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LACTATION RELATED CHANGES OF HAEMATOLOGICAL PARAMETERS OF FEMALE DROMEDARY CAMELS REARED UNDER SEMI-INTENSIVE FARMING SYSTEM IN ALGERIAN EXTREME ARID REGION

Maria Chikha[1], Tarek Khenenou[1], Djalel Eddine Gherissi[2], Rabah Mayouf[3], Djallal Eddine Rahmoun[2], Naif Al-Gabri[4,5], Nacira Ramdani[6], Anas Ayyad Abu-Sulik[7], Hafiza Aidoudi[1] and Sabry Mohamed El-Bahr[8,9]

[1]Laboratory of Science and Techniques for Living, Institute of Agricultural Sciences and Veterinary Sciences, Mohamed-Cherif Messaadia University - Souk Ahras, BP 41000 Souk-Ahras, Algeria
[2]Laboratory of Animal Production, Biotechnologies and Health, Institute of Agricultural Sciences and Veterinary Sciences, Mohamed-Cherif Messaadia University - Souk Ahras, BP 41000 Souk-Ahras, Algeria
[3]Faculty of Biology, Echahid Hamma Lakhdar University, The new group BP 789, 39000 El Oued, Algeria
[4]Department of Pathology, Faculty of Veterinary Medicine, Thamar University, Yemen
[5]Laboratory of Salam Veterinary group, Al-Qassim, 51911 Buraydah, Saudi Arabia
[6]National Institute of Veterinary Medicine, 16000 Algiers, Algeria
[7]Faculty of Medicine, Jordan University of Science and Technology, P.O.Box 3030, 22110 Irbid, Jordan
[8]Department of Biomedical Sciences, College of Veterinary Medicine, King Faisal University, 31982 Al-Ahsa, Saudi Arabia
[9]Department of Biochemistry, Faculty of Veterinary Medicine, Alexandria University, 21526 Alexandria, Egypt

ABSTRACT

Thirteen female camels were used in this study to investigate the changes in some haematological parameters during the different stages of lactation including early lactation, mid-lactation and the last stage of lactation. A significant decrease (P<0.001) in mid and late lactation, compared to early lactation was recorded for the following parameters: number of white blood cells, number of lymphocytes, number of monocytes, number of granulocytes, per cent ratio of lymphocytes and mean corpuscular volume. While, the levels of per cent ratio of monocytes, per cent ratio of granulocytes, red blood cells and haematocrit were low in early lactation then showed a significant raise in mid and late lactation (P<0.001). Moreover, The levels of mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were high during early lactation, then significantly decreased (P<0.001) in mid-lactation and then increased in late lactation. No significant difference was observed in mean corpuscular volume and haemoglobin concentration between early and mid-lactation. There was no significant difference in the number of platelets (p> 0.05). The current study gives baseline data about the value change of the main haematological parameters during lactation in female camels in the Algerian desert and these results could be used as a database for the diagnosis of different disorders and also for upcoming research in camels.

Key words: Camel, blood analysis, haematology, lactation, physiology

Blood metabolites are utilised 80% by the secretory cells of the mammary gland for milk synthesis during lactation (Piccione *et al,* 2009). About 500 litre of blood circulate to produce one litre of milk (Braun and Forster, 2012). In dairy animal, pregnancy and lactation are considered as the two most critical stages which affect the haematological and the biochemical profile of the blood (Krajnicakova *et al,* 1993; Iriadam, 2007; Das *et al,* 2016).

In dromedary camel, few authors, have studied the haematological profiles during lactation stages and others studied it during postpartum period (Hussein *et al,* 1992; El-Zahar *et al,* 2017; El-Sayed, 2020). However, the change of haematological parameters during lactation in female camels reared under extreme arid condition of the Algeria Sahara is least studied. This study was therefore, planned to evaluate the physiological changes of some haematological parameters during different stages of lactation in camels of Algeria Sahara in extreme conditions.

SEND REPRINT REQUEST TO MARIA CHIKHA email: m.chikha@univ-soukahras.dz

Materials and Methods

Studied animals

In the current study, thirteen multiparous female dromedary camels aged 8-12 years were used. Animals were housed in a semi-intensive breeding system in El Oued region, located in the southeast of Algeria. These were apparently healthy and kept in the same nutritional and environmental conditions. The camels were housed in an open stall in the desert, far away from any residential buildings and roads. These were milked in early morning and later, these were sent for grazing in a natural desert pasture. They returned back in the middle of day and were separated from their calves. They were supplied by Alfalfa (*Medicago sativa L.*) and a mix of barley (*Hordeum vulgare*), white bran, wheat flour and olive pomace pellets in the morning. All camels had normal parturition.

Blood collection and analysis

During this study, blood samples for 13 female camels were collected in morning at each stages of lactation, i.e. first months of lactation (15 days post-calving), mid-lactation at the fifth months of lactation (150 days post-calving) and the last stage of lactation (300 days post-calving). Afterwards, samples were kept in cold packs and transported to the laboratory for haematological analyses. Haematology auto analyser MINDRAY (BC-3000Plus, China) was used for determination of white blood cells (WBC), lymphocyte (LYM), number of monocyte (MON), number of granulocyte (GRAN), per cent ratio of lymphocyte (LYM %), per cent ratio of monocyte (MON%), per cent ratio of granulocyte (GRAN%), number of red blood cells (RBC), haemoglobin concentration (HGB), haematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), number of platelets (PLT) and mean platelet volume (MPV).

Statistical analysis

The data of haematological parameters were analysed by IBM SPSS Statistics, version 25.0, Armonk, NY, USA. The results were presented as mean values ± standard Deviation (SD).To compare multiple measures during the different stages of lactation, repeated measures ANOVA were used. To verify data distribution, the Kolmogorov–Smirnov test was used. Bonferroni multiple comparison test was used as a Post Hoc Tests. The level of significance was set at $p<0.05$.

Results and Discussion

The results of white blood cell and red blood cell and platelet parameters are summarised in table 1 and table 2, respectively. As shown in table 1, there was a significant difference in WBC during the different stages of lactation, where a high level was observed in the first stage of lactation. Similar results had been obtained in camels (Hussein *et al,* 1992) and in jennies (Bonelli *et al,* 2016) except for the value of WBC which was higher in our study in the first stage of lactation ($54.08\pm25.28\times10^9$/L) when compared with that obtained by Hussein *et al* (1992) ($6.6\pm1.0\text{x}10^9$/L) and Bonelli *et al* (2016) (10.9±0.8 K/mL). This difference might be attributed to the difference of breeding and/or feeding system. However, no significant difference in WBC were reported during the different stages of lactation in Baladi goats (Azab and Hussein, 1999), cows (Coroian *et al,* 2017) and Mehshani buffaloes (Das *et al,* 2016). There was a significant difference in the number of lymphocyte in animals of present study, similar results were reported by Hussein *et al* (1992) and El-Sayed (2020) in camels during lactation. However, no significant difference had been detected during post-partum period in camels (El-Zahar *et al,* 2017) and Baladi goats (Azab and Hussein, 1999).

There was a significant change in the percentage of lymphocytes during lactation, however, these changes were not observed earlier in camels (El-Zahar *et al,* 2017) and in Baladi goats (Azab *et al,* 1999) during postpartum period and in Mehshani buffaloes (Das *et al,* 2016) during the different stages of lactation. In the current study, a high number of monocytes was observed in the first stage of lactation. Parallel to the current findings, Hussein *et al* (1992) and El-Sayed (2020) reported a significant difference in the number of monocyte during lactation in camels. The current study indicated a significant change in the percentage of monocyte during lactation, however, previous studies did not find significant difference during postpartum period in camels (El-Zahar *et al,* 2017), Baladi goats (Azab and Hussein, 1999) and Mehshani buffaloes (Das *et al,* 2016) during different stages of lactation. The current study reported that there were a significant difference during lactation in the number of granulocyte, however, Hussein *et al* (1992) found a significant difference in neutrophils and not in eosinophils during lactation in camels. The current study reported that there was a significant change in the percentage of granulocytes during lactation, however, no significant difference was observed during postpartum period in camels (El-Zahar *et al,* 2017) and in Mehshani buffaloes (Das *et al,* 2016) during the different stages of lactation. In Baladi goats, a significant difference in the percentage

of eosinophils along with insignificant difference in the percentage of neutrophils and basophils were observed (Azab and Hussein, 1999). The significant increase in white blood cell, lymphocytes, monocytes, granulocytes and the percentage of lymphocytes in the first stage of lactation is probably due to the physiological change from pregnancy to lactation and the high milk production in this period.

As shown in table 2, there was a significant difference during lactation in red blood cells. Similar results were reported in camels (Hussein *et al,* 1992), jennies (Bonelli *et al,* 2016) and Baladi goats (Azab and Hussein, 1999). However, other researchers didn't observe any difference during post-partum period in camels (El-Zahar *et al,* 2017) and Mehshani buffaloes (Das *et al,* 2016). The low value at the first stage of lactation could be due to the effects of the residual of late gestation and also due to a rise of milk production demand (Hussein *et al,* 1992). In the current study, a low value of haemoglobin in the first and mid stage of lactation was reported, then the haemoglobin was significantly increased in the last stage of lactation. In accordance with the current findings, a significant effect of lactation in haemoglobin was observed in camels (El-Sayed, 2020) and Baladi goats (Azab and Hussein, 1999), however, Azab and Hussein (1999) reported a significant decrease in haemoglobin during long lactation. Contrarily, no significant difference were observed during lactation in camels (Hussein *et al,* 1992), in Jennies (Bonelli *et al,* 2016) and Mehshani buffaloes (Das *et al,* 2016; Hagawane *et al,* 2009).

In agreement with the current findings, a significant difference of haematocrit during the different stages of lactation and post-partum period was also observed in Jennies (Bonelli *et al,* 2016) and Baladi goats (Azab and Hussein, 1999). However, no significant difference of haematocrit was observed during lactation in camels (El-Zahar *et al,* 2017; Hussein *et al,* 1992) and Mehshani buffaloes (Das *et al,* 2016; Hagawane *et al,* 2009). The lower HCT value during the first stage of lactation as reported in the current study which could be due to a high

Table 1. White blood cell parameters values in 13 female camels during lactation period (early, mid, late).

Parameters	Stage of lactation			P value
	Early lactation (n=13)	Mid-lactation (n=13)	Later lactation (n=13)	
WBC ($\times10^9$/L)	54.08±25.28^a	10.63±1.71^b	11.41±2.86^b	0.000
LYM ($\times10^9$/L)	37.97±21.93^a	1.83±0.63^b	1.51±0.70^b	0.000
MON ($\times10^9$/L)	4.43±2.46^a	1.47±0.66^b	1.45±0.54^b	0.000
GRAN($\times10^9$/L)	12.43±3.78^a	7.33±1.66^b	8.44±2.26^b	0.000
LYM%	66.86±13.01^a	17.52±7.50^b	13.05±4.56^c	0.000
MON%	7.86±2.61^a	14.09±6.08^b	12.95±4.98^b	0.000
GRAN%	25.27±11.96^a	68.38±9.62^b	73.99±7.37^b	0.000

a,b,c; Means within a column with different superscripts differ significantly ($p<0.05$). WBC; Number of white blood cells, LYM; Lymphocyte, MON; Monocyte, GRAN; Granulocyte, LYM; % Percent Ratio of Lymphocyte, MON%; Per cent Ratio of Monocyte, GRAN%; Percent ratio of Granulocyte.

Table 2. Red blood cell and platelets parameters value in 13 female camels during lactation period (early, mid, late).

Parameters	Stage of lactation			P value
	Early lactation (n=13)	Mid-lactation (n=13)	Later lactation (n=13)	
HGB (g/dl)	12.42±1.00^{ab}	12.39±1.70^a	13.90±1.64^b	0.013
RBC ($\times10^{12}$/L)	4.27±0.66^a	5.33±0.65^b	5.35±0.53^b	0.000
HCT%	18.33±2.43^a	22.98±2.82^b	22.48±2.02^b	0.000
MCV fL	43.13±2.05^{ab}	43.16±0.65^a	42.05±0.72^b	0.000
MCH pg	29.56±5.62^a	23.03±2.04^b	25.96±2.48^c	0.000
MCHC g/dL	68.41±9.97^a	53.56±4.44^b	61.86±5.47^c	0.000
PLT ($\times10^9$/L)	164.30±59.24	143.76±45.27	163.92±46.53	0.282
MPV fL	6.746±1.01^a	5.77±0.64^b	6.19±0.71^b	0.000

a,b,c; Means within a column with different superscripts differ significantly ($p<0.05$). RBC; Number of red blood cells, HGB; Haemoglobin concentration, HCT; Haematocrit, MCV; Mean corpuscular volume, MCH; Mean corpuscular haemoglobin, MCHC; Mean corpuscular haemoglobin concentration, PLT; Number of Platelets, MPV; Mean Platelet Volume.

water intake and also to the fluid losses with the beginning of lactation and subsequent dilution of erythrocyte and hyper-hydration (Bonelli *et al,* 2016). Furthermore, low value of RBC, HCT and HGB perhaps was attributed to the physiological haemodilution during lactation that improves the flow of the blood into the udder in response to high demand of milk production.

The current study demonstrated that there were significant differences during lactation in MCV, followed by a decrease during late lactation. Similar results were reported in camel by Hussein *et al* (1992) and El-Sayed (2020). On the other hand, no significant difference was reported in MCV during lactation in camels (El-Zahar *et al,* 2017), Mehshani buffaloes (Das *et al,* 2016), Baladi goats (Azab and Hussein, 1999) and Jennies (Bonelli *et al,* 2016). The current study reported a significant difference in MCH and MCHC during lactation. Similarly, Hussein *et al* (1992) and El-Sayed (2020) reported a significant difference in MCH but not in MCHC during lactation in camel, however, no significant difference was reported in both MCH and MCHC in camel (El-Zahar *et al,* 2017), in Mehshani buffaloes (Das *et al,* 2016), Baladi goats (Azab and Hussein, 1999) and Jennies (Bonelli *et al,* 2016). The high value of MCHC, MCH and MCV during early lactation could be due to the increase of the capacity of the red blood cell for oxygen fixation and due to the physiological haemodilution that improves the flow of the blood to the udder as a response to the high demand of milk production. There was no significant difference in the PLT during the difference stages of lactation. Similar result was reported in Mehshani buffaloes (Das *et al,* 2016) and Jennies (Bonelli *et al,* 2016). A higher value of MPV was seen during the first stage of lactation followed by a significant decrease. This result was near to the value that detected earlier in non-pregnant female camel (Hussein *et al,* 2010). This study would help in standardisation of haematological parameters with maximum and minimum limits in order to serve as a guide for monitoring the camel population raised in local conditions.

Conflict of Interests

The authors have not declared any conflict of interests.

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