Haryana Veterinarian (Dec., 2025) **64(2),** 43-47 ISSN 0033-4359 (P) **Research Article**

METABOLIC AND HAEMATOLOGICAL DYNAMICS DURING THE TRANSITION PERIOD IN PARTURIENT SAHIWAL COWS

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Received: 27.01.2025; Accepted: 03.04.2025

ABSTRACT

Bos indicus (zebu) cattle are known for their resilience and adaptability, yet limited data exist on their haematological and biochemical profiles during the transition period. This study investigated metabolic and haematological changes in eight healthy Sahiwal cows during late pregnancy to early postpartum (Group-1), with blood samples collected at five intervals: 14 and 7 days prepartum, the day of calving, and 7 and 14 days postpartum. Eight healthy mid-lactation Sahiwal cows served as standard controls (Group-2) to provide baseline values. A non-significant decline in total erythrocyte count (TEC) and a significant increase in total leukocyte count (TLC) and absolute granulocyte count were observed on the day of parturition. Compared to standard controls (Group-2), transition cows showed significantly lower TEC and absolute lymphocyte percentages across several time points and higher TLC and granulocyte counts on the day of calving. Biochemical analysis revealed significant postpartum elevations in serum glucose, urea, ALKP, and AST activities, alongside significant decreases in serum calcium and phosphorus levels. These findings indicate pronounced haematological and metabolic shifts during the transition period in Sahiwal cows, with potential implications for health and productivity management. Therefore, targeted nutritional and management strategies are essential to support a smooth transition and maintain health and productivity of Sahiwal cows.

Keywords: Biochemical, Haematological, Metabolic, Sahiwal cow, Transition period

How to cite: Singh, V.K., Singh, S.K., Srivastava, A., Srivastava, M., Yadav, B. and Singh, D.N. (2025). Metabolic and haematological dynamics during the transition period in parturient Sahiwal cows. *Haryana Veterinarian.* **64(2)**: 43-47.

The transition from late gestation to early lactation (transition period) is a critical phase in dairy cow management, marked by increased susceptibility to metabolic and infectious diseases (García-Roche *et al.*, 2021). This period is characterized by a substantial drop in dry matter intake (DMI) before calving, coupled with a dramatic rise in energy demands to support milk production (Grummer, 1995; López *et al.*, 2021). Consequently, the cow enters a state of negative energy balance (NEB), triggering extensive mobilization of body fat and protein reserves to meet physiological needs (Roche *et al.*, 2013; Singh *et al.*, 2021; Yadav *et al.*, 2021). Prolonged NEB impairs immune and endocrine functions, increasing the risk of disorders such as mastitis, metritis, ketosis, and hepatic lipidosis (Drackley *et al.*, 2001; Ingvartsen and Moyes, 2015; Yadav *et al.*, 2017). These challenges have been exacerbated by modern breeding strategies favoring high milk yield, which has intensified the incidence of metabolic stress (Oltenacu and Broom, 2010; Brito *et al.*, 2021). In this context, health monitoring using haematological and biochemical profiles has become essential for understanding physiological changes during the transition period (Aswal *et al.*, 2021).

India, home to 30.52% of the global cattle population, holds a significant proportion of indigenous breeds (20th Livestock Census, 2019), among which Bos indicus (zebu) cattle are valued for their resilience to disease, heat stress and environmental extremes (Cooke *et al.*, 2020). Sahiwal cattle, a prominent zebu breed from the arid Punjab region, are especially noted for their high milk production and adaptability. Physiological differences in reproductive and metabolic processes between *B. indicus* and *B. taurus* further emphasize the need for breed-specific research (Cooke *et al.*, 2020).

Despite their importance, the haemato-biochemical changes in zebu cows during the transition period remain poorly documented (Yadav *et al.*, 2021). Understanding these changes in high-yielding Sahiwal cows could inform effective health and management strategies. Therefore, this study aims to assess the metabolic and haematological responses in parturient Sahiwal cows during the transition period, providing insights for improving productivity and disease resistance in indigenous dairy systems.

MATERIALS AND METHODS

The study was conducted on multiparous Sahiwal cows at the University's Instructional Livestock Farm Complex. Eight healthy Sahiwal cows in the last trimester of pregnancy (Group-1) were selected, and blood samples

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were collected at five time points: 14 and 7 days before calving, on the day of parturition (day 0) and 7 and 14 days postpartum. Due to the difficulty in accurately predicting the exact calving date, prepartum samples were categorized based on the estimated days before parturition (±3 days). On each sampling day, 5 mL of blood was collected from the jugular vein of each cow for haematological and serum biochemical analysis. Serum samples were stored at -20° C until further examination. For baseline comparisons, blood samples were also collected from eight healthy, non-pregnant Sahiwal cows in mid-lactation (>90 days), designated as the control group (Group-2).

All blood samples were subjected to comprehensive haematological analysis using a fully automated haematology analyzer (BS-2800 Vet, Mindray Electronic Co. Ltd.). The analysis included total erythrocyte count (TEC), total leukocyte count (TLC), differential leukocyte count (DLC), haematocrit (HCT), haemoglobin concentration (Hb) and platelet count. Serum metabolic profiling was performed using an automated biochemistry analyzer (BS-120, Shenzhen Mindray Biochemical Electronics Co. Ltd.) in conjunction with Span Diagnostics Ltd. kits. The metabolic panel included measurements of glucose, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALKP), total protein, albumin, creatinine, urea, calcium and phosphorus. Data are presented as mean ± SEM. Repeated measures One-Way ANOVA with mixed linear models (SPSS 16) assessed within-group differences over time. Student's t-test compared baseline controls to parturient sample days, with significance set at $p < 0.05$.

RESULTS AND DISCUSSION

In transition Sahiwal cows (Group-1), a non-significant decline in total erythrocyte count (TEC) was observed on days 0, +7 and +14 compared to day -14 (Table 1). However, TEC was significantly lower in transition cows than in standard control cows (Group-2) on days -7 (P≤0.042), 0 (P≤0.05), +7 (P≤0.005) and +14 (P≤0.035) (Table 1), indicating a sustained reduction in erythropoiesis or increased erythrocyte turnover during the transition period. These results align with previous reports of decreased erythrocyte counts in dairy buffaloes one week postpartum (Kumar *et al.*, 2018), possibly due to hemodilution and the metabolic demands of late pregnancy and early lactation. However, contrasting observations of increased erythrocyte counts on the day of calving in other breeds (Aswal *et al.*, 2021) suggest that breed-specific physiological responses may influence haematologic profiles during this critical phase.

Total leukocyte count (TLC) increased significantly on the day of parturition (day 0) compared to day -14 (P≤0.0001) and was also higher than in control cows (Group-2) on the same day (P≤0.008) (Table 1). This leukocytosis likely reflects a physiological response to parturition-induced stress and inflammation. No significant differences in TLC were observed at other time points. Such a transient rise in TLC at calving is a common feature in transition cows, attributable to the release of stress hormones such as cortisol that mobilize leukocytes into circulation. Absolute granulocyte counts in transition cows also peaked significantly on day 0 (P ≤ 0.003) and were notably higher than in standard control cows (P ≤ 0.001) (Group-2). Granulocyte percentages remained significantly elevated throughout the transition period-on days -7 (P ≤ 0.024), 0 (P ≤ 0.001), +7 (P ≤ 0.046) and +14 (P ≤ 0.046) - suggesting a prolonged systemic inflammatory state. Granulocytosis around parturition is often linked to the immune system's acute response to calving stress, tissue injury and increased pathogen exposure. Additionally, elevated cortisol levels near calving can upregulate granulocyte production and mobilization, as reported by Preisler *et al.* (2000) and Mikuła *et al.* (2021), while simultaneously down regulating glucocorticoid receptors on immune cells, modulating their activity.

In contrast, absolute lymphocyte counts remained stable within the transition cows (Group-1) over time but were significantly lower than in standard control cows (Group-2) on days -14 (P ≤ 0.021), -7 (P ≤ 0.042) and +14 (P ≤ 0.04). Similarly, lymphocyte percentages were reduced in transition cows on days -14 (P ≤ 0.022), -7 (P ≤ 0.028), 0 (P ≤ 0.001) and +14 (P ≤ 0.048). This consistent lymphopenia likely reflects immunosuppression associated with parturition-related stress and hormonal changes. Cortisol, in particular, has been shown to induce apoptosis or sequestration of lymphocytes, weakening the adaptive immune response during the transition period. Furthermore, monocyte percentages were significantly lower in transition cows compared to controls on day 0 (P ≤ 0.035), potentially indicating a redistribution of monocytes from blood to inflamed tissues during calving. Such redistribution may reflect a physiological attempt to enhance innate immune surveillance in reproductive and mammary tissues immediately after parturition. Overall, these haematological findings illustrate the dynamic immune modulation occurring in transition Sahiwal cows. The decline in erythrocyte indices, leukocytosis with granulocytosis, and concurrent lymphopenia are hallmark responses to the physiological and metabolic stressors of

Table 1. Comparison of haematological parameters (Mean ± SE) between parturient Sahiwal cows (Group-1) during the transition period and standard control cows (Group-2).

Groups	Days	TECx ($10^6/\mu l$)	TLC x ($10^3/\mu l$)	Hb (gm/dl)	HCT (%)	Lymphocyte (%)	Monocyte (%)	Granulocyte (%)	Lymphocytex ($10^3/\mu l$)	Monocytex ($10^3/\mu l$)	Granulocytex ($10^3/\mu l$)
Transition Sahiwal cows (Group-1)	-14	6.47± 0.40	11.77± 0.50	9.82± 0.50	30.44± 2.11	30.42E± 2.20	8.87± 0.28	46.12± 1.31	4.64A± 0.14	1.04± 0.01	7.10± 0.23
	-7	6.43[B]± 0.33	13.68± 0.43	9.55± 0.42	30.91± 1.28	28.70[F]± 2.56	8.37± 0.26	62.92[I]± 1.64	3.92[B]± 0.12	1.17± 0.055	8.58± 0.41
	0	6.03[K]± 0.34	20.08[a]± 0.31	7.81± 0.38	32.32± 1.16	25.78[D]± 0.81	6.12[H]± 0.23	68.08[D]± 0.95	5.04± 0.21	1.21± 0.02	13.87[b,D]± 0.15
	+7	6.02[L]± 0.15	14.14± 0.38	8.32± 0.24	32.14± 0.72	34.60± 1.40	8.22± 0.25	56.57[J]± 1.43	4.27± 0.32	1.17± 0.01	8.57± 0.30
	+14	6.28[H]± 0.16	11.60± 0.43	8.64± 0.32	31.15± 0.97	33.01[G]± 1.27	9.50± 0.28	57.48[J]± 1.40	3.80[C]± 0.17	1.11± 0.02	6.77± 0.21
Standard controls (Group-2)	-	7.19± 0.10	13.27± 0.54	8.87± 0.32	31.00± 0.92	46.55± 1.29	9.18± 0.21	44.25± 1.40	6.15± 0.16	1.17± 0.06	5.94± 0.15

[a]Significantly (P<0.0001) differ, when compared with day -14 values of the same group. [b]Significantly (P=0.003) differ, when compared with day -14 values of the same group. [A]Significantly (P=0.021) differ, when compared with Standard controls. [B]Significantly (P=0.042) differ, when compared with Standard controls. [C]Significantly (P=0.04) differ, when compared with Standard controls. [D]Significantly (P<0.001) differ, when compared with Standard controls. [E]Significantly (P=0.022) differ, when compared with Standard controls. [F]Significantly (P=0.028) differ, when compared with Standard controls. [G]Significantly (P=0.048) differ, when compared with Standard controls. [H]Significantly (P=0.035) differ, when compared with Standard controls. [I]Significantly (P=0.024) differ, when compared with Standard controls. [J]Significantly (P=0.046) differ, when compared with Standard controls. [K]Significantly (P<0.05) differ, when compared with Standard controls. [L]Significantly (P=0.005) differ, when compared with Standard controls.

Table 2. Comparison of biochemical parameters (Mean±SE) between parturient Sahiwal cows (Group-1) during the transition period and standard control cows (Group-2).

Groups	Day	Glucose mg/dL	Creatinine mg/dL	AST u/L	ALT u/L	ALKP u/L	Protien g/dL	Albumin g/dL	Calciumm g/dL	Phosphorus mg/dL	Ueam g/dL
Transition Sahiwal cows (Group-1)	-14	49.00 ±2.21	1.25± 0.086	68.62 ±3.44	20.72 ±1.44	73.28 ±6.66	6.48 ±0.10	2.97 ±0.05	7.58 ±0.03	7.52 ±0.60	13.74 ±1.25
	-7	57.14[A] ±2.04	1.11± 0.02	69.75 ±3.64	22.22 ±1.22	90.57 ±7.45	5.94± 0.14	2.94± 0.02	7.17± 0.54	7.98± 0.42	17.67± 1.58
	0	93.42[a,B] ±6.77	1.01± 0.02	71.84 ±6.25	19.97 ±1.32	104.85[f] ±9.25	6.08± 0.24	2.83± 0.02	6.471[c,A] ±0.16	7.22± 0.40	21.76[e] ±1.26
	+7	85.85[b,B] ±8.00	0.91± 0.02	86.38[g,E] ±4.32	20.98 ±1.56	76.57 ±6.95	6.34± 0.16	2.88± 0.0	6.65[d,C] ±0.19	8.11± 0.34	24.70 ±1.22
	+14	49.28 ±2.56	1.05± 0.26	84.314[g,E] ±2.00	22.98 ±1.88	90.28 ±5.46	6.47± 0.14	2.85± 0.01	7.02[D] ±0.14	8.45± 0.33	22.20 ±2.14
Standard controls (Group-2)	-	40.28 ±2.22	0.92± 0.24	69.85 ±2.45	29.60 ±1.99	102.14 ±6.75	6.58± 0.19	3.06± 0.07	7.72± 0.16	5.92± 0.42	28.95 ±2.11

[a]Significantly (P<0.0001) differ, when compared with day -14 values of the same group. [b]Significantly (P=0.003) differ, when compared with day -14 values of the same group. [c]Significantly (P=0.002) differ, when compared with day -14 values of the same group. [d]Significantly (P=0.028) differ, when compared with day -14 values of the same group. [e]Significantly (P=0.035) differ, when compared with day -14 values of the same group. [f]Significantly (P=0.024) differ, when compared with day -14 values of the same group. [g]Significantly (P<0.05) differ, when compared with day -14 values of the same group. [A]Significantly (P<0.001) differ, when compared with Standard controls. [B]Significantly (P<0.0001) differ, when compared with Standard controls. [C]Significantly (P=0.009) differ, when compared with Standard controls. [D]Significantly (P=0.016) differ, when compared with Standard controls. [E]Significantly (P<0.05) differ, when compared with Standard controls.

calving. These adaptations are essential for supporting fetal delivery, lactogenesis and protection against infections, though they may also predispose animals to immunosuppression if prolonged or unbalanced.

During the transition period, significant metabolic changes were observed in Sahiwal cows (Group-1), both over time and in comparison, with control cows (Group-2) (Table 2). Transition cows exhibited a significant increase in serum glucose levels on day 0 ($P \leq 0.0001$) and day +7 ($P \leq 0.003$) postpartum compared to prepartum baseline (day -14). However, glucose levels subsequently declined by day +14, showing no significant difference from baseline. Notably, when compared to controls (Group-2), transition cows (Group-1) had consistently higher serum glucose levels on days -7 ($P \leq 0.001$), 0 ($P \leq 0.0001$) and +7 ($P \leq 0.0001$). These transient elevations likely reflect an acute stress response around calving, followed by glucose depletion due to increased demands for lactogenesis and maintenance of energy homeostasis. Although earlier reports suggested persistently low glucose levels in postpartum cows, particularly in high-producing animals (Wilkens *et al.*, 2020), the initial increase observed here may be a breed-specific metabolic response or reflect variation in prepartum energy balance.

A significant decline in serum calcium levels was observed on day 0 (P ≤ 0.002) and day +7 (P ≤ 0.028) postpartum in transition cows, with a non-significant recovery by day +14. These findings are consistent with the onset of colostrum and milk synthesis, which demands a sudden increase in extracellular calcium. This demand is often not met due to decreased intestinal calcium absorption, attributed to a reduction in 1, 25-dihydroxy vitamin D receptor expression (Goff, 2000). Compared to controls (Group-2), transition cows exhibited significantly lower serum calcium on days 0 (P ≤ 0.001), +7 (P ≤ 0.009) and +14 (P ≤ 0.016), suggesting prolonged subclinical hypocalcaemia during early lactation. This condition may impair insulin secretion, consequently reducing glucose uptake by peripheral tissues and exacerbating energy deficits (Wilkens *et al.*, 2020). The early postpartum rise in glucose levels, although atypical, may represent a compensatory response to insulin resistance, which has been reported to persist from late gestation into early lactation (De Koster and Opsomer, 2013). Glucose-induced insulin secretion depends on pancreatic β-cell calcium signaling, which may be disrupted by hypocalcaemia (Dokovi *et al.*, 2009).

Serum phosphorus levels declined on day 0 postpartum but remained statistically unchanged through day +14, gradually returning toward baseline. Although this mirrored the calcium trend, the less pronounced fluctuation in phosphorus suggests a more stable phosphate homeostasis or compensatory mobilization mechanisms from bone or intracellular stores. Serum AST activity increased significantly on days +7 and +14 (P ≤ 0.05) postpartum in transition cows (Group-1) compared to both their prepartum values and to controls (Group-2), indicating potential liver stress or muscle tissue breakdown. Elevated AST levels are commonly associated with hepatic lipidosis or muscle proteolysis, both of which may occur under negative energy balance or postpartum dehydration (Nozad *et al.*, 2012). While total protein, albumin and alanine aminotransferase (ALT) remained unchanged, these stable values suggest that overall hepatic synthetic function was preserved despite enzymatic alterations. Additionally, urea levels were significantly elevated on day 0 (P ≤ 0.035), suggesting increased protein catabolism or dietary protein imbalance during early lactation. This aligns with the practice of using serum urea as an indicator of protein-energy balance in dairy cows. ALKP activity was also significantly increased on day 0 (P ≤ 0.024), potentially reflecting uterine enzymatic activity postpartum (Peter *et al.*, 1987). However, bone-specific ALKP isoforms were not assessed, which limits interpretation of the enzyme's precise tissue origin.

CONCLUSION

The physiological shifts collectively illustrate the metabolic challenges faced by Sahiwal cows during the periparturient transition period. Sahiwal cows undergo pronounced haemato-metabolic adaptations during the transition period to accommodate the physiological demands of parturition and lactation. The observed trends-hypocalcaemia, transient hyperglycaemia, elevated liver enzymes and altered nitrogen metabolism-underscore the importance of proactive nutritional and managerial interventions. Monitoring metabolic profiles during this critical period is essential to prevent clinical and subclinical disorders and to support optimal productivity and animal welfare.

Ethical Approval

The study was conducted adhering to the ethical guidelines established by Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan (DUVASU) in Mathura, India.

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