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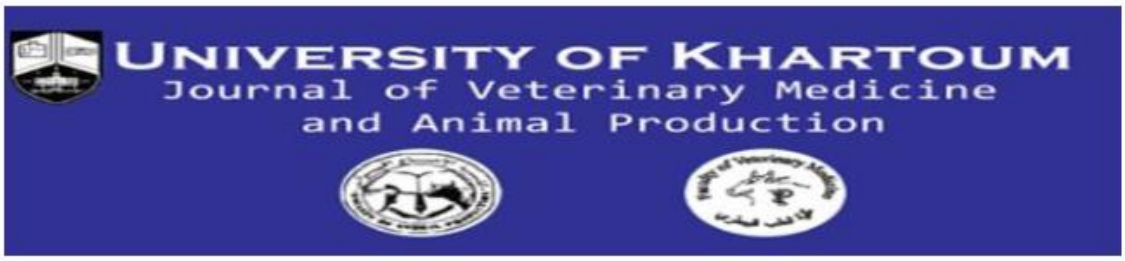

Effect of the Physiological Status on the Haematological Parameters of Female Camels (*Camelus dromedarius*)

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Abstract

The objective of the study was to assess the effect of the physiological status (age, late pregnancy and early lactation) on the haematological parameters in female dromedary camels under a semi-intensive system. Twenty-two healthy female camels (Age: 3-16 years) were used. The animals were divided into 4 groups: control group: non-pregnant non-lactating (5 animals, age: 8-16 years), pregnant (5 animals, age: 11-16 years, number of parities: 2-3), lactating (5 animals, age: 11-16 years, number of parities: 2-3) and young females (7 animals, age: 3-5 years). Blood samples were collected once by jugular venepuncture and used for the determination of haematological parameters (total erythrocytes and leukocytes counts: TEC and TLC, haemoglobin: Hb, blood haematocrit: HCT, mean corpuscular volume: MCV, mean corpuscular haemoglobin: MCH and mean corpuscular haemoglobin concentration: MCHC) using Automated Haematology analyzer. The physiological status had a significant ($P \leq 0.05$) effect on TEC, [Hb], neutrophils lymphocytes and monocytes percentage while HCT, MCV, MCH, MCHC, TLC, eosinophils and basophils percentage were not changed significantly. The TEC decreased significantly ($P \leq 0.05$) in young female camels compared to the control, pregnant and lactating camels. Blood-[Hb] increased significantly ($P<0.05$) during late pregnancy and decreased ($P<0.05$) in young females compared to the control and early lactation. Neutrophils percentage increased significantly ($P<0.05$) during early lactation and decreased ($P<0.05$) during late pregnancy compared to the control and young females. Lymphocytes percentage increased ($P<0.05$) during late pregnancy compared to early lactation, whereas monocytes percentage increased ($P<0.05$) in young females compared to the control, late pregnancy and early lactation. The physiological status had a negative influence on the haematological parameters in female camels. The data could be utilized to assess the metabolic profile in growing, pregnant and lactating female camels.

Key words: *Dromedary camels, haematological parameters, physiological status*

الخلاصة

الهدف من الدراسة هو تقييم تأثير الحالة الفسيولوجية (العمر والمرحلة الأخيرة من الحمل والمرحلة المبكرة من فترة الإلبان) على قياسات الدم لإناث الإبل وحيدة السنام. تم إستخدام 22 من أناث الإبل صحية إكلينيكياً (العمر: 3-16 سنة). تم

تقسيم الحيوانات إلى 4 مجموعات: المجموعة الشاهد: نوق غير حوامل وغير حلوب (5 حيوانات، العمر8-16 سنة)، نوق حوامل فى الفترة الأخيرة من الحمل (5 حيوانات، العمر11-16 سنة، عدد الولدات: 2-3)، نوق حلوب فى المرحلة المبكرة من فترة الإلبان (5 حيوانات، العمر11-16 سنة، عدد الولدات: 2-3) وحواشى (نوق غير بالغة: 7 حيوانات، العمر3-5 سنوات). تم جمع عينات الدم مرة واحدة عن طريق وخذ الوريد الوداجي وإستخدمت لتحديد قياسات الدم بإستخدام جهاز تحليل الدم الآلي. أثرت الحالة الفسيولوجية معنوياً ($P\leq0.05$) على العدد الكلى لكريات الدم الحمراء (TEC) وتركيز هيموقلوبين الدم والنسبة المئوية للخلايا العدلات (neutrophils) الليمفاوية (lymphocytes) الوحيدة (monocytes) بينما لم يتأثر مكداس الدم (HCT) ومتوسط حجم الكرية الحمراء (MCV) ومتوسط تركيز هيموقلوبين الكرية الحمراء (MCH) ومتوسط تركيز هيموقلوبين الكريات (MCHC) والعدد الكلى لكريات الدم البيضاء (TLC) والنسبة المئوية للخلايا الحمضية (eosinophils) والقاعدية (basophils) معنوياً. إنخفض العدد الكلى لكريات الدم الحمراء إنخفاضاً معنوياً ($P<0.05$) في الحواشى مقارنة بالمجموعة الشاهد والنوق الحوامل والحلوب. إرتفع تركيز الهيموقلوبين معنوياً ($P<0.05$) خلال المرحلة الأخيرة من الحمل وإنخفض معنوياً ($P<0.05$) في الحواشى مقارنة بالمجموعة الشاهد والمرحلة المبكرة من فترة الإلبان. إرتفعت نسبة العدلات معنوياً ($P<0.05$) خلال المرحلة المبكرة من فترة الإلبان وإنخفضت ($P<0.05$) خلال المرحلة الأخيرة من الحمل مقارنة بالمجموعة الشاهد والحواشى. إرتفعت نسبة الخلايا الليمفاوية معنوياً ($P<0.05$) خلال الفترة الأخيرة من الحمل مقارنة بالمرحلة المبكرة من فترة الإلبان، في حين أن نسبة الخلايا الوحيدة إرتفعت معنوياً ($P<0.05$) فى الحواشى مقارنة بالمجموعة الشاهد والمرحلة الأخيرة من الحمل والمرحلة المبكرة من فترة الإلبان. كان للحالة الفسيولوجية تأثيراً سلبياً على قياسات الدم في إناث الإبل. يمكن إستخدام هذه البيانات لتقييم صورة التمثيل الغذائي في الحواشى النامية والنوق الحوامل والحلوب.

كلمات مفتاحية: *الإبل وحيدة السنام ، قياسات الدم ، الحالة الفسيولوجية*

Introduction

Sudan is one of the largest countries in the world populated by dromedary camels (4.849.003 heads, FAOSTAT, 2017) in which camels are mainly kept under traditional management system as a source of milk, meat, and as a pack and riding animal (Bakheit *et al.,* 2015; Shuiep *et al.,* 2014). However, El Zubier and Nour (2006) and Babiker and El Zubeir, (2014) described camel husbandry and practices under intensive and semi-intensive systems in the pre-urban area of Khartoum State.

Evaluation of the physiological status of an animal has been accomplished with the analysis of blood and serum parameters (Antunovic *et al.,* 2011). In all animal species, a variety of factors such as age, sex, breed, nutrition, illness, stress, exercise, transport, and season have been reported to influence the haematological parameters (Jain, 1998; Onasanya *et al.,* 2015; Faye and Bengoumi, 2018). In camels, significant variations have been observed in the haematological parameters concerning age (Elkhair and Elmgboul, 2015; Al-Sultan, 2008; Saeed and Hussein, 2008), breed (Aichouni *et al.,* 2010), physiological status (Al-Busadah and Osman, 2000; Ayoub *et al.,* 2003; Ahmed, 2017; Axay *et al.,* 2017; Jalali *et al.,* 2018), management (Yousif *et al.,* 2018), season (Amin *et al.,* 2007; Badawy *et al.,* 2008), and in female camels with reproductive disorders (Zaher *et al.,* 2017). Late pregnancy and early lactation are demanding physiological states that lead to significant changes in the metabolic profile in camels (Tharwat *et al.,* 2015; Ahmed, 2017). The haematological parameters are the most common indicators to assess metabolic profile during different physiological states and significant variations in the haematological parameters have been reported previously during late pregnancy and early lactation (Derar *et al.,* 2014; Kelanemer *et al.,* 2015; Tharwat *et al.,* 2015; Abd-El-Rahman *et al.,* 2017; El Zahar *et al.,* 2017). Abd El-Salaam and Arafa, (2018) reported that the values of HCT and Hb decreased significantly during late pregnancy then the values showed non-significant changes during postpartum months in Maghrebi camels. Higher values of TEC, Hb, and HCT have been reported during late pregnancy and early lactation in camels (Getnet and Abebe, (2005). Ayoub *et al.,* (2003) stated that pregnancy

had no significant effect on HCT, Hb, TLC, whereas neutrophilia and eosinophilia accompanied by lymphocytosis and monocytosis were observed in pregnant camels. Furthermore, significantly higher values of neutrophils, MCH and MCHC accompanied by significantly lower values of lymphocytes have been reported during the transition period in camels (Tharwat *et al.,* 2015).

Few studies have been conducted to describe the haematological profile of female camels in relation to age, pregnancy and lactation (Al-Sultan, 2008; Elkhair and Elmgboul, 2015; Ahmed, 2017; Yousif *et al.,* 2018). Therefore, the present study aimed to provide additional information on the haematological parameters in female camels during different physiological states.

Materials and Methods

Animals and Management

Twenty-two clinically healthy female camels (Age: 3-16 years) were used. The animals were selected from the herd of the Camel Research Centre of the University of Khartoum, Sudan. The females were divided into 4 groups: control group non-pregnant non-lactating (5 animals, age: 8-16 years), pregnant (5 animals, age: 11-16 years, number of parities: 2-3), lactating (5 animals, age: 11-16 years, number of parities: 2-3) and young female camels (7 animals, age: 3-5 years).Time-mated pregnant camels were selected according to the records of mating time for each female included in the experiment, which indicated the expected time for parturition. The pregnant camels were monitored from one month prepartum (late pregnancy) up to one month postpartum (early lactation). During the experimental period, the females were housed in an outdoor environment in a shaded corral. The animals were maintained on grazing and browsing trees and shrubs in the vicinity of the Camel Centre and occasionally received fresh grass and concentrate supplements, which was offered daily with free access to freshwater.

Blood Collection and Laboratory Analysis

Blood samples were collected once from the control, young females, during late pregnancy and early lactation by jugular venepuncture into collection tubes containing EDTA. The blood samples were used for the determination of total erythrocytes and leukocytes counts, and differential leukocytes counts (TEC, TLC and DLC), haemoglobin (Hb), blood haematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration: MCHC) using an Automated Haematology analyzer (URIT-3010 VET, URIT medical electronics).

Statistical analysis

Statistical analysis was performed using SPSS for Windows version 20. General Linear Model (GLM), ANOVA (Levine's and Post Hoc Tests) was used to assess the significant differences among the groups. The difference was considered significant at $P \leq 0.05$.

Results and Discussion

The effects of the physiological status (age, late pregnancy and early lactation) on the haematological parameters of dromedary camels are shown in Table 1. The age had a significant ($P \leq 0.05$) effect on TEC, [Hb] and monocytes percentage. Late pregnancy showed a significant ($P \leq 0.05$) influence on [Hb], neutrophils and lymphocytes percentage, whereas early lactation showed a significant effect ($P \leq 0.05$) on neutrophils and lymphocytes percentage.

Table 1: Effect of the physiological status on the haematological parameters of female camels (*Camelus dromedarius*) (n=22)

Parameter	Young Females	Late pregnancy	Early lactation
TEC ($\times 10^6/\mu l$)	*	NS	NS
Blood- Hb] (g/dl)	*	*	NS
HCT (%)	NS	NS	NS
MCV (fl)	NS	NS	NS
MCH (pg)	NS	NS	NS
MCHC (g/dl)	NS	NS	NS
TLC ($\times 10^3/\mu l$)	NS	NS	NS
Neutrophils (%)	NS	*	*
Lymphocytes (%)	NS	*	*
Monocytes (%)	*	NS	NS
Eosinophils (%)	NS	NS	NS
Basophils (%)	NS	NS	NS

The detailed results shown in Fig. 1 indicated that TEC decreased significantly ($P \leq 0.05$) in young female camels compared to the control, pregnant and lactating camels. Blood-[Hb] increased significantly ($P<0.05$) during late pregnancy and decreased ($P<0.05$) in young females compared to the control and early lactation while the study showed that HCT, MCV, MCH, MCHC were not changes significantly. In contrast, Hussein *et al.,* (1992), Albusadah and Osman (2000) and Al-Sultan (2008) reported significant changes in HCT, MCV, MCH and MCHC with age in camels. The variation in the respective erythrocyte's parameters may be attributed differences in the erythrocyte size and its oxygen carrying capacity in relation to the physiological states. Similar result has been reported by Yagoub (1988) who observed lower values of TECin camels aged 1-5 years compared to camels less or more than 5 years. Al-Rammahi *et al.,* (2016) noted that the TEC was significantly lower TEC in calves and lactating females, whereas [Hb] was significantly higher in adult males. Saeed *et al.,* (2011) reported lower TEC, Hb and HCT in pregnant camels compared to non-pregnant camels. The significant influence of age on the haematological parameters has been also observed by Albusadah and Osman (2000) who reported lower mean values of TEC and Hb in young camels compared to adult camels. In contrast, Hussein *et al.,* (1992) reported higher mean values of TEC and Hb in young camels. On the other hand, the pattern of erythrocytes parameters in response to the physiological status could be attributed to increased demand for oxygen consumption and the requirements of higher metabolic rate for growth and during late pregnancy and early lactation. Similar results have been observed by Abd El-Salaam and Arafa (2018) who reported higher values of Hb during late pregnancy in Maghrebi camels. Higher values of TEC, Hb, and HCT have been reported during late pregnancy and early lactation in camels

(Getnet and Abebe, 2005; Tharwat *et al.,* 2015; El Zahar *et al.,* 2017).

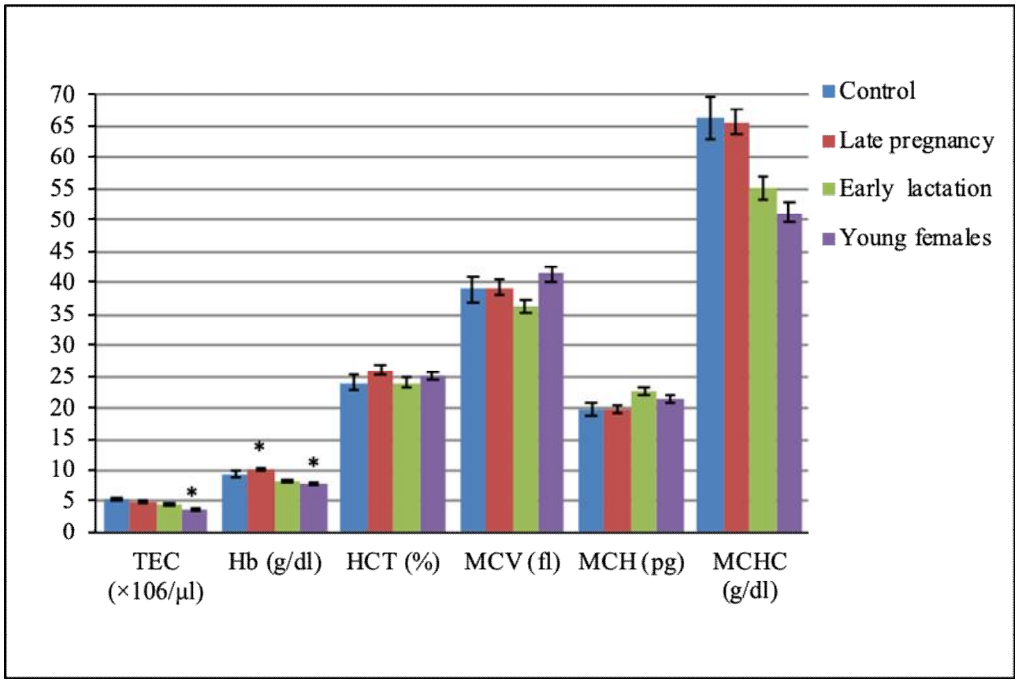

Fig. 1 Erythrocytes parameters of female camels (*Camelus dromedarius*) during different physiological states (n=22)

*Bars bearing different superscripts are significantly different at *P≤0.05*

Fig. 2 shows that the physiological status had no significant effect on TLC, eosinophils and basophils percentage. Similar results have been observed by Omer *et al.,* (2016) and Tharwat *et al.,* (2015). However, Hussein *et al.,* (1992), Albusadah and Osman (2000) and Al-Sultan (2008) reported significant changes in TLC with age in camels. Furthermore, the values of TLC, eosinophils and basophils percentage did attain statistical significance during the respective physiological status, which can be considered as a good indicator for optimum management and feeding regime programme for the camels investigated. In contrast, Axay *et al.,* (2017) stated that TLC showed lower values during early lactation compared to late lactation in camels. Moreover, Albusadah and Osman, (2000) reported that the TLC of young camels was significantly higher compared to the lactating camels. Muhammad *et al.,* (2011) and Saeed *et al.,* (2011) reported that TLC remained unchanged during late pregnancy compared with non-pregnant camels.

In the present study, neutrophils percentage increased significantly ($P<0.05$) during early lactation and decreased ($P<0.05$) during late pregnancy compared to the control and young females. Lymphocytes percentage increased ($P<0.05$) during late pregnancy compared to early lactation, whereas monocytes percentage increased ($P<0.05$) in young females compared to the control, late pregnancy and early lactation (Fig. 2). Conversely, an earlier study conducted by Hussein *et al.,* (1992) showed that age had no significant effect on monocytes percentage. The significant changes in neutrophils and lymphocytes percentage could be due to cortisol and ACTH release in response to pregnancy, parturition and lactation stress (Hussein *et al.,* 1992;

Jainudeen and Hafez, 1994). Neutrophilia and lymphocytosis observed in lactating and late pregnant camels are in agreement with Getnet and Abebe, (2005), Saeed *et al.,* (2011) Tharwat *et al.,* (2015) and Ahmed (2017).

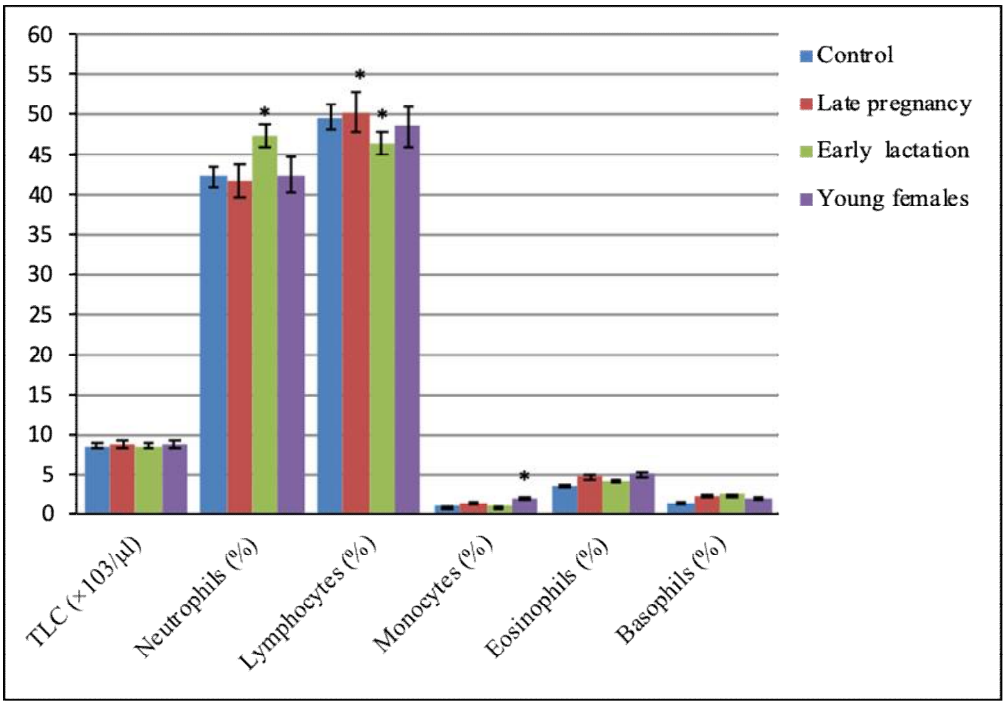

Fig. 2 Leukocytes parameters of female camels (*Camelus dromedarius*) during different physiological states (n=22)
*Bars bearing different superscripts are significantly different at *P≤0.05*

Conclusions

The physiological status had a negative influence on the haematological parameters in female camels. The data could be utilized to assess the metabolic profile in young, pregnant and lactating camels. The critical changes in the haematological parameters during the respective physiological status could be associated with increased requirements for growth, foetal intensive growth and lactogenesis.

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