however, exceeded physiological limits, was higher than reported for other Indian breeds, which may reflect greater oxygen-carrying capacity and adaptation of this hardy draught breed to a hot tropical environment; These values may provide the first haematological baseline for Khariar cattle, and further studies with a larger population are needed to establish age- and sex-specific reference intervals.

INTRODUCTION

India maintains a large number of registered indigenous cattle breeds, each shaped by its own climate, feed base and use. Khariar cattle belong to Nuapada district in western Odisha, where they are kept mainly for draught in small, low-input farms and are valued for hardiness and resistance to local diseases. The breed is registered with ICAR-National Bureau of Animal Genetic Resources (accession number INDIA_CATTLE_1500_KHARIAR_03034), yet its physiology has received far less study than that of the major dairy zebu breeds.

A complete blood count is the most widely used laboratory tool for judging the health of cattle, but its value depends on comparison with appropriate reference values (Weiss and Wardrop, 2010; Roland *et al.*, 2014). Most published bovine ranges come from taurine dairy cows, and haematological values shift with breed, age, sex, climate and analytical method (Mohri *et al.*, 2007; George *et al.*, 2010; Kim *et al.*, 2021). Indian zebu breeds differ from crossbreds and from each other in erythrocyte and leucocyte responses to heat (Chitra *et al.*, 2026; Tiwari *et al.*, 2026), and a recent study of Punganur cattle showed that indigenous breed values do not always match textbook ranges (Avinash *et al.*, 2025). Leucocyte ratios such as the neutrophil-to-lymphocyte ratio are also increasingly used as stress and inflammation markers, but their baseline in zebu cattle is poorly defined (Davis *et al.*, 2008; George *et al.*, 2010).

We hypothesized that Khariar cattle have a haematological profile that differs in specific respects from taurine-derived reference ranges. The objective of this study was to describe baseline leucocyte, erythrocyte and platelet values, including derived leucocyte and platelet ratios, in clinically healthy Khariar cattle and to compare them with published values for other indigenous breeds.

MATERIALS AND METHODS

Animals and study area

The study was carried out in the Livestock Farm Complex, School of Veterinary and Animal Sciences, Centurion University, Paralakhemundi, Gajapati, Odisha, India. Thirty-six Khariar cattle were sampled, comprising 22 cows, 4 bulls and 10 calves, from the above study area and from the Khariar region of Nuapada district, Odisha, during July to September 2026. Each animal was examined by a veterinarian before sampling. Animals were included only if they had normal rectal temperature, appetite and demeanour, no visible ectoparasites, no clinical signs of disease and no treatment in the preceding 100 days. The animals were dewormed regularly and were free of clinical symptoms.

Blood collection

About 2 mL of blood was drawn from the jugular vein of each animal with sterile disposable syringes under aseptic conditions, transferred at once into EDTA vacutainer tubes and mixed by gentle inversion. Samples were kept at 4-8ºC and analysed within 12 hours of collection.

Haematological analysis

Complete blood counts were determined on Genrui SB31-VET Haematology analyser (Genrui Biotech Inc.) using its bovine species setting. The analyser provided a three-part leucocyte differential: lymphocytes, mid-sized cells (MID; mainly monocytes with eosinophils and basophils) and granulocytes. The variables measured were total leucocyte count, absolute and percentage lymphocyte, MID and granulocyte counts, red blood cell count (RBC), haemoglobin (HGB), haematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), red cell distribution width as coefficient of variation (RDW-CV) and standard deviation (RDW-SD), platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW-CV and PDW-SD), plateletcrit (PCT), platelet large cell count (P-LCC) and platelet large cell ratio (P-LCR). Because the analyser does not separate neutrophils from other granulocytes, the granulocyte-to-lymphocyte ratio (GLR) was calculated for each animal as an approximation of the neutrophil-to-lymphocyte ratio. The platelet-to-lymphocyte ratio (PLR) was calculated in the same way.

Statistical analysis

Mean, standard deviation (SD), standard error of the mean (SEM), 95% confidence interval (CI) of the mean (t distribution, 35 degrees of freedom) and observed range were computed for each variable in Python 3.11 with the pandas, NumPy and SciPy libraries. Formal reference intervals were not derived: with fewer than 40 animals, guidelines of the American Society for Veterinary Clinical Pathology call for the robust method with tests of distribution and outlier screening (Friedrichs *et al.*, 2012), and the pooled sample of cows, bulls and calves was not homogeneous enough for a single interval. Results are presented as mean ± SD unless stated otherwise.

RESULTS

All 24 variables were obtained for every animal (Table 1). Total leucocyte count ranged from 7.01 to 14.75 × 10^3/µL, and lymphocytes were the predominant leucocyte, although the lowest individual lymphocyte percentage was 37.10%. Granulocyte count and GLR were the most variable leucocyte measures, with coefficients of variation of 55% and 72%, respectively; the highest GLR recorded was 1.28.

Among erythrocyte variables, RBC, HCT and MCV varied moderately between animals (coefficients of variation 9-15%), whereas MCHC and RDW-CV were tightly clustered (3-4%). Every animal had an MCHC above 42 g/dL. Platelet count ranged from 138 to 362 × 10^3/µL; MPV stayed within a narrow band of 4.8-6.0 fL, while P-LCC and P-LCR varied more widely (coefficients of variation 34-37%). Mean values for Khariar cattle are set beside published values for Punganur and Ladakhi cattle in Table 2.

Table 1: Haematological values of clinically healthy Khariar cattle (n = 36)

Parameter	Mean	SD	SEM	95% CI of mean	Range
Total leucocyte count (×10^3/µL)	10.48	2.56	0.43	9.61-11.35	7.01-14.75
Lymphocytes (×10^3/µL)	6.61	1.86	0.31	5.98-7.24	3.97-9.88
MID cells (×10^3/µL)	1.30	0.48	0.08	1.14-1.46	0.85-2.48
Granulocytes (×10^3/µL)	2.63	1.45	0.24	2.14-3.12	0.92-6.86
Lymphocytes (%)	63.63	10.93	1.82	59.93-67.33	37.10-74.70
MID cells (%)	12.25	2.00	0.33	11.57-12.93	10.10-16.80
Granulocytes (%)	24.36	10.18	1.70	20.92-27.80	13.40-47.60
GLR	0.43	0.31	0.05	0.33-0.53	0.18-1.28
PLR	36.74	14.36	2.39	31.88-41.60	19.74-71.28
RBC (×10^6/µL)	6.51	0.95	0.16	6.19-6.83	5.45-8.92

Parameter	Mean	SD	SEM	95% CI of mean	Range
HGB (g/dL)†	15.34	2.00	0.33	14.66-16.02	12.20-19.40
HCT (%)	34.16	5.22	0.87	32.39-35.93	27.20-45.10
MCV (fL)	52.60	4.61	0.77	51.04-54.16	43.70-59.50
MCH (pg)†	23.15	2.48	0.41	22.31-23.99	18.50-26.50
MCHC (g/dL)†	44.29	1.29	0.21	43.85-44.73	42.20-46.50
RDW-CV (%)	20.74	0.77	0.13	20.48-21.00	19.90-22.20
RDW-SD (fL)	41.31	3.19	0.53	40.23-42.39	35.80-47.20
PLT (×10³/µL)	236.80	54.12	9.02	218.49-255.11	138.00-362.00
MPV (fL)	5.36	0.45	0.07	5.21-5.51	4.80-6.00
PDW-CV (%)	12.81	1.88	0.31	12.17-13.45	11.50-18.80
PDW-SD (fL)	7.57	2.06	0.34	6.87-8.27	5.80-13.80
PCT (%)	0.126	0.027	0.004	0.117-0.135	0.066-0.181
P-LCC (×10³/µL)	14.73	4.98	0.83	13.05-16.41	6.00-27.00
P-LCR (%)	6.37	2.33	0.39	5.58-7.16	3.70-12.10

SD: standard deviation; SEM: standard error of the mean; CI: confidence interval; MID: mid-sized cells (mainly monocytes with eosinophils and basophils); GLR: granulocyte-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; RBC: red blood cell count; HGB: haemoglobin; HCT: haematocrit; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration; RDW: red cell distribution width; PLT: platelet count; MPV: mean platelet volume; PDW: platelet distribution width; PCT: plateletcrit; P-LCC: platelet large cell count; P-LCR: platelet large cell ratio. †Values likely overestimated by the analyser; see Discussion.

Table 2: Mean haematological values of Khariar cattle compared with other Indian indigenous breeds

Parameter	Khariar (present study)	Punganur (Avinash *et al.*, 2025)[a]	Ladakhi (Tiwari *et al.*, 2026)[b]
Total leucocyte count (×10³/µL)	10.48	8.56-8.95	8.73
RBC (×10⁶/µL)	6.51	6.72-6.74	6.81
HGB (g/dL)	15.34	9.09-9.16	11.40
HCT (%)	34.16	27.27-27.70	34.80
MCV (fL)	52.60	41.93-43.63	NR
MCH (pg)	23.15	13.85-14.75	NR
MCHC (g/dL)	44.29	33.23-34.05	NR
PLT (×10³/µL)	236.80	287.86-308.00	NR

[a]Range of female (n = 96) and male (n = 79) means. [b]Cattle of the cold, arid Trans-Himalayan region; leucocyte count reported as 8,727 cells/µL. NR: not reported.

DISCUSSION

Leucocyte profile

A lymphocyte predominant differential is the normal pattern in healthy cattle, unlike the neutrophil predominant pattern of many other domestic species (Weiss and Wardrop, 2010; Roland *et al.*, 2014). The mean leucocyte count of Khariar cattle was slightly higher than in Punganur (8.56-8.95 × 10³/µL; Avinash *et al.*, 2025) and Ladakhi cattle (8.73 × 10³/µL; Tiwari *et al.*, 2026). Including calves probably contributed, since young cattle carry more circulating lymphocytes and leucocyte counts fall with age (Mohri *et al.*, 2007; Kim *et al.*, 2021; Serrano-Albal *et al.*, 2025).

The mean GLR of 0.43 is well below the neutrophil to lymphocyte ratio of 1.17 reported for healthy Holstein cows by George *et al.* (2010), who also cautioned against reading a ratio above 1 as proof of inflammation. A low ratio could be consistent with relatively unstressed animals, because glucocorticoids raise neutrophil and lower lymphocyte numbers (Davis *et al.*, 2008). This interpretation should be read with two limitations in mind. First, GLR slightly overstates the true neutrophil-to-lymphocyte ratio, because the granulocyte channel also counts some eosinophils and basophils. Second, the lymphocyte-rich blood of calves lowers the group mean. The MID percentage of 12.25% is likewise higher than typical bovine monocyte percentages, as it

combines monocytes with eosinophils and basophils.

Erythrocyte profile

Erythrocyte count in Khariar cattle was close to that of Punganur (6.72-6.74 × 10^6/µL) and Ladakhi cattle (6.81 × 10^6/µL), and haematocrit matched the Ladakhi value of 34.8% (Avinash *et al.*, 2025; Tiwari *et al.*, 2026). Mean corpuscular volume was larger than in Punganur cattle (41.93-43.63 fL), a pattern also reported in Sahiwal calves, which had a higher erythrocyte volume than crossbred calves under heat stress (Chitra et al., 2026). The inclusion of both calves and adults in our sample may also have influenced this value.

Mean haemoglobin (15.34 g/dL) was markedly higher than the values reported for Punganur (9.09-9.16 g/dL), Ladakhi (11.40 g/dL) and Sahiwal bull calves (9.6-10.2 g/dL) (Kuraichya *et al.*, 2025; Avinash *et al.*, 2025; Tiwari *et al.*, 2026). Combined with a normal haematocrit, it produced an MCHC of 44.29 g/dL, and every animal exceeded 42 g/dL. Erythrocytes cannot hold haemoglobin above saturation, and bovine MCHC normally lies near 30-36 g/dL (Weiss and Wardrop, 2010; Roland *et al.*, 2014), as it did in Punganur cattle (33.23-34.05 g/dL). An MCHC above this ceiling is more likely to reflect a measurement artefact, such as haemolysis, lipaemia or haemoglobin overestimation, than true hyperchromasia (Stockham and Scott, 2008). Automated analysers have shown poor agreement with manual haemoglobin and haematocrit methods in zebu cattle (Farooq *et al.*, 2025), and conversion rules derived for humans do not hold in cattle (Ahmad *et al.*, 2022). Further studies in a larger population of Khariar cattle, stratified by age and sex and using the cyanmethaemoglobin method and microhaematocrit, may therefore be needed to confirm the haemoglobin, MCH and MCHC values reported here. The RDW-CV of 20.74% suggests some variation in erythrocyte size, which may reflect the mix of calves and adults; peripheral blood smear examination could potentially clarify this.

Platelet profile

Platelet count in Khariar cattle was relatively lower than in Punganur cattle (287.86-308.00 × 10^3/µL; Avinash *et al.*, 2025) but within the broad range expected for healthy cattle (Roland *et al.*, 2014). The low MPV is consistent with the smaller platelet size reported in cattle, and the narrow MPV range could indicate minimal platelet activation, and the lower platelet count could be attributed to haemoprotozoan infections such as theileriosis and babesiosis, which are associated with reduced platelet counts, haemoglobin and haematocrit (Ahmed et al., 2026); however, the absence of such a pattern here could be consistent with the clinical health of the animals, although subclinical infection cannot be excluded without smear or molecular screening.

Limitations

This study provides descriptive baseline haematological values for Khariar cattle. The sample of 36 clinically healthy animals, comprising cows, bulls and calves, gives an initial overview of the breed, and larger age- and sex-specific groups could allow formal reference intervals to be established in line with ASVCP guidelines (Friedrichs *et al.*, 2012). Sampling was carried out at two locations during a single season, and values from additional locations and seasons, together with confirmation of haemoglobin and haematocrit by the cyanmethaemoglobin method and microhaematocrit, could further refine these estimates. Future studies in a larger population, stratified by age, sex, physiological stage and season, are therefore recommended to establish reference intervals for the breed.

CONCLUSION

Khariar cattle showed a lymphocyte-predominant leucocyte profile with a low granulocyte-to-lymphocyte ratio, erythrocyte counts similar to other Indian zebu breeds and platelet values within the expected bovine range. Haemoglobin and the derived indices were higher than published bovine ranges, and confirmation by manual methods in a larger population is recommended. These data could serve as the first haematological baseline for the breed and a basis for future reference interval studies.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the School of Veterinary and Animal Sciences, Centurion University of Technology and Management, Paralakhemundi, Odisha, for the financial support and encouragement provided.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

1. Ahmad, S., Farooq, U., Lashari, M. H., Idris, M., Ur-Rehman, Z., Khan, N. and Sajjad, N. 2022. Devising and validating a pen-side hematological formula for hemoglobin estimation in Cholistani cattle. Tropical Animal Health and Production 54: 377.
2. Ahmed, M., Rabbi, M. R. R., Sajib, M. M. R., Zim, M. M. R., Miah, M. A. H., Roy, B. C. and Talukder, M. H. 2026. Comprehensive surveillance of bovine piroplasmosis in Bangladesh: clinicopathology and molecular insights. Veterinary Parasitology: Regional Studies and Reports 70: 101450.
3. Avinash, P., Aswani Kumar, K. and Punya Kumari, B. 2025. Assessment of age and sex variability on haematological parameters of indigenous Punganur cattle. Indian Journal of Animal Sciences 95(11): 967-971.
4. Chitra, A., Dhaka, S. S., Bangar, Y. C., Kumar, N., Patil, C. S. and Magotra, A. 2026. Comparative study of hematological responses to thermal stress in Sahiwal and Hardhenu calves. Tropical Animal Health and Production 58(7). https://doi.org/10.1007/s11250-026-05235-y
5. Davis, A. K., Maney, D. L. and Maerz, J. C. 2008. The use of leukocyte profiles to measure stress in vertebrates: a review for ecologists. Functional Ecology 22: 760-772.

6. Farooq, U., Lashari, M. H., Rehman, Z. U., Idris, M., Rashid, H., Nasreen, S., Laraib, F., Ameer, R., Chauhdary, M. and Fatima, I. 2025. Performance evaluation of Rayto RT-7600Vet hematology analyzer in side-by-side comparison with manual hematological methods for apparently healthy Cholistani cattle blood. PLoS One 20(3): e0302617.
7. Friedrichs, K. R., Harr, K. E., Freeman, K. P., Szladovits, B., Walton, R. M., Barnhart, K. F. and Blanco-Chavez, J. 2012. ASVCP reference interval guidelines: determination of de novo reference intervals in veterinary species and other related topics. Veterinary Clinical Pathology 41: 441-453.
8. George, J. W., Snipes, J. and Lane, V. M. 2010. Comparison of bovine hematology reference intervals from 1957 to 2006. Veterinary Clinical Pathology 39: 138-148.
9. Kim, U. H., Lee, S. H., Cho, S. R., Kang, S. S., Jin, S., Ahn, J. S. and Lee, S. H. 2021. Hematological changes and reference intervals in Hanwoo calves during the first 28 weeks of life. Animals 11: 1806.
10. Kuraichya, P., Nair, P. M., Srivastava, R., Dhaigude, V., Chaudhary, P., Bhakat, M., Mani, V. and Mondal, G. 2025. Effect of dietary micronutrient supplementation on growth and reproductive parameters in bull calves. Journal of Thermal Biology 132: 104225.
11. Mohri, M., Sharifi, K. and Eidi, S. 2007. Hematology and serum biochemistry of Holstein dairy calves: age related changes and comparison with blood composition in adults. Research in Veterinary Science 83: 30-39.
12. Roland, L., Drillich, M. and Iwersen, M. 2014. Hematology as a diagnostic tool in bovine medicine. Journal of Veterinary Diagnostic Investigation 26: 592-598.
13. Serrano-Albal, M., Romero-Aguirregomezcorta, J., Cánovas, S., Heras, S., Gadea, J., Coy, P. and Romar, R. 2025. Long-term study of physical, haematological, and biochemical parameters in cattle with different embryo origins. Animals 15: 1763.
14. Stockham, S. L. and Scott, M. A. 2008. Fundamentals of Veterinary Clinical Pathology. 2nd edn. Blackwell Publishing, Ames.
15. Tiwari, M., Sodhi, M., Vivek, P., Jast, A., Niranjan, S. K., Kataria, R. S., Bharti, V. K., Dabbas, P. S., Amarjeet, Gujar, G., Verma, P. and Mukesh, M. 2026. Comparative evaluation of physio-hematological, antioxidant and hypoxia associated gene expression responses in cattle breeds adapted to hot semi-arid environment and cold arid Trans-Himalayan region of Leh-Ladakh. International Journal of Biometeorology 70(4). https://doi.org/10.1007/s00484-026-03164-x
16. Weiss, D. J. and Wardrop, K. J. (Eds.) 2010. Schalm's Veterinary Hematology. 6th edn. Wiley-Blackwell, Ames.