



## Evaluation of Hematological and Biochemical Parameters in Feedlot Libyan Local Lambs

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### ABSTRACT

This study was conducted to assess the impact of feed lot conditions on local breed lambs in Eastern Libya to identify any potential variation in hematological and biochemical parameters between the beginning and the end of the feedlot period. Blood parameters ranges may vary significantly depending on feeding, handling and transportation conditions. 20 clinically healthy native sheep from Al Jabal Al Akhdar Libya age between 6 and 7 months were included in this study, the animals were evaluated prior to their entry into the fattening phase. Body condition scoring was used as more convenient and accurate method compared to visual assessment alone. Clinical examination revealed no significant changes in body temperature, heart rate, respiration rate, mucous membrane appearance or body condition score. The mean values of red blood cell (RBC), hemoglobin concentrations, packed cell volume (PCV) and platelets (Plt) showed a noticeable increase by the end of the feedlot period. Additionally, significant increases were observed in several biochemical parameters including blood urea nitrogen (BUN) creatinine (CREA), total protein (TP), sodium, potassium, chloride, magnesium (Mg), cortisol and alanine aminotransferase level. Conversely, a significant decrease was observed the main counts of monocyte, basophil, eosinophil and albumin levels at the end of the feedlot period compared to the beginning. In general, although statistically significant differences were detected in the mean hematological and biochemical parameters between the beginning and the end of feedlot period, these changes were not clinically remarkable.

### 1. INTRODUCTION

Ovine is a crucial livestock in terms of a production in Libya which make significant contribution to the country's GDP food supply, wool production, rural job opportunities. Sheep are valuable in Libyan agrarian economy due to their versatile such as meat, skin, dung, and occasionally milk, all those materials can be used both traditional and consumable products(A. Saleh, Kawafi, Zafir, & Mahmoud, 2025). It is acknowledged that variation in the environmental factors including temperature, humidity and radiation might pose potential risks to the developments and productivity of all domestic livestock species(Gomaa, Abdulhadi, Mohamad, & Saleh, 2025). High ambient temperature and high air humidity both could lead to further discomfort and increase stress levels to this particular group of animals.

The aforementioned combination causes abnormalities in an animal both physiological and metabolic parameters and lead the biological process to decline. Environmental factors were widely documented to lower animal output in tropical subtropical and arid regions (S. M. Bufarwa et al., 2025). According to Daddy et al 2016 who suggested that the objective of sheep farmers is to achieve a higher weight gain in their herd at a younger age. Land owners commonly apply feedlot management as a technique to attain a steady supply of high-quality lamb to satisfy market requirements of net weight, fat marbling and body score (Alsadi et al., 2023). When pasture supply is restricted and grass sources are scarce, farmers ability to sustain productivity is embedded. Therefore, farmers are heavily dependent on concentrates to achieve their ultimate goal in a shorter period. Although feedlotting allow farmers to rear lambs regardless the season, such process comes with disadvantages due to environmental and nutritional challenges (Abdalnaser, Bellhamad, et al., 2025). Therefore, the importance of measuring hematological and biochemical parameters is crucial in order to provide valuable data regarding lamb status, health condition, and stress risk (Abduljalil et al., 2024). Such measurements might usually benefit the feed lot process and decrease risk factors and expenses to the lamb's farmer. In order to determine potential difference among blood parameters at the start (receiving phase) and the end (finishing phase) of feedlot period, as well as to correlate any variation that might be detected between the two phases. This study was to measure and compare blood parameters in fattening local lab during feedlot period in eastern Libya.

## 2. METHOD

This study was conducted on total 20 clinically healthy lambs collected from different localities in Al Jabal Al Akhdar, Libya. The animals aged between six and seven months and were maintained under a special diet consisting solely of barley. All animals were subjected to complete physical examination and were routinely pretreated against ecto and endoparasite prior to the study, blood samples were collected at two time points: at the beginning of feedlot cycle, and at the end of the feedlot cycle (after 2 months). The body score ranged from 3 to 4 according to the method described by (Soutiyah et al., 2023). A complete and thorough clinical examination of the lambs was performed following the method described by (Mustapha et al., 2025). The examination included measurement of temperature, pulse rate, respiration rate, conjunctival mucous membrane evaluation, examination of superficial lymph node and auscultation of lung and heart sounds. body condition scoring was also assessed according to the method described by. Blood samples were collected from the jugular vein of all examined animals in the early morning according to Two blood samples were obtained from each animal as follows:

3 ml in EDTA tubes for hematological analysis.

5 ml without anticoagulant for serum separation.

Serum was obtained by centrifuging of blood samples at 3000 RPM for 5 minutes, clear non-hemolyzed serum was carefully aspirated using an automatic pipette, transferred into clean, dry, labeled Eppendorf tubes and stored at  $-20^{\circ}\text{C}$  until analysis. Only clear non hemolyzed serum was used for a quantitative determination of calcium, phosphorus, magnesium, liver enzymes, urea, creatinine, glucose and cortisol levels. Biochemical analysis was carried out using spectrophotometric method with special diagnostic kits according to the method described by (M. Saleh, Reem, Attitalla, & Saleh, 2023). Statistical analysis was performed using the independent T-test for equal variance to compare the means of the two groups. Data were analyzed using IBM SPSS software. mean  $\pm$  standard deviation (SD). Differences were considered statistically significant at  $p < 0.05$ , according to (R. Hamad & Saleh, 2019).

## 3. ETHIC APPROVAL

This study was conducted on field cases, and the samples were collected and examined routinely. This study did not include experimental procedures, and verbal consents were obtained from the owners of the cases referred to the veterinary clinics, as well as during field visits. These are observations of clinical cases, and the approval of the ethics committee was not required for such a study.

## 4. RESULT AND DISCUSSION

Clinical examination of the demonstrated a good general health status throughout the experimental period. No signs of infectious disease, injuries, dehydration, or systematic disturbance were observed. Rectal temperature, rate pulse and respiratory rate remained within physiological reference ranges (**Table 1**),

Table 1 Mean value of temperature, pulse rate and respiratory rate before and after the feedlot period.

Relationships	Pre-feedlot	Post-feedlot
Temperature C	38.31±0.26	38.63±0.17
Pulse rate p/m	82.75±1.58	81.25±1.11
Respiratory r/m	18.1±1.11	19.55±1.23

Mean ±SD., N = 20

Confirming That the animals were clinically stable during both the receiving and finishing phases of the feedlot cycle. The absence of clinical abnormalities suggests that the observed hematological and biochemical alteration were adaptive physiological responses rather than pathological changes. On the other hand, alteration in hematological and biochemical parameters are commonly attributed to stress, nutritional imbalance and pathological damage, which may lead to direct and indirect economic losses such as reduced body weight gain and poor feed conversion efficiency (Saeed et al., 2025). No significant differences were detected in total white blood cell count (WBC), neutrophils or lymphocytes between control and feedlot lambs (Table 2), and this aligns with (Mahmoud, Mohamad, Saleh, Bufarwa, & EL-Seifat, 2024) who emphasized that leukocytes primarily function in immune-defense through phagocytosis and antibody-mediated responses. The absence of leukocytosis or neutrophilia in the study suggests that no active infection or systematic inflammatory response occurred during the fattening period. However, a statistically significant decrease ( $p < 0.05$ ) was recorded in monocyte, eosinophil and basophil in the feedlot group compared with the control group (Table 2).

Table 2 Mean values of total differential white blood cells counts before (control group) and after (feedlot group) the feedlot period.

Relationships	Control group	Feedlot group	Normal range
WBC ( $10^3/\mu\text{l}$ )	6.73±0.13	6.7±0.06	4-12
Neu %	53.19±0.35	54.44±0.31	10-62
LY%	34.16±0.70	35.9±0.42	33-84
Mon%	2.32±0.09	1.88±0.03	0-1
E %	7.65±0.15	6.00±0.13	0 -20
B %	2.25±0.19	1.73±0.86	0 -2

Interestingly, higher eosinophil, monocyte, and basophil counts were observed at the beginning of the feedlot cycle, this may be attributed to parasitic exposure prior to confinement and routine anti-parasitic treatment. Eosinophil is commonly associated with parasitic infestation as supported by (Mahmoud, Saleh, & Gaballah, 2024). The subsequent reduction in these leukocyte subsets during the finishing phase likely reflects improved parasite control and reduce environmental exposure in the feedlot system. Moreover, erythrocytic indicators including RBC count showed no significant increase in the feedlot lambs (Table 3).

Table 3 Mean values of total differential white blood cells count before (control group) and after (feedlot group) the feedlot period.

Relationships	Control group	Feedlot group	Normal range
RBC ( $10^6/\mu\text{l}$ )	9.81±0.11	10.6±0.54	9 -15
Hb (g/dl)	12.43±0.25	13.9±0.04	9 -15
PCV	26.20±0.40	28.40±0.38	27-45
PLT ( $10^3/\mu\text{l}$ )	447±0.88	468±0.9	300 – 800
RBC ( $10^6/\mu\text{l}$ )	9.81±0.11	10.6±0.54	9 -15
Hb (g/dl)	12.43±0.25	13.9±0.04	9 -15

Mean ±SD., N = 20

A slight elevation may reflect enhanced erythropoietic activity associated with accelerated growth and increased metabolic demand during the finishing phase. Increased hemoglobin concentration improves oxygen transport capacity, supporting intensified tissue growth and nutrient utilization.

These findings are consistent with adaptive hematological response observed in intensively fed lambs under high energy diet according to. who reported that normal RBC values are associated with the absence of hemolytic anemia and adequate erythropoietic activity. Reduced RBC count is generally considered a predisposing factor for anemia related disorders in animals. Therefore, the normal erythrocytic profile observed in this feed lotting experience indicates that the intensive feeding regime did not negatively affect oxygen carrying capacity or bone marrow function. Conversely, a significant increase in PCV was observed during the feeding cycle (**Table 3**). This increase may be attributed to an adequate nutrition formula which improved protein-energy balance(Mahmoud, Gaballa, et al., 2024) ,similarly reported that the higher PCV values in lambs fed concentrates-rich diet is indicative of improved nutritional status. Increased hemoglobin concentration enhances tissue oxygenation, supporting accelerated growth and metabolic activity which is a typical for feedlot systems. Biochemical parameters play critical roles in maintaining physiological homeostasis, and their imbalance may indicate to structural or functional disturbances (Alsadi et al., 2023).In the present study serum aspartate aminotransferase (AST) and alanine aminotransferase levels were significantly increased during feedlot cycle, while alkaline phosphatase (ALP) and Alb were significantly decreased (**Table 4**).

Table 4 Mean values of AST, ALT, ALP, Alb, TP, BUN and CREA before (control group) and after (feedlot group) the feedlot period.

Relationships	Control group	Feedlot group	Normal range
AST(IU/L)	225.6±8.32	233±0.48	60-280
ALT(IU/L)	30.0±0.4	31.8±0.27	22-38
ALP(g/dl)	142.4±1.25	140.2±0.32	70-390
Alb (g/dl)	3.16±0.07	2.69±0.03	2.4-3
T.P (g/dl)	6.75±0.03	7.34±0.03	6-7.9
BUN (mg/dl)	23.5±1.21	27.11±0.15	10-35
CREA (mg/dl)	1.57±0.02	1.81±0.01	1.2-1.9

Mean ±SD., N = 20., Normal range according to(Abdalnaser, Bellhamad, et al., 2025).

AST and ALT levels increased during the feedlot period but remained within normal reference ranges. According to kaneko et al 2008, enzymatic values within physiological limits do not indicate a hepatic injury rather than reflect metabolic activity. Elevated transaminases in intensively fed animals are often linked to increase amino acid metabolism and hepatic adaptation. Only values exceeding reference limits would suggest hepatic and cellular degeneration(A. Saleh, Farhat, et al., 2025). Gamma glutamyle transferase (GGT) concentration may decrease under feed restriction due to its involvement in the glutathione metabolism and cysteine supply for protein synthesis, particularly albumin production, increased GGT levels may signal hepatic dysfunction(A. G. Zafir, Almardi, Alorfi, Saleh, & Hamad, 2023), the current study showed that liver enzyme values did not exceed physiological thresholds, further confirms normal hepatic status. Moreover, TP levels increased during feedlot period. This elevation may reflect enhanced protein synthesis associated with an adequate dietary crude protein intake. some authors attributed that increased TP to protein supplementation while others suggested higher crude protein diets in growing lambs improved protein deposition and synthesis(A. Saleh, Mahmoud, Am Zafir, Abd Alati, & Hasan, 2025) . (Mahmoud & Abdullah, 2024)similarly reported increased TP levels at the end of feedlot periods due to higher protein requirements during rapid growth. The finding of the present study supported the interpretation that dietary protein adequacy contributed to improved metabolic status. Serum urea and creatinine concentration increased significantly during the feedlot period (Table 4). BUN levels increased significantly during the feedlot period. This rise may be explained by higher dietary protein intake and increased ruminal ammonia production. (Taher & Moustafa, 2025)reported that elevated BUN in lambs fed high crude protein diet is associated with increased ammonia absorption across the ruman wall. Urea synthesis in the liver occurs proportionally to ammonia production; therefore, higher dietary protein consumption results in elevated blood urea concentration (Z. A. Zafir, Alsadi, Gomaa, Saleh, & Hamad, 2022).The observed increase in BUN in this study likely reflects intensified nitrogen metabolism rather than renal dysfunction as creatinine levels remained within normal limits. The mean urea concentration  $17.11 \pm 4.15$  mg/dL while creatinine analysis revealed noticeable changes in lambs following the feedlot period compared to the pre-fattening values. A relative increase in serum creatinine concentration was observed in lambs receiving higher protein diet during the finishing phase. This increase may attribute it to enhanced muscle mass accretion and intensified protein metabolism rather than renal dysfunction.

Creatinine is primarily a byproduct of creatine phosphate metabolism in skeletal muscle, therefore, increase muscle growth and protein turnover during rapid finishing lambs can contribute to its elevation. These findings are consistent with (Alakib, Saleh, & Farhat, 2025) who reported that higher dietary protein intake and accelerated growth rate are associated with mild increase in serum creatinine within physiological limits. Mineral profile analysis demonstrated significant alterations in serum mineral concentration following the feedlot period. Higher serum mineral levels observed in concentrate fed lambs may be attributed to improved dietary mineral composition and enhanced bioavailability. These findings are consistent with (Gomaa et al., 2023) who reported that concentrate based diets significantly affect mineral metabolism in growing ruminants.

Magnesium and calcium concentration increased significantly in feedlot lambs compared to controls, whereas phosphorus level decreased (Table 5). Magnesium is the fourth most abundant mineral element in the animal body and closely associated with calcium and phosphorus metabolism within tissues. Both magnesium and calcium act as essential enzymatic cofactors and numerous energy-dependent biochemical reactions and play a critical role in skeletal development and neuromuscular function. Unlike certain electrolytes, magnesium homeostasis is highly dependent on dietary intake, as regulatory mechanism is relatively limited. Therefore, dietary composition represents the primary determinants of serum magnesium levels (Abdalnaser, Othman, Saleh, & Mahmoud, 2025). Similarly, calcium levels are influenced predominantly by dietary supply, particularly during periods of rapid growth when skeletal mineralization is accelerated. The increase observed in feedlot lambs may reflect an adequate mineral supplementation and improved absorption efficiency under concentrate feeding systems. Electrolyte analysis revealed significant increases in sodium, potassium, and chloride concentration at the end of the feedlot period. These results are in agreement (Bogandora & Saleh, 2025), who reported that electrolyte concentration tend to be higher in growing animals and may be influenced by age, dietary protein and metabolic rate. Increased dietary protein and concentrate intake may alter acid-base balance and osmotic regulation which contribute to variation in serum electrolyte levels. Serum cortisol concentration was significantly elevated in feedlot lambs (Table 6). Although statistically significant, cortisol values remained within physiological reference ranges. This elevation may be associated with transportation stress, regrouping, housing adaptation and dietary transition from grazing to concentrate based feeding. (Ashour) suggested that transportation, bulk handling and management changes lead to transient increase in circulating cortisol concentration. Cortisol acts as glucocorticoid stress hormone that regulates energy metabolism and facilitates physiological adaptation under stress conditions. Importantly, the absence of Leukocytosis or clinical abnormalities indicates that cortisol elevation represented physiological adaptation rather than chronic stress pathology. Dietary factors may also contribute to cortisol variation. Even nutritionally balanced diets can induce metabolic shifts during transition phases, particularly when lambs are exposed to dietary monotony or abrupt changes in feed composition (Y. Hamad, Meriz, Zafir, & El-khodery, 2025). Such metabolic adjustments may influence endocrine response as part of adaptive physiological mechanisms.

Table 5 Mean values of magnesium (Mg), calcium (Ca), phosphorus (S. M. Bufarwa et al.), sodium (Gomaa et al.), potassium (A. Saleh, Kawafi, et al.) and chloride before (control group) and after (feedlot group) the feedlot period.

Relationships	Control group	Feedlot group	Normal range
Mg(mg/dl)	2.36±0.03	2.53±0.03	2.2-2.8
Ca(mg/dl)	11.21±0.1	12.37±0.06	11.5-13
P(mg/dl)	6.44±0.32	6.32±0.029	5-7.3
Na(mg/dl)	142 ±0.66	144±0.41	145-152
K(mg/dl)	4.39±0.04	4.61±0.04	3.9-5.4
Cl(mg/dl)	104.7±1.02	111±0.21	95-103
Mg(mg/dl)	2.36±0.03	2.53±0.03	2.2-2.8

Mean ±SD., N = 20., Normal range according (M. Saleh, 2023) .

Table 6 Mean values of cortisol concentration before (control group) and after (feedlot group) the feedlot period.

Relationships	Control group	Feedlot group	Normal range
CREA (mg/dl)	55.8±0.48	75.9±0.44	42-82

Mean ±SD., N = 20., Normal range according to (S. Bufarwa, Abdel-Latif, & Bahnasy, 2023) .

## 6. CONCLUSION

Overall, the observed increases in creatinine, cortisol, minerals, and electrolytes appear to reflect adaptive metabolic responses associated with growth acceleration, Improved dietary nutrition density and transitional stress conditions inherent to feedlot management systems under Libyan conditions. The results support that well-managed feedlot systems under Eastern Libyan conditions promote growth-related metabolic adaptation rather systemic dysfunction.

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