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Original Article *Internal Medicine*

Evaluation of Hematological and Biochemical Changes in Dromedary Camel during the Different Stages of Lactation

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ABSTRACT

Objective: To assess the potential hematobiochemical alterations in healthy dromedary camel during the different stages of lactation.

Design: Randomized controlled study.

Animals: Fifteen healthy female dromedary camels, with mean body weight of 499.6 kg and mean age of 20 years.

Procedures: Camels were categorized into 3 groups' according to their stage of lactation: group 1, early lactation (1-3 months), group 2, mid-lactation (four-6 months) and group3, late lactation (≥ 7 months). Blood samples were collected from every animals for hematological and biochemical evaluation.

Results: Total erythrocyte count (TEC), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), total leukocytes (TLC), lymphocytes, neutrophils, monocytes, Calcium, glucose, aspartate aminotransferase (AST), alanine transaminase (ALT), gamma glutamyl transferase (GGT) and alkaline phosphatase (ALP) confirmed significant ($p < 0.05$) variation between different stages of lactation. However, non-notable ($p > 0.05$) dissimilarity were located in packed cell volume (PCV), mean corpuscular hemoglobin concentration (MCHC), in organic phosphorus (P), magnesium (Mg), cholesterol, total protein (TP), albumen, globulin, blood urea nitrogen (BUN) and creatinine kinase (CK) in the course of different ranges of lactation,

Conclusion and clinical relevance: The results of this investigation may be useful as reference guide for dromedary camel to evaluate the metabolic health status at different stages of lactation.

Keywords: Camel, Hematobiochemical changes, Lactation stages.

1. INTRODUCTION

Blood metabolic profile (BMP) that is considered one of the most commonly reported diagnostic procedures that used to assess the nutritional status and animal health [1].The most common indicators that are used to accomplish the BMP are biochemical and hematological variables [2]. Many genetic, non-genetic factors and physiological status including the age and reproductive stage have been reported to affect the findings of BMP [2-4]. Lactation period is of utmost significance to the dairy animal and the proper caring with the animal during this critical time will minimize the deleterious metabolic consequences which might affect the performance of the dairy animals [5, 6]. The BMP is considered a valuable tool that is used for identification, prediction and control of diseases of the lactating animal by providing an idea for successful interpretation of laboratory information [7-9]. It well be accepted that blood and mammary gland secretory cells are the main source of milk and milk components and utilize 80% of the blood-circulating metabolites for milk synthesis [10].

The data regarding BMP in lactating Egyptian dromedary camel are still lacking. Hence, the present study was delineated to evaluate the influence of different stages of lactation on (BMP) in Egyptian dromedary camel. We hypothesized that the applied BMP could reflect the alterations of physiologic status and provided updated and valuable details about the proper management plans in camel during the lactation periods.

2. MATERIALS AND METHODS

2.1. Animals and management

Fifteen apparently healthy female dromedary camels with a mean body weight of 499.6 kg (range: 387 - 634 kg) and mean ages of 20 years (range: 18 -22 years) were used. The camels were considered clinically sound on the basis of physical examination of heart, lungs, rumen and intestine and other vital signs [11]. The animals were also examined for parasites and deworming of the animals was done regularly. All procedures were performed in accordance with the guidelines of Desert Research Center (Egypt) and approved by its Ethical Committees. Camels were housed in an open yard and fed on a maintenance ration composed of a concentrate mixture including 50% corn, 47% barley, 2% minerals, 1% salt which given at rate of 3 kg/head/day, while Egyptian clover hay (Trifolium alexandrinum) and fresh water were offered ad libitium.

2.2. Study design

Camels were divided into 3 group's instep of their lactation phase: Early lactation (1-3 months), Mid-lactation (4-6 months) and Late Lactation (≥ 7 months).

2.3. Laboratory examination

2.3.1. Blood samples

Two blood samples were collected from each camel via jugular vein puncture into tube with anticoagulant (EDTA or sodium fluoride) and without anticoagulant to yield serum. The tubes containing EDTA were used for hematological examination. On the other side, tubes containing sodium fluoride were used for quantifying concentrations of glucose which were measured spectrophotometrically using a commercial test kit supplied by Spectrum Egypt. The plain tubes were kept at room temperature overnight to be centrifuged at 3000 rpm for 15 minutes. Only clear sera were collected then aliquoted and kept frozen at -20 0C for subsequent biochemical analyses using commercial test kits according to the standard protocols of suppliers.

2.3.2. *Hematological profile*

The haematological indices included total leucocytes (WBC) and differential leukocytes (lymphocytes, neutrophils, monocytes, and eosinophil), red blood cells (RBC), haemoglobin (HGB), hematocrit, mean erythrocyte volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) were carried out using the automatic blood cell counter (Exigoeos veterinary Hematology system, Catalogue number; 1420001, Boule Medical AB, Sweden).

2.3.3. *Biochemical serum analysis*

For the (TP), albumen, calcium, P and Mg commercial test kits supplied by BioMed Egypt were performed. For AST, ALT ALP, GGT, CK and cholesterol, commercial test kits supplied by Spectrum Egypt were used. For BUN, commercial test kits supplied by BioScien Egypt were used.

2.3.4. *Statistical analysis*

Statistical analyses have been finished the usage of a statistical software application (SPSS, ver.20, Inc., Chicago, USA). Descriptive statistics have been performed for all parameters. Repeated measure ANOVA became used to test the effect of various periods of lactation on (BMP). Outcomes have been taken into consideration statistically significant at $p < 0.05$.

3. RESULTS

Data summarizing results of the effect of lactation stage on serial measurements of serum hematological and biochemical profile in dromedary camels are illustrated in tables 1, 2. Clinically, the investigated camels showed no detectable clinical alterations throughout the study period and remain clinically healthy.

Table 1 summarizes the hematological variables in examined camels during different lactation stages. The TEC and lymphocyte count were significantly ($p = 0.001$ and 0.029) lowered in mid lactation while, MCV and MCH levels demonstrated the opposite pattern ($p = 0.052$ and 0.002) at the same time point. TLC and monocyte count were significantly ($p = 0.019$ and 0.035) higher in late lactation while, neutrophil count had the conflicting pattern at the same time compared with other lactation stages. Hb levels were significantly ($p = 0.037$) elevated in early lactation while PCV and MCHC values were not remarkably ($P > 0.05$) differed all over the sampling time.

Table 1. Changes of hematological parameters in female dromedary camels at different stages of lactation (n=15).

Groups Items	Early lactation (n=15)	Mid lactation (n=15)	Late lactation (n=15)	P value
TEC ($\times10^9$ /l)	10.3 ± 0.36	9.3 ± 0.7*	12.9 ± 1	0.001*
Hb (g/dl)	12.9 ± 0.8*	9.1 ± 0.5	8.1 ± 1.2	0.002*
PCV (%)	33.2 ± 3.9	33.7 ± 4.5	37 ± 4.6	0.589
MCV (fl)	33.3 ± 3.9	37.1 ± 4.4*	27.6 ± 2.5	0.04*
MCH (pg/cell)	8.9 ± 1	11.4 ± 0.9*	8.3 ± 0.6	0.002*
MCHC (g/dl)	32.4 ± 3.4	32.1 ± 1.7	28.8 ± 2.8	0.09
TLC ($\times10^9$ /l)	5.4 ± 1.6	9.6 ± 4.7	11.7 ± 3.2*	0.019*
Lym ($\times10^9$ /l)	3.1 ± 1.2	1.5 ± 0.3*	3.4 ± 0.4	0.029*
Neut ($\times10^9$ /l)	8.1 ± 1.9	6.9 ± 2.2	3.2 ± 1.3*	0.037*
Mon ($\times10^9$ /l)	0.27 ± 0.15	0.21 ± 0.01	0.47 ± 0.09*	0.035*

Data are presented as mean ± SD. *Values with an asterisk within the same raw are statistically significant (P<0.05)

TEC= Total erythrocytes count, Hb= Hemoglobin, PCV= Packed cell volume, MCV= Mean corpuscular volume, MCH= Mean corpuscular hemoglobin, MCHC= Mean corpuscular hemoglobin concentration, TLC= Total Leukocytic count, Lym= Lymphocyte, Neut= Neutrophil, Mon= Monocyte.

Table 2. Changes of biochemical parameters in female dromedary camels at different stages of lactation (n=15).

Groups Items	Early lactation (n=15)	Mid lactation (n=15)	Late lactation (n=15)	P value
Ca (mmol/l)	1.5 ± 0.16*	2.1 ± 0.13	2.2 ± 0.03	0.006*
P (mmol/l)	1.19 ± 0.26	1.17 ± 0.15	0.9 ± 0.03	0.217
Mg (mmol/l)	1.2 ± 0.49	1.4 ± 0.54	1.6 ± 0.18	0.413
Gluc (mg/dl)	64.3 ± 3.8*	99.6 ± 8.3	98.6 ± 3.5	0.031*
Chol (mg/dl)	42.6± 5	38.6 ± 6.1	37 ± 2.6	0.452
TP (g/dl)	4.9± 0.6	4.7 ± 0.36	4.4 ± 0.36	0.342
Alb (g/dl)	3.5± 0.46	3.3 ± 0.34	3.1 ± 0.22	0.539
Glob (g/dl)	1.5± 0.15	1.3 ± 0.1	1.1 ± 0.13	0.351
BUN (mg/dl)	4 ± 0.6	4.3 ± 0.57	4.5 ± 0.24	0.591
AST (U/l)	158.6 ± 3.5	109 ± 16.3*	118.3 ± 2.8*	0.005*
ALT (U/l)	91 ± 3.6	64 ± 10.5*	65.3 ± 4.7*	0.021*
GGT (U/l)	23.8 ± 3.6	15.3 ± 3.7*	10 ± 1*	0.005*
ALP (U/l)	83.3 ± 11	65.6 ± 8.5*	48.3 ± 3*	0.033*
CK (U/l)	25 ± 2.6	24.6 ± 2.5	26 ± 2	0.499

Data are presented as mean ± SD. *Values with an asterisk within the same raw are statistically significant (P<0.05)

Ca: Calcium; P: Phosphorus; Mg: Magnesium; Gluc: Glucose; Chol: Cholesterol; TP: Total protein; Alb: Albumen; Glob: Globulin; BUN: Blood urea nitrogen; AST: aspartate aminotransferase; ALT: Alanine transaminase; GGT:Gamma glutamyl tranferase; ALP: Alkaline phosphatase; CK: Creatinine kinase

Biochemically, serum values of calcium and glucose showed statistically significant decrease ($P = 0.006$ and $P = 0.031$, respectively) at early stage of lactation. Serum concentrations of AST, ALT, GGT and ALP were significantly ($p = 0.005$, 0.021, 0.005 and 0.033, respectively) lower in mid and late lactation than early lactation. Other biochemical parameters including P, Mg, cholesterol, TP, albumen,

globulin, BUN and CK were not significantly (P >0.05) varied all-round the study period (Table 2).

4. DISCUSSION

The findings of the present study clearly demonstrate significant decrease of TEC at mid-stage of lactation. These findings were in accordance with the previous studies [12, 13]. Lower TEC in mid lactation might also suggest a negative correlation among better milk production and RBCs attention in lactating animals [2].Unlike to our findings, some authors have found a trend of higher values of TEC [14-17]. This variation may be due to differences in breed, physical and environmental conditions. The finding of lymphopenia was in consistent with that shown in previous reports [12, 18] in camels; but [19] observed a higher lymphocytic count during early lactation.

Hb significantly increased at early lactation stage which could be attributed to higher demand for oxygen during and after parturition [12-14, 16, 20]. In contrary, other reports recorded a significant decrease [15, 17, 21].

There were significant high values of MCV and MCH at mid-lactation. This finding was in part similar to some reports [12, 13] and disagreed with other results [14, 16, 20]. There was a non-significant (P >0.05) variation of PCV% and MCHC values throughout the study period. In contrast, some reports observed significant changes [12, 16]. However, the difference within the values of (TLC) and monocyte count can be assigned to the variations in species, nutrients, husbandry, environment and strategies of assay [22]. The finding of neutropenia at late lactation was nearly similar to previous results [12, 18].

Hypocalcaemia was evident in the examined camels particularly at the early lactation period. Similar finding was observed in some reports [20, 23]. In the later study, the authors allocated such finding to excessive secretion of blood calcium through colostrum and milk and its rearrangement in bone [24]. Unlike to our findings, [21] noted that the highest and lowest levels of calcium observed in mid and late lactation, respectively in Holstein dairy cows.

Hypoglycemia was proof in the present work at early stage of lactation which could be attributed to the utilization of large amount of blood glucose by mammary gland for the synthesis of lactose likewise; the lactose production is associated with higher glucose uptake by lactating mammary gland [25]. These results were in consistent with some records [4, 20, 21]. In contrary to the above results, [26] concluded that, the serum glucose values were the same all over the lactation period, whereas, [27] showed higher glucose level at parturition then declined during lactation period in beef cattle. On the other hand, P and Mg showed non-significant changes; however, other reports recorded significant changes [28-30].

Serum concentrations of cholesterol were not significantly differed all-round the sampling time. Our results were in harmony with that given by [17], but in opposite to that recorded in crossbred Istrian x East Friesian dairy ewes [31] who showed a significant increase of cholesterol levels at late lactation period. The authors attributed such finding to low milk production and decreased requirements for substances needed for the milk fat synthesis. On the contrary, TP, albumen, globulin and BUN showed a non-significant variations at all sampling time, suggesting non-deleterious effect on the camels' health.

In our study, The AST, ALT, GGT and ALP concentrations were decreased significantly at mid and late lactation. Nearly similar finding was given by several authors elsewhere [16, 32, 33].

The increased level of AST, ALT, GGT and ALP during early lactation can be because of massive physiological and biochemical modifications of liver to overcome the side results of negative strength balance. Later on, the ongoing drop of AST, ALT and GGT concentration with the progress of lactation may due to the destruction of the cellular structure of body, which might also suggest hepatic lipidosis, damage of hepatocytes and release of intracellular enzymes into circulation [2]. However, the greater ALP level during the beginning of lactation can also assign to accelerate the production of ALP by placenta to reinforce the oesteoblastic activity of the fetus. Away from our finding, Cozzi et al. [34] and Ronald et al. [20] found non-outstanding variation in serum AST and ALT concentration all through the lactation period in Holstein dairy cows and Mehshani buffaloes, respectively while, Cozzi et al. [34] noted decreased concentration of GGT in Holstein dairy cows. In the opposite, CK showed a non-significant variations at all sampling time. CK is usually concentrated in muscles, myocardium and brain. In consequence non-significant changes in CK levels may point out good farm management by absence of any stress have the ability to induce muscle damage. These findings were in agreement with that given in camels [16, 33], but not agreeable with that reported previously [22].

Conclusion

The data herein demonstrated a profound haematobiochemical alteration during the different stages of lactation in dromedary camels. Such alterations could reflect a physiological variation and could be used as a reference guide for she-camels during the different lactation periods.

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Conflict of Interest statement

The authors declare that they have no conflict of interest.

Ethical approval

All procedures were performed in accordance with the guidelines of Desert Research Center (Egypt) and approved by its Ethical Committees.

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