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Effect of bedding materials on haemato-biochemical parameters of Rathi calves

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Abstract

This study investigates the impact of various bedding materials on the haematological and physiological parameters of Rathi calves across four distinct seasonal macroclimates: Monsoon, Post-monsoon, Winter, and Summer. Twenty healthy female Rathi calves, aged 5 to 6 months and with an average body weight of 67 ± 2 kg, were randomly assigned to four treatment groups, each consisting of five calves. The calves were provided with different bedding materials (concrete, sand, wooden sawdust, and rubber mat) and fed a uniform diet with ad libitum access to green and dry fodder. Hemoglobin (Hb) levels, lymphocyte counts, monocyte counts, neutrophil counts, eosinophil counts, and basophil counts were measured across the different bedding types throughout the study period. The results showed no significant differences in any of the haematological parameters between bedding materials across all seasons. Hb levels, lymphocyte, monocyte, neutrophil, eosinophil, and basophil counts remained stable, suggesting that bedding material had minimal or no effect on the blood parameters of the calves. This study contributes to the understanding of the role of bedding materials in livestock health and suggests that while bedding may affect comfort and behavior, its impact on blood parameters is limited.

Keywords: Rathi calves, bedding materials, haematology

Introduction

India, a predominantly agricultural country, has a significant livestock sector, with cattle farming being a key component DAHD (2023) ^[1]. India's total cattle population stood at 193.46 million, with Rathi cattle being one of the prominent indigenous breeds in Rajasthan. Known for their resilience and dual-purpose utility, Rathi cattle are adapted to Rajasthan's semi-arid conditions, where they provide both milk and draught power (Sharma *et al.*, 2005; Dhaka *et al.*, 2015) ^[8, 2]. Proper care and management of young calves, especially during the first few months of life, are essential for ensuring their growth and development, with bedding quality playing a pivotal role in calf welfare.

Bedding materials in calf pens impact the comfort, health, and overall well-being of dairy calves, directly influencing their growth and resistance to diseases. A variety of bedding materials such as wheat straw, sawdust, sand, and wood shavings are commonly used on farms, and the choice of bedding can affect several health parameters, including haematological markers. Haematological parameters, including blood cell counts and biochemical markers, serve as vital indicators of calf health, immune function, and overall development.

Studies have shown that bedding quality significantly influences the time calves spend lying down, a behavior essential for growth (Tucker *et al.*, 2009) ^[3]. Calves are known to spend approximately 18 hours a day lying down, and any disruption in this resting pattern due to poor bedding can impair growth and increase the risk of health issues (Wilson *et al.*, 1999) ^[4]. Inadequate bedding may also lead to joint injuries, body discomfort, and increased susceptibility to infections, which can adversely affect blood parameters such as red blood cell count, hemoglobin levels, and immune system markers (Elmore *et al.*, 2015) ^[5].

The quality and depth of bedding also play an important role in regulating thermal comfort, which is critical in the early stages of a calf's life. Bedding that provides adequate insulation can help prevent cold stress and improve overall health, reducing the likelihood of diseases

such as pneumonia and gastrointestinal disorders (Lorenz *et al.*, 2011) [6]. As these diseases can significantly impact haematological parameters, proper bedding helps in maintaining optimal blood health by supporting immune function and reducing the stress that could otherwise lead to abnormal haematological readings.

In this study, we aim to assess the effect of different bedding materials on the haematological parameters of Rathi calves, both pre- and post-weaning. The research focuses on how various bedding types—such as straw, sawdust, and sand—affect the calves' blood health, immune response, and growth performance. The findings will provide valuable insights into the relationship between bedding quality and calf health, contributing to improved management practices for Rathi cattle and other dairy breeds. Furthermore, this study highlights the significance of environmental factors in calf welfare and their direct impact on health parameters crucial for the productivity of dairy farming in Rajasthan.

Materials and Methods

The study was conducted at the Livestock Research Station, Bikaner, Rajasthan, from July 2023 to May 2024. A total of 20 healthy female Rathi calves, aged 5-6 months with an average body weight of 67 ± 2 kg, were selected for the study. After a 15-day acclimatization period, the calves were randomly divided into four treatment groups, each consisting of five animals. The treatments were as follows:

1. T₁: Concrete floor (control)
2. T₂: Concrete floor with sand bedding
3. T₃: Concrete floor with wooden sawdust bedding
4. T₄: Concrete floor with rubber mattress bedding

Each group was housed in a loose house with a cement-paved floor, with the respective bedding material provided. The sand and sawdust bedding were replaced regularly (daily and weekly), while the rubber mattress bedding was maintained without frequent changes. All calves were fed according to ICAR guidelines, receiving milk twice daily (1/10th body weight) and ad libitum access to green fodder and roughage. Clean drinking water was provided at all times. Health management practices included routine deworming and daily monitoring for signs of illness, with sick calves receiving appropriate treatment.

Haematological analysis

Blood samples were collected periodically to assess haematological parameters, including hemoglobin (Hb), lymphocytes, monocytes, neutrophils, eosinophils, and basophils. Hb was determined using a Sahil Hemoglobinometer, and other parameters were measured using a fully automated blood analyzer.

Statistical analysis

Data were analyzed using one-way ANOVA to evaluate the effect of bedding materials on the blood parameters across different seasons. Results were considered statistically significant at $p < 0.05$.

Results

The effects of various bedding materials on the haematological parameters of Rathi calves were evaluated over a ten-month period, encompassing four distinct seasonal conditions: Monsoon, Post-monsoon, Winter, and Summer. The study measured hemoglobin (Hb) levels, lymphocyte, monocyte, neutrophil, eosinophil, and basophil counts across different bedding materials, including concrete, sand, wooden sawdust, and rubber mat.

Hemoglobin (Hb) Levels

Hemoglobin levels remained stable throughout the study, with no significant differences observed among the bedding types in any season (Table-1). During the Monsoon season, average Hb levels were $11.71 \pm 0.14\%$ for concrete, $11.66 \pm 0.15\%$ for sand, $12.86 \pm 0.23\%$ for wooden sawdust, and $12.16 \pm 0.20\%$ for rubber mat. The post-monsoon, winter, and summer seasons exhibited comparable trends, with slight variations across bedding materials, but no significant statistical differences. In summer, the average Hb levels for concrete and rubber mat were $12.04 \pm 0.42\%$ and $12.60 \pm 0.59\%$, respectively.

Lymphocyte Counts

Lymphocyte counts did not exhibit significant differences between bedding materials across all seasons (Table-1). In the Monsoon season, lymphocyte counts averaged 9.46 ± 1.96 (T₁), 7.76 ± 0.80 (T₂), 8.88 ± 2.25 (T₃), and 8.82 ± 1.67 (T₄), with no significant variations. Similar results were observed in the Post-monsoon, Winter, and Summer seasons, with values ranging from 8.44 ± 1.95 (T₁) to 9.45 ± 1.89 (T₃) in winter and from 9.18 ± 2.54 (T₁) to 9.18 ± 1.02 (T₄) in summer.

Monocyte Counts

Monocyte counts also remained stable across all bedding types and seasons (Table-1). During the Monsoon season, average values for monocytes were 0.73 ± 0.20 (T₁), 0.58 ± 0.17 (T₂), 0.83 ± 0.17 (T₃), and 0.88 ± 0.16 (T₄). The Post-monsoon, Winter, and Summer seasons exhibited similar patterns, with no significant differences in monocyte counts across bedding types.

Neutrophil Counts

Neutrophil counts showed no significant variation between bedding materials in any season (Table-1). The average neutrophil counts during the Monsoon were 4.86 ± 1.21 (T₁) and 3.94 ± 0.35 (T₄). In the Post-monsoon and Winter seasons, neutrophil counts remained comparable, ranging from 4.67 ± 1.52 (T₁) to 4.12 ± 0.30 (T₄) in Summer.

Eosinophil and Basophil Counts

No significant differences were observed in eosinophil counts across bedding materials in any season (Table-1). The Monsoon and Post-monsoon seasons showed minimal variation in eosinophil counts, with values ranging from 0.16 ± 0.08 (T₁) to 0.15 ± 0.03 (T₄). Similarly, basophil counts remained consistent across all bedding types, with averages of 0.03 ± 0.01 (T₁) during the Monsoon season and 0.04 ± 0.00 (T₁) in Summer.

Table 1: Effect of Bedding Materials on Hematological Parameters of Rathi Calf

Seasons		Concrete Floor (T ₁)	Sand Floor (T ₂)	Wooden Saw Dust Floor (T ₃)	Rubber Mat Floor (T ₄)
		Mean±SE	Mean±SE	Mean±SE	Mean±SE
Hb (%)	Monsoon	11.71±0.14	11.66±0.15	12.86±0.23	13.16±0.20
	Post-monsoon	11.80±0.05	11.66±0.15	12.85±0.23	13.15±0.20
	Winter	11.82±0.05	11.71±0.20	13.11±0.19	13.17±0.26
	Summer	12.04±0.42	13.19±0.95	13.19±0.36	13.60±0.59
Lymphocyte (1000 X g/l)	Monsoon	10.46±1.96	7.76±0.80	8.88±2.25	6.82±1.67
	Post-monsoon	10.44±1.95	7.75±0.81	8.87±2.25	6.81±1.67
	Winter	11.34±1.84	8.36±0.71	12.45±1.89	9.44±1.43
	Summer	9.18±2.54	6.30±0.79	6.31±0.82	5.18±1.02
Monocytes (1000 X g/l)	Monsoon	0.73±0.20	0.58±0.17	0.83±0.17	0.88±0.16
	Post-monsoon	0.73±0.20	0.58±0.17	0.83±0.17	0.88±0.16
	Winter	0.59±0.16	0.35±0.06	0.84±0.10	0.83±0.13
	Summer	0.93±0.25	0.87±0.19	1.04±0.13	1.03±0.13
Neutrophil (1000 X g/l)	Monsoon	4.86±1.21	4.46±0.65	4.60±0.79	3.94±0.35
	Post-monsoon	4.86±1.21	4.46±0.65	4.60±0.79	3.94±0.35
	Winter	5.45±1.08	4.96±0.78	5.72±0.30	3.94±0.32
	Summer	4.67±1.52	3.67±0.31	4.00±0.34	4.12±0.30
Eosinophil (1000 X g/l)	Monsoon	0.19±0.08	0.10±0.04	0.11±0.05	0.11±0.03
	Post-monsoon	0.19±0.08	0.10±0.04	0.11±0.05	0.11±0.03
	Winter	0.27±0.05	0.15±0.03	0.19±0.04	0.16±0.03
	Summer	0.16±0.11	0.09±0.04	0.08±0.04	0.09±0.04
Basophil (1000 X g/l)	Monsoon	0.03±0.01	0.04±0.01	0.04±0.01	0.04±0.01
	Post-monsoon	0.03±0.01	0.04±0.01	0.04±0.01	0.04±0.01
	Winter	0.03±0.00	0.04±0.01	0.06±0.01	0.04±0.01
	Summer	0.02±0.00	0.03±0.01	0.03±0.00	0.03±0.01

Discussion

This study aimed to investigate the impact of various bedding materials on the haematological and physiological parameters of Rathi calves across four distinct seasonal macroclimates: Monsoon, Post-monsoon, Winter, and Summer. The results demonstrate that there were no significant differences in hemoglobin (Hb) levels, lymphocyte, monocyte, neutrophil, eosinophil, and basophil counts across bedding types in any of the seasons. Despite variations in bedding materials, the blood parameters remained stable, suggesting that bedding materials had minimal or no effect on the haematological profile of Rathi calves under the conditions studied.

The lack of significant differences in Hb levels across bedding types supports the notion that bedding material has a limited effect on blood parameters. Although rubber mats generally yielded higher Hb values compared to concrete and sand, the differences were not statistically significant. This finding is consistent with previous research, such as that of who also reported no significant differences in hematological parameters among calves housed on different bedding types. These results suggest that while bedding materials may affect calf comfort and behavior, their direct influence on blood parameters is negligible.

Lymphocyte counts, which reflect immune function, did not show significant differences across bedding materials in any season. This indicates that bedding type did not alter the immune status of the calves. This finding is in line with Chaiyabut *et al.* (2010) [9], who noted that housing systems and microclimatic conditions, such as temperature and humidity, are likely more influential in shaping immune function than bedding material alone. While there were some variations in lymphocyte counts, the absence of significant differences suggests that environmental stressors and management practices may have a more significant role in immune function than bedding material.

Monocyte and neutrophil counts, which are key components of the inflammatory response, also showed no significant differences across bedding types and seasons. This suggests that bedding materials did not have a substantial impact on the calves' inflammatory responses. These findings align with previous studies by Marai *et al.* (1999) [7], which suggested that environmental stressors, such as heat stress or inadequate shelter, have a more profound effect on inflammatory parameters than bedding choices. The consistency of basophil and eosinophil counts further supports the conclusion that bedding materials had minimal or no influence on immune responses in the calves.

Environmental conditions, particularly temperature and humidity, likely played a more significant role in influencing the calves' physiological responses than bedding materials. For instance, the heat stress associated with higher temperatures during the summer season may have induced physiological changes, such as hemodilution, which could explain the observed blood parameters. This finding underscores the critical role that seasonal environmental factors play in shaping the calves' health and physiological status. Furthermore, other management factors, such as feeding practices and space allocation, may have contributed to the overall health and physiological responses of the calves, potentially mitigating any effect of bedding materials on blood parameters.

In conclusion, the results of this study suggest that bedding materials do not significantly affect the haematological parameters of Rathi calves across different seasons. The stable blood parameters across the various bedding types indicate that environmental factors, such as temperature, humidity, and management practices, play a more significant role in influencing the calves' health and physiological status than the bedding material itself. While bedding materials may contribute to calf comfort and behavior, their direct effect on blood parameters is limited.

Future research should explore a broader range of environmental conditions, including heat stress, air quality, and management practices, to fully understand their effects on the haematological and immune status of young animals.

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