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Comparative Evaluation of Blood Hematological & Biochemical Dynamics in Indigenous (Achi Kunari) Breed Cow's at Various Stages of Lactation & Related calves

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ABSTRACT

Lactation is a vital phase in the production cycle of cows, significantly affecting both milk yield and animal health. Post-calving, different stages of lactation, milk quality and hematobiochemical parameters, and electrolytes, change due to hematobiochemical and physiological alterations in the body. During different stages of pregnancy and lactation, harmful Hematologic and Metabolic disorders like anemia, hypoalbuminemia, ketonemia, reduced milk yield, and hormonal imbalances may arise in cows. Hematologic and Metabolic disorders increase the demand of oxygen carrying, production stress and reduce milk quality, harming cow health. Studying these parameters can aid in early disease diagnosis and guide appropriate treatment, Proper nutritional management during calving to helps prevent these disorders. The experiment was assessed the impacts of Early, Middle and Late lactation stages of Hematobiochemical parameters of the cow and related calves at different stages of lactation. A cross sectional observational comparative study including indigenous Achi breed Cows and related Calves. Total samples were 48 in which 24 lactated cow and 24 related calves. Around 3 ml blood's samples were collected from jugular vein in Heparinized tubes. Lactation stages were further divided into Early, Middle and Late each stages had 8 cows + 8 related calves, respectively. Clinically healthy adult cows and immature calves, not treated with systemic corticosteroid or other drugs affecting metabolism within 15 days. Whereas, cow with mastitis, fever, visible disease, metabolic disorders or under medication that affects Hematobiochemical parameters have been excluded. During the sampling the consent of the owner was obtained. Data were shown as mean ± standard error. Statistical difference among groups were assessed using one – way analysis of variance followed by Tukey, LSD test. $p<0.05$ was considered statistically significant. Based on the results, at different stages of lactation of cow and their calves there was lower values of hematological parameters in early stages of lactation compare to middle and late lactation($p<0.0$). In terms of biochemical parameters of the cow and their calves there was the lowest values of the glucose, cholesterol and total protein only in early lactation stage compare to middle and late lactations stages($p<0.05$). there was no difference between middle and late lactation stages($p>0.0$). In concluded that cow's and related calves in early lactation stage there was the lowest blood hematobiochemical parameters compare to middle and late lactation stages of the cows and their calves. There wase no significantly difference of the hematobiochemical parameters between middle and late lactation stages.

Keywords: Biochemical, Calves, Cow, Lactation Stages, Hematological, Parameters.

INTRODUCTION

The calving process is a vital phase in the production cycle, significantly affecting both milk yield and animal health. Post-calving, milk quality and blood biochemical parameters, such as protein, fat, glucose, and electrolytes, change due to biochemical and physiological alterations in the body (Oetzel, 2005). During this period, harmful metabolic disorders like ketonemia, reduced milk yield, and hormonal imbalances may arise (Leblanc, 2010). Milk quality indicators such as protein and fat content and milk taste are important market-driven traits (Rojas et al., 2020). Blood biochemical parameters provide essential information for assessing cow health. Glucose levels indicate metabolism and energy production, while electrolyte balance is crucial for fluid status

and heart function. (Bicalho & McArt, 2016). Metabolic disorders increase production stress and reduce milk quality, harming cow health (Oetzel, 2005; Ghanem et al., 2016). Studying these parameters can aid in early disease diagnosis and guide appropriate treatment. Proper nutritional management during calving helps prevent these disorders (Ingvartsen & Moyes, 2015). Balanced nutrition of protein, carbohydrates, and minerals is key to preventing metabolic disorders (Dechow & Eicker, 2017). Thus, good feeding practices positively influence cow health. Improving milk quality through nutritional management directly benefits farmers' income (LeBlanc, 2010; Ramin & Gholizadeh, 2019). Maintaining proper feeding and care during calving is essential for cow health and milk quality, impacting farmers' revenue and market demand (Mcart et al., 2012). The characteristics of indigenous breeds include high resistance to harsh climatic conditions, lower feed requirements, greater resistance to diseases, lower production rates but longer working ability (Ramin & Gholizadeh, 2019). Crossbred breeds are those that result from crossbreeding between indigenous and exotic breeds Crossbred cattle are known for higher production of milk and meat but require better nutrition and care compared to indigenous breeds (Vet Med, 2020). Some of these crossbreeds show lower resistance to diseases but are widely used for economic benefits. The most common crossbred breeds include Holstein, Brown Swiss, and Jersey. The economic importance of indigenous breeds lies in their adaptability and long-term sustainability, while crossbred breeds are economically valuable due to their higher milk and meat production despite requiring more intensive management (Nwachukwu et al., 2023). The neonatal period is a critical phase for physiological development. During this period, newborn calves experience metabolic instability and increased susceptibility to diseases, especially immune-related conditions, leading to high mortality rates (Arfuso et al., 2017). Calves are often hypo calcemic at birth and must initiate gluconeogenesis and internal glucose production since lactose from milk may not fulfill their total glucose requirements (Jenkins et al., 1988). In Afghanistan, cattle are among the most important animals used for dairy, meat production, and agricultural purposes. The cattle breeds are generally divided into indigenous and crossbred types. Indigenous breeds are those that have existed in the region for a long time and have well adapted to local environmental conditions. Crossbred cattle are known for higher production of milk and meat but require better nutrition and care compared to indigenous breeds. Some of these crossbreeds show lower resistance to diseases but are widely used for economic benefits. The most common crossbred breeds include Holstein, Brown Swiss, and Jersey. In the eastern zone of Afghanistan there is one of the most papular indigenous breeds of the cow by the name of Achi Kunari. therefore, the objective of the study to assess serum Hematobiochemical parameters of Indigenous Achi Kunari cow at various stages of lactation and related calves as well for the assessment of the health status of dairy cows and their calves in one of the Afghans rural areas, focusing on blood hematobiochemical parameters such as red blood cells, hemoglobin, white blood cells, hematocrit, glucose, cholesterols, and protein. The findings provided farmers and veterinarians with scientific data to improve nutrition and health management, thereby enhancing productivity and reducing economic losses.

MATERIALS AND METHODS

Study Area

The present study was conducted in Kuz Kunar District, located in the northern part of Nangarhar province, eastern Afghanistan. Geographically, the district is located between approximately 34.57o Northern latitude and 70.58 Eastern longitude. This district experiences normally hot and humid tropical climate with temperature ranging from 3 °C in winter to +35 °C in summer.

Ethical approval

All experimental procedures involving animals were conducted in accordance with the institutional Care guidelines of Nangarhar University, Jalalabad, Afghanistan. Animals were cared for using owner-based husbandry guidelines and standard operating procedures of animals' and approved by the ethics committee of Nangarhar University, Afghanistan.

Study Design

A cross sectional observational comparative study Cow + Calf with 3 lactation stages. Total samples were 48 in which 24 lactated cow and 24 their calves'. Blood samples were collected from jugular vein around 3 ml in Heparin tubes. The lactation stages were further divided into Early lactation (8 cow + 8 calves), middle lactation (8 cow + 8 calves) and Late lactation (8 cow + 8 calves). Clinically healthy adult cows, not treated with

systemic corticosteroid or other drugs affecting metabolism within 15 days. Whereas, cow with mastitis, fever, visible disease, metabolic disorders or under medication that affects Hematobiochemical parameters have been excluded. During the sampling the consent of the owner was obtained.

Determination of Hematobiochemical parameters

1.Hematological parameters

Hematocrit (HCT) %, Hemoglobin (HB) concentration, red blood cells (RBC) count and White blood cells (WBC) counts were detected using an automated hematological analyzer (Mindray BC- 3000 Plus) following the standard procedures explain by Jain (1993).

2.Biochemical parameters

Whole blood was centrifugated around 5000 RPM / Minute then serum was separated. Serum Glucose, cholesterol and total protein concentration were measured using commercial diagnostic kits (Marek diagnostics) and analyzed spectrophotometrically (Microlab300) according to the manufacturer's protocol.

Statistical Analysis

All the data were analyzed with one-way analysis of variance (ANOVA), by followed (Tukey, LSD), and homogeneity of variance test to validate the data. Using statistical Package for the Social Sciences (SPSS) software (IBM SPSS Statistics 23 License Authorization Wizard) (SPSS, 23 version). Probability values less than 0.05 were considered significant while using following model.

$Y_{ij=} \mu + t_i + \Sigma ij$

Where; Y_{ij}= observation of dependent variable documented on i^{th} treatment

μ = Population means; t_i= Effect of i^{th} treatment i.e. Σ_{ij} = Residual outcome of j^{th} observation in i^{th} treatment NID ~ 0, σ^2.

RESULTS

Hematological Findings

Based on the results there were significant alterations discovered in terms of HB, HCT, RBC and WBC of the cow in Table-1. The values of hematological parameters among the various stages of lactation($p<0.05$). cow in early lactation showed lower HB and HCT values compared to middle and late lactation. RBC and WBC number tended to increase toward late lactation, possibly reflecting improved metabolic adaptation and immune recovery. In terms of calf, there was no significant alteration about HB, HCT and RBC among the all stages of lactation($p>0.05$). While, the WBC values were significantly altered among the all stage of lactation ($p<0.05$). WBCs values were higher in early lactation period rather than mid & late stages.

Biochemical Findings

Based on the results serum biochemical parameters were significantly different which were showed in Figure-1 and Figure- 2. There was variation in terms of serum glucose which was significantly lower level in early lactation cows because of high glucose utilization for lactose synthesis in milk. The values of cholesterol increased in mid and late lactation it may be enhanced lipid metabolism of body fat reserves. In terms of total protein content were lowest during early lactation. Whereas, there was no significantly difference between middle and late lactation period. In terms of calf, there was no significantly difference about glucose and cholesterol in all respected stages of lactation. Nevertheless, significant alteration about Total protein among the respected stages of lactation($p<0.05$). total protein values were significantly higher only in early lactation stage compare to middle and late lactation stages($p<0.05$). the values of glucose and cholesterol were not significantly altered between the early and middle stages of lactation($p>0.05$).

Table-1: Show the Hematological parameters of the lactated cow at different stages.

Animal	Parameters	Early Lactation	Mid Lactation	Late Lactation
Cow	HB (gr/dl)	9 ± 0.31^b	11 ± 0.30^a	12.0 ± 0.22^a
	HCT (%)	29.0 ± 1.0^b	32.5 ± 0.87^a	35.20 ± 1.01^a
	RBC (10^6/µl)	5.2 ± 0.20^b	6.5 ± 0.20^b	7.00 ± 0.15^a
	WBC (10^3/µl)	5.9 ± 0.40^b	7.5 ± 0.40^b	8.2 ± 0.5^a

[a, b] Different values in the same row are significantly different ($P<0.05$). Where, Hb: hemoglobin; HCT: hematocrit; RBC: Red Blood Cells; and WBC: White Blood Cells.

Table-2: Show the Hematological parameters of the related calves at different stages of lactation.

Animal	Parameters	Early Lactation	Mid Lactation	Late Lactation
Calf	HB (gr/dl)	9.5 ± 0.20^{b}	10.5 ± 0.25^{a}	11.5 ± 0.25^{a}
	HCT (%)	30.5 ± 0.9^{b}	32.0 ± 0.80^{a}	35.5 ± 0.1^{a}
	RBC (10^{6}/µl)	7.0 ± 0.3^{a}	7.5 ± 0.20^{a}	8.10 ± 0.10^{a}
	WBC (10^{3}/µl)	12.0 ± 0.5^{a}	11.0 ± 0.4^{b}	10.0 ± 0.50^{b}

[a, b] Different values in the same row are significantly different ($P<0.05$). Where, Hb: hemoglobin; HCT: hematocrit; RBC: Red Blood Cells; & WBC: White Blood Cells.

Figure – 1: Show Biochemical figures of the Early, Middle & Late stages of Lactated cows.

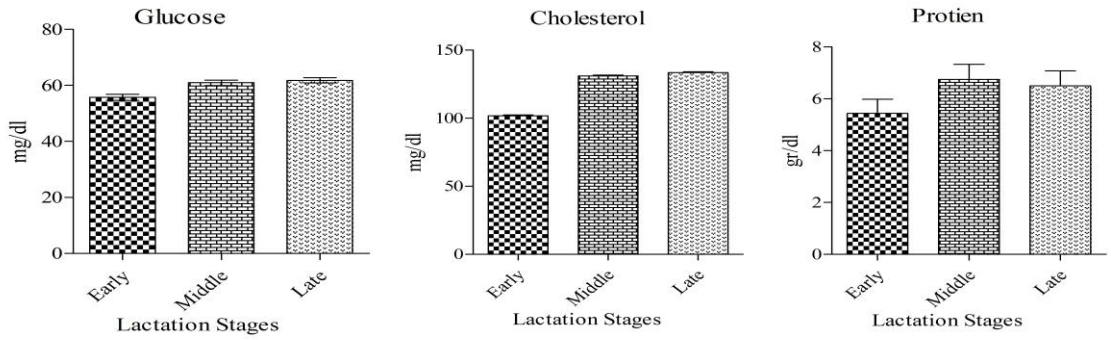

Figure -1: Indicates the figures of glucose, cholesterol & protein at Early, Middle & Late stages of lactated cows. Bar graph & Error bar indicates the mean of parameter and Standard deviation of the mean, respectively. On the bases of the results early, middle & late stages of lactation had significantly impact on glucose, cholesterol & protein of the lactated cows ($P < 0.05$).

Figure – 2: Show Biochemical figures of the Early, Middle & late stages of related calves.

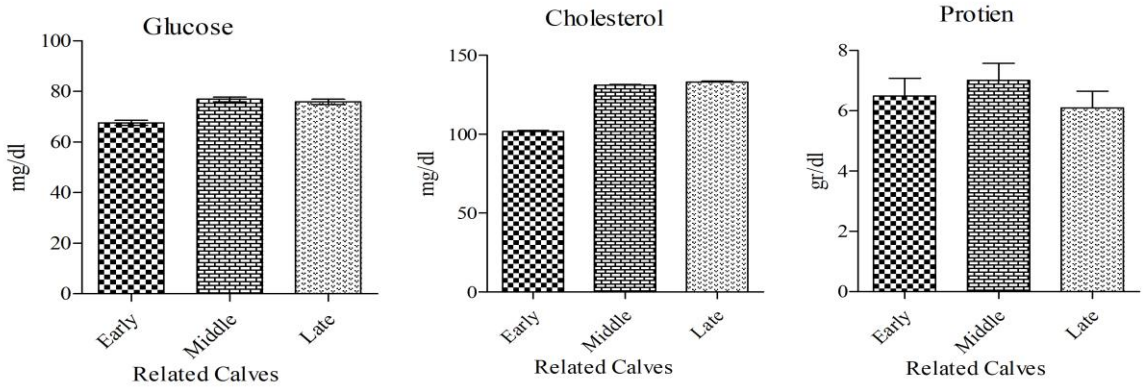

Figure -2: Indicates the figures of glucose, cholesterol & protein at Early, Middle & Late stages of related calves. Bar graph & Error bar indicates the mean of parameter and Standard deviation of the mean, respectively. On the bases of the results early, middle & late stages of lactation had significantly impact on glucose, cholesterol & protein of the lactated cows ($P < 0.05$).

DISCUSSION

Significant differences ($p<0.05$) were observed in HB, HCT, RBC and WBC values among different stages of lactation. Cow in early lactation revealed lower Hb and HCT values compared to mid and late lactation and there was no significant difference between RBC and WBC numbers in all stages of lactations. The present study accepts the work of (Sharma et al.,2020). Similar trends were reported by Hussein et al. (2021), who found that early lactating cows show mild anemia due to negative energy balance and fluid shifts, RBC & WBC counts tented to increase toward late

lactation, possibly reflecting improved metabolic adaptation and immune status. Khan et al. (2012) was revealed Serum biochemical dynamics (glucose, cholesterol and total protein) levels were meaningfully lower in early lactation cows than middle and late lactation. Cholesterol concentration was higher in middle and late lactation, possibly due to increased fat metabolism and mobilization of the body fat reserves (Piccione et al.,2019). El-Sherif and Assad, (2018) examined the lowest level of total protein during early lactation but increased progressively, indicating restoration of protein synthesis and metabolic stability. The present study revealed similar results, there were the lowest serum glucoses, cholesterol and total protein in early lactation compare to middle and late lactation stages($p<0.05$). Knowles et al. (2000) examined the blood composition of growing claves across various ages and breeds. They observed significant age related hematobiochemical variation($p<0.05$). Similarly, our results showed a significant variation in total protein at early stage of lactation than middle and late stages of lactation. However, serum glucose and cholesterol were not differed significantly among the all stages of lactation($p>0.0$). Our finding was similar to Du Xui et al. (2020), who found that in all lactation stages there was significantly difference among all stages of lactation($p<0.0$).

CONCLUSION

Hematological and biochemical parameters in blood such as RBC, WBC, Hb and HCT are significant molecules found in whole blood that reflect blood circulatory, physiological and metabolic functions. These vital parameters assist in evaluating the animal health, physiology, nutritional status and disease status of various body systems of the animal body. This study showed a statistically significant difference in blood hematobiochemical parameters. In cow there was lower values of hematological parameters in early stages of lactation compare to middle and late lactation there was no variation between middle and late stages of lactation. In calves, there was the lowest values of Hb and HCT in early lactation. However, there was no difference Hb, HCT, RBC and WBC between middle and late lactation compare to early lactation. In terms of biochemical parameters of the cow and their calves there was the lowest values of the glucose, cholesterol and total protein only in early lactation stage compare to middle and late lactations stages there was no difference between middle and late lactation stages. The current study provides beneficial information for veterinary therapeutic clinics by clarifying normal Hematobiochemical variation during various stages of lactation. Theses finding assist veterinarians distinguish physiological variation from disease status, especially during early lactation and support accurate diagnosis, effective treatment and improved herd health management.

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Author Contributions

Sargand and Stanikzai conceived and planned the experiments. Sargand and Dermal carried out the experiments. Sargand, and Bawari planned and carried out the simulations. Sargand contributed to manuscript preparation. Sargand, Stanikzai, Bayer and Bawari contributed to the interpretation of the results. Sargand took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript. All authors contributed to the study conception, design, material preparation, data collection, analysis and drafting of the manuscript.

Data Availability Statement

The data supporting this study findings are available from the corresponding author upon reasonable request.

Conflict of Interest

No potential conflict of interest was found by the authors.

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