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Some Hematologic Values and Serum Biochemical Parameters in Male Camels (*Camelus dromedarius*) before and during Rut

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ABSTRACT

The study was carried out to investigate the possible correlation between the hematological values and some biochemical parameters of male dromedary camels (*Camelus dromedarius*) and the rutting and non-rutting conditions. Blood samples were collected from ten dromedary mature camel males of the different breeds, for a period of one year. The results revealed that Red Blood Cells (RBC) and Hemoglobin (HGB) values are decreased during rut, while total White Blood Cells (WBC), neutrophils and lymphocytes values are increased. As far as the serum biochemical constituents are concerned, little variations have been detected to occur under the effect of rut and non-rut seasons. During rutting season, significant increase ($p < 0.05$) of total cholesterol levels, glucose and LDH-L (L-lactate dehydrogenase) values were recorded. The difference between the other hematological parameters of Serum Glutamic-pyruvic Transaminase (SGPT), blood urea nitrogen, creatinine, γ -glutamyltransferase (GGT), total protein and iron contents which were determined as a normal values was statistically significant ($p < 0.05$) in both of rut and non-rut camel males. In conclusion, such hematological investigations provide an evidence of the importance of hemogram and/or serum biochemical values which have a good effect upon the sexual behavior and for detecting a rutted and non-rutted camel male condition.

Key words: *Camelus dromedarius*, male camel, hematologic values, serum biochemical parameters, rut, non-rut

INTRODUCTION

Investigation of blood constituents can provide valuable benefit and indication about the general health of animals. Observation of a deviation of certain blood parameters from their normal limits could be an indication for diagnosis or differential diagnosis of a diseased condition (Dessouky, 1992). It has been increasingly realized that more fundamental knowledge of hemogram, blood metabolites and hormones in the dromedary contributes greatly to the understanding of the physiology of this species. Many of the researches that had conducted are incomplete or lack references to fluctuations in the parameters studied caused by environmental conditions or time of sampling during the day. It was thus considered that a useful contribution in physiological knowledge could be made by studying the diurnal variations of blood Nonesterified Fatty Acids (NEFA), corticoids, glucose, urea, total proteins, insulin, cholesterol, GOT, gamma-GT, GPT (Jimale *et al.*, 1990) and other hematological and serum biochemical values in grazing dromedaries (Dessouky, 1992; Al-Bashan, 2011).

Male dromedary camels are early known as seasonal breeders (Leese, 1927; Marai *et al.*, 2009), where the breeding season is confined to the cool winter months of the year. In the rut, the male exhibits morphological, behavioral and endocrinological changes (Marai *et al.*, 2009;

Yagil and Etzion, 1980), in addition to hematological alterations (Dessouky, 1992). The rut stage of a male can last from 50 to 100 days (Tibary and Anouassi, 1997). However, Marie (1987) mentioned that the marked peak in sexual activity (the rut) is during the breeding season and it is generally thought that the male is sexually quiescent for the remainder of the year, but it is capable of mating and fertilizing an estrous female at any time of the year. Azouz *et al.* (1992) reported a significant decrease in testosterone level out of the breeding season as compared with the levels during rut. Hormonal concentration of blood samples collected from camels slaughtered at defined seasons (summer, autumn, winter and spring) was studied (Al-Qarawi and El-Mougy, 2008). The results clearly differentiated the samples during the non-rutting and rutting seasons. Seasonal, age and sex variations have been reported to occur in the hemogram of camel. Literature bears evidence that white blood cell count and lymphocytes tend to elevate by increasing age in camel and lymphocytes are higher in males than in females. It is noticed that the red blood cells and hemoglobin are decreased during rut while total white cells, neutrophils and lymphocytes are increased (Khan and Kohli, 1978; Dessouky, 1992). It is evident that normal hematologic values of RBC, HB, PCV, MCV, MCH, MCHC and WBC are higher in males than in females (Nassar *et al.*, 1977). Reports on seasonal variations describe that red blood cell count reaches its maximum normal limit in summer while white blood cells reach the maximum normal limits in winter (Dessouky, 1992). As far as the serum biochemical constituents are concerned, little variations have been reported to occur under the effect of age, sex and season. Nevertheless, it has been declared that high normal values of plasma proteins and calcium and low normal values of phosphorus are expected to be seen in adult animals and calcium and phosphorus are increased with feeding green ration (Moustafa, 1969; Ragab, 1975; Abd-El-Gadir *et al.*, 1979; Khan and Kohli, 1981; Bashandy, 1986; Abd El-Samee, 1987).

In this study, it is aimed to give an account on some hematologic values and serum biochemical parameters in male camels (*Camelus dromedarius*) before and during rut.

MATERIALS AND METHODS

Animals: This study was carried out for one year that starting from December 2009 until November 2010, in Taif Governorate, Kingdom of Saudi Arabia. Ten dromedary camel bulls aged between 8 to 10 years old were used. They were clinically healthy and proved to be free from diseases, especially the external, internal and blood parasites as revealed by clinical examinations of fecal samples and peripheral blood samples stained with Giemsa stain (Finegold and Baron, 1986; Forbes *et al.*, 2002). Each animal was kept separately in its stable to avoid aggressive temperament during rutting season. The camels were daily fed at 8 am on a pelleted concentrates of 14% crude protein supplemented with barley as a source of energy in addition to straw and Berseem hay adlib. Camels were allowed to drink twice daily, with 3 h free grazing period once a day throughout the year.

Experimental design

Blood samples collection: Before (November), during (February), after rutting (May) and non-rutting (August) season, blood samples were taken and collected in sterile screw-cap non-heparinized tubes from the neck jugular vein of the camel males subjected to trials. On arrival at the laboratory, the samples were immediately subjected to hematological and biochemical processing. All blood samples were tested at Al-Janadriya Veterinary Center, Taif City, Kingdom of Saudi Arabia (KSA). Hematological picture and biochemical analysis of camel males were determined after the methods of Bauer (1982).

Statistical analysis: Analysis of variance was detected using GLM procedure by SPSS (SPSS version 11.5 for Windows; SPSS Inc., Chicago, IL, USA). The differences between means were detected using Duncan's Multiple Range Test (DMRT) (Snedecor and Cochran, 1967).

Results were quoted as arithmetic Mean±standard error of mean (SEM) and significance was attributed (p<0.05).

RESULTS

Mean values of hematological picture and some serum biochemical parameters variations are illustrated in Table 1. As shown in Table 1, male dromedary camels in rutting season had higher (p<0.05) WBC, neutrophils and lymphocytes than non-rutted male dromedary camels which had higher levels of Red Blood Cells (RBC) count and Hemoglobin (HGB) value. The rutting male Dromedary camels were found to have higher (p<0.05) total cholesterol levels, glucose and LDH-L (L-lactate dehydrogenase) values than the non-rutting male dromedary camels which had lower mean levels of these mentioned parameters. When the biochemical indices of rutting male

Table 1: Mean haematological values and serum biochemical parameters of male dromedary camels in pre-rut, rut, post-rut and non-rut seasons

Parameter	Pre-rut (November)	Non-rut (August)	Post-rut (May)	Rut (February)
RBC ($\times 10^6 \mu\text{L}^{-1}$)	10.55±1.39 ^b	10.90±1.04 ^b	9.87±1.33 ^b	8.90±1.450 ^b
HGB (g dL ⁻¹)	14.49±1.46 ^b	14.80±1.15 ^b	15.20±1.40 ^b	14.20±1.550 ^b
HCT (%)	33.10±1.39 ^a	30.20±1.11 ^a	24.49±1.29 ^a	24.40±1.470 ^a
PCV (%)	38.20±2.29 ^a	39.80±1.99 ^a	41.20±2.15 ^a	39.50±2.650 ^a
MCV (fl)	39.60±3.18 ^a	40.10±2.86 ^a	37.20±3.13 ^a	36.40±3.390 ^a
MCH (Pg)	15.90±2.30 ^a	16.70±1.97 ^a	16.40±2.21 ^a	16.00±2.370 ^a
MCHC (g dL ⁻¹)	49.50±3.60 ^a	49.30±3.12 ^a	47.40±3.44 ^a	46.20±3.770 ^a
PLT ($10^3 \mu\text{L}^{-1}$)	2660.00±4.29 ^a	245.00±3.84 ^a	231.00±4.10 ^a	189.00±4.380 ^a
MPV (fl)	4.02±2.33 ^a	3.80±1.90 ^a	3.7.0±2.13 ^a	3.5.0±2.510 ^a
WBC ($\times 10^3 \mu\text{L}^{-1}$)	10.30±1.68 ^a	10.10±1.20 ^a	9.7.0±1.48 ^a	10.5.0±1.890 ^a
Differential leucocytic count (%)				
Neutrophiles	27.00±1.53 ^a	29.00±1.10 ^a	30.00±1.34 ^a	35.00±1.660 ^a
Lymphocytes	40.00±1.32 ^a	45.00±1.05 ^a	50.00±1.19 ^a	54.00±1.480 ^a
Monocytes	5.50±0.39 ^a	6.80±0.12 ^a	7.10±0.23 ^a	8.00±0.490 ^a
Eosinophiles	6.90±0.28 ^a	7.50±0.06 ^a	8.20±0.17 ^a	9.00±0.380 ^a
Basophiles	1.30±0.22 ^a	1.50±0.03 ^a	1.70±0.12 ^a	1.9.0±0.270 ^a
Granulocytes	4.26±0.42 ^a	5.23±0.11 ^a	5.40±0.28 ^a	5.520±0.52 ^a
Total protein (mg dL ⁻¹)	7.25±0.20 ^a	7.31±0.27 ^a	7.44±0.22 ^a	7.200±0.16 ^a
Glucose (mg dL ⁻¹)	114.33±3.20 ^{ab}	108.03±2.45 ^{bc}	103.32±2.76 ^b	118.700±1.25 ^a
Creatinine (mg dL ⁻¹)	1.48±0.41 ^{ab}	1.53±0.47 ^{ab}	1.57±0.65 ^c	1.450±0.66 ^a
Total cholesterol (mg dL ⁻¹)	22.03±0.52 ^{ab}	21.80±1.30 ^b	16.89±1.34 ^f	24.990±1.88 ^a
Blood urea nitrogen (mg dL ⁻¹)	30.50±0.16 ^{ab}	30.20±0.22 ^{ab}	30.80±0.19 ^a	30.200±0.14 ^b
LDH-L (IU L ⁻¹)	357.00±1.55 ^{ab}	355.00±2.01 ^{ab}	350.00±1.33 ^a	380.000±1.22 ^b
ALT (SGPT) (IU L ⁻¹)	19.50±1.23 ^{ab}	18.80±1.44 ^{bc}	14.6.0±0.45 ^a	14.3.0±0.610 ^b
GGT (IU L ⁻¹)	25.20±2.02 ^{ab}	24.90±2.13 ^{ab}	20.90±1.03 ^c	15.50±0.710 ^b
Iron ($\mu\text{g dL}^{-1}$)	69.80±0.10 ^{ab}	71.40±0.33 ^{bc}	70.50±0.51 ^a	77.10±0.340 ^b

Means with different superscripts in the same raw are significantly different at p<0.05

dromedary camels were compared with those of the pre-rutted, post-rutted and non-rutted male dromedary camels, the formers were found to have higher ($p < 0.05$) total cholesterol levels, glucose and LDH-L (L-lactate dehydrogenase) values. The difference between the other hematological parameters of Serum Glutamic-pyruvic Transaminase (SGPT), Blood urea nitrogen, creatinine, γ -glutamyltransferase (GGT), total protein and iron contents which were determined as a normal values, was statistically significant ($p < 0.05$) in both of rut and non-rut camel males. No significant differences were observed between the pre-rutting and post-rutting male dromedary camels in the mean values of RBC and HGB investigated as well as WBC, neutrophils and lymphocytes. Hematological examination of blood samples by different methods revealed that red blood cells and hemoglobin were decreased during rut with mean values of 8.90 and 14.2, respectively, while total white blood cells (10.5), neutrophils (35%) and lymphocytes (54%) were increased. Except for cholesterol, ALT (SGPT), blood urea nitrogen, Creatinine, GGT, Iron and LDH-L all monitored parameters presented in Table 1 showed significant variations before, during, after rutting and non-rutting conditions due to seasonal effects.

DISCUSSION

The dromedary (*Camelus dromedarius*), also called Arabian camel or one humped camel was domesticated some 5,000 years ago (3,000 years B.C.) in the Arabian Peninsula. The name dromedary is derived from *dromos* (road in Greek) in relation with its first use in transportation. Due to its ability to survive under the extremely harsh climate conditions of the desert, the camel has provided life in a place uninhabited by most animals (Ouajd and Kamel, 2009). This species is able to survive in hot a temperature that is normally lethal to others species. It can walk 5-7 days with little or no food and water and can lose a quarter of its body weight without impairing its normal functions. All the functions of this species are seen to be adapted to desert environment which is characterized by little water and poor food (Wilson, 1988; Ouajd and Kamel, 2009). The one humped camel is an essential source of food and milk in many parts of the world and especially in developing countries in Africa and Asia. The dromedary plays also economic, social and ecological roles (Wardeh, 1992; Ouajd and Kamel, 2009).

The camel's reproduction is characterized by a seasonal activity (Zarrouk *et al.*, 2003). During the sexual seasons, the male is very aggressive and presents some characteristic signs like the extrusion of the soft palate and becomes very vocal. Occipital glands (neck glands) become active and secrete a brownish liquid during sexual activity. Copulation induced ovulation occurs in the down position over a relatively long time period (10 to 15 min) (Ouajd and Kamel, 2009).

On the other hand, although the camel is considered an important animal in certain areas of the world, yet, few reports and papers have been published on its blood parameters as affected by different seasonal, physiological and pathological events. In recent years, a considerable amount of research has been carried out on the blood chemistry of the camel. Much of this has taken place in India, Egypt and Sudan and to a lesser extent in Israel (Wilson, 1988) and Saudi Arabia (Al-Bashan, 2011). Unfortunately, many of the results appear to be contradictory, the anomalies perhaps arising from different methods of analysis and the difficulties of reproducing the same conditions in exactly the same way. Some of the differences can be explained by seasonal and nutritional factors and by the effects of sex and the rut (Wilson, 1988; El-Bahrawy and El Hassanein, 2011) but many anomalies are unexplained (Wilson, 1988).

This study describes the changes in the hemogram and biochemical blood constituents before, during, after rutting and non-rutting conditions of camel in comparison with the old and new literature. The results obtained in this investigation regarding occurrence of significant differences between the rutting and non-rutting male dromedary camels in serum content of WBC (neutrophils and lymphocytes) and RBC and HGB support the conclusion of Nasr (1959), Ragab (1975), Nassar *et al.* (1977), Khan and Kohli (1978, 1981), Dessouky (1992), Patodkar *et al.* (2010) and El-Bahrawy and El Hassanein (2011) who detected relationship between the camel sex, rutting and non-rutting conditions and several biochemical blood parameters of males and females dromedary camels they estimated in camels. The result recorded by Dessouky, (1992) and El-Bahrawy and El Hassanein (2011), however, was in line with the result of this work as both studies confirmed the higher total cholesterol levels, glucose and LDH-L (L-lactate dehydrogenase) values in the serum content of the rutting male dromedary camels compared to pre, post and non-rutting male dromedary camels serum content ones. Total white blood cells, neutrophils, lymphocytes, Glucose, total cholesterol and LDL-L levels show a peak of (10.5, 35%, 54%, 118.7±1.25, 24.99±1.88, 380±1.22) consecutively during rut (winter season), levels are highly than that of the pre-rut season as compared with total white cells, neutrophils and lymphocytes, Glucose, total cholesterol and LDL-L concentrations during post-rut in May (late spring) or out of rut (summer season). In the same trials, the results revealed that Red Blood Cells (RBC) and hemoglobin (HGB) values were decreased during rut, while total White Blood Cells (WBC), neutrophils and lymphocytes values are increased. As far as the serum biochemical constituents are concerned, little variations have been detected to occur under the effect of rut and non-rut seasons. During rutting season, significant increase ($p < 0.05$) of total cholesterol levels and LDH-L (L-lactate dehydrogenase) values were recorded, with significant ($p < 0.05$) decline in post-rut. Contrarily, a significance differences ($p < 0.05$) were established for Serum Glutamic-pyruvic Transaminase (SGPT), Blood urea nitrogen, Creatinine, γ glutamyltransferase (GGT) and iron contents declaring the stability of their values within normal limits in rut and non-rut seasons. However, only Creatinine declared decrease during pre-rut in November (autumn) and rut in February (winter) seasons with levels of (1.48±0.41) and (1.45±0.66) (mg dL^{-1}), respectively, as compared to other seasons of the years. Total white cells, neutrophils and lymphocytes, Glucose, total protein, total cholesterol and LDL-L levels were in range of other results reported by Nasr (1959), Ragab (1975), Nassar *et al.* (1977), Khan and Kohli (1978, 1981), Dessouky (1992), Patodkar *et al.* (2010) and El-Bahrawy and El Hassanein (2011). The results established that glucose levels were significantly higher starting from the beginning of rut and during rut as compared to other seasons. These results are in coincidence with those obtained by Roy (2007) who recorded the values during non-rutting season in comparison to the rutting season being 116 and 126 mg dL^{-1} , respectively in young dromedary camels. While, Amin *et al.* (2007) noted that total protein rose during the dry season, contrarily, glucose levels raised during the green season. It was believed that this may be attributed to seasonal effect with relation to nutritional effect for difference of roughs while grazing during different seasons. Creatinine levels detected in the present investigation were low as compared to other levels established by Saeed *et al.* (2004). In general, Creatinine level did not tremendously decrease during the winter (rutting season) as compared to other seasons. This suggests that the dromedary camels do not demonstrate a winter physiological state of protein conservation; this agrees with the findings previously reported by Harlow and Nelson (1990). Moreover, the obtained results on the cholesterol levels estimated in this study were generally in

agreement to some extent with some reports in the field of normal values recorded by Saeed *et al.* (2004) and Abd El-Hag *et al.* (2005). However, the results showed no effect of season on total protein, while glucose and cholesterol level declared a significant increase during rut, whereas Creatinine level decreased during autumn and winter seasons. result are in coincidence with that reported by El-Bahrawy and El Hassanein (2011). Generally, some workers have been investigated the hemogram of camels. Banerjee *et al.* (1962) recorded that the mean blood estimations of 20 healthy male camels not in rut were as follows: red cell count 7.24 million per cu.mm, haematocrit 27%, red cell measurements 7.7×4.2 per cu.mm, Hb content 17.4 g dL^{-1} , white cell count 18.100 per cu.mm; differential white cell count (%): neutrophils 51, eosinophiles 6, basophiles 0.05, lymphocytes 40 and monocytes 3%. Camel red cells are oval and these of the dromedary are somewhat larger than these of the bactrian camel. As well as, the mean cell volume is very small and is not compensated by the large number, so the haematocrit is low. On the other hand, Bhargava *et al.* (1964), have been monitored the blood biochemistry of adult male camel and recorded that serum *B-globulins* formed $31.5 \pm 1.01\%$ of the total serum proteins volume were $24.4 \pm 1.80\%$ in male not in rut and the amount of total protein was not affected by rut.

In conclusion, the raising up of total white blood cells, neutrophils and lymphocytes and some serum biochemical constituents such as total cholesterol, glucose and LDL-L values affected by rutting condition and sex of camels (dromedaries) which in turn affect their general physiological states and functions including sexual performance.

REFERENCES

- Abd El-Hag, S.E.D., S.A. Shaddad and T. Hassan, 2005. Status of some chemical and biochemical parameters of camel blood in the rainy season in the Sudan. *J. Anim. Vet. Adv.*, 4: 713-715.
- Abd El-Samee, A.A., 1987. Blood parameters in camels in health and disease. M.V.Sci. Thesis, Faculty of Veterinary Medicine, Cairo University.
- Abd-El-Gadir, S.E., A.A. Wahbi and O.F. Idris, 1979. A note on hematology of adult Sudanese camels. Proceedings of the Workshop on Camel, Khartoum, Sudan, December 18-20, 1979, International Foundation of Science, Stockholm, Uppsala, Sweden, pp: 347-354.
- Al-Bashan, M.M., 2011. *In vitro* assessment of the antimicrobial activity and biochemical properties of camel's urine against some human pathogenic microbes. *Middle-East J. Sci. Res.*, 7: 947-958.
- Al-Qarawi, A.A. and S.A. El-Mougy, 2008. Seasonality and the melatonin signal in relation to age as correlated to the sexual cycle of the one-humped male camel (*Camelus dromedaries*). *Biol. Rhythm Res.*, 39: 131-142.
- Amin, A.S.A., K.A. Abdoun and A.M. Abdelatif, 2007. Seasonal variation in blood constituents of one-humped camel (*Camelus dromedarius*). *Pak. J. Biol. Sci.*, 10: 1250-1256.
- Azouz, A., M.Z. Ateia, H. Shawky, A.D. Zakaria and A.A. Farahat, 1992. Hormonal changes during rutting and the non-breeding season in male dromedary camels. Proceeding of the 1st International Camel Conference, February 2-6, 1992, Dubai, UAE., pp: 169-171.
- Banerjee, S., R.C. Bhattacharjee and T.L. Singh, 1962. Hematological studies in the normal adult Indian camel (*Camelus dromedaries*). *Am. J. Physiol.*, 203: 1185-1187.
- Bashandy, M.M., 1986. Clinical significance of serum cholesterol measurement in some diseased conditions of buffaloes and camels. Ph.D. Thesis, Faculty of Veterinary Medicine, Cairo University, Egypt.
- Bauer, J.D., 1982. *Clinical Laboratory Methods*. 9th Edn., The C.V. Mosby Company, St. Louis, Toronto, London.

- Bhargava, A.K., P.N. Mehrotra and S. Banerjee, 1964. Biochemical studies on Indian camel (*Camelus dromedaries*): V Serum proteins and their variation with age, sex, pregnancy, rut and infection. *Indian J. Exp. Biol.*, 2: 52-54.
- Dessouky, M.I., 1992. Studies on the hemogram and blood biochemical constituents in camel in health and disease. Proceedings of the Training Course on Camel Diseases, April 11-30, 1992, Arab Organization for Agricultural Development, Cairo, pp: 333-344.
- El-Bahrawy, K.A. and E.E. El Hassanein, 2011. Seasonal variations of some blood and seminal plasma biochemical parameters of male dromedary camels. *Am.-Eurasian J. Agric. Environ. Sci.*, 10: 354-360.
- Finegold, S.M. and E.J. Baron, 1986. Baily and Scott's Diagnostic Microbiology. 7th Edn., The C. V. Mosby Company, St. Louis, Toronto.
- Forbes, B.A., D.F. Sahm and A.S. Weissfeld, 2002. Baily and Scott's Diagnostic Microbiology. 11th Edn., Mosby, Inc., St Louis, MO, USA.
- Harlow, H.J. and R.A. Nelson, 1990. Seasonal serum urea-creatinine ratios in wild and captive American badgers, *Taxidea taxus*. *Comp. Biochem. Physiol. A Physiol.*, 95: 65-68.
- Jimale, M.A., A.M. Dahir, I.M. Halane and G. Bono, 1990. Diurnal variations in blood levels of some haematochemical and hormonal parameters in grazing dromedaries. Proceedings of the International Conference on Camel Production and Improvement, December 10-13, 1990, Tobruk, pp: 160-165.
- Khan, A.A. and I.S. Kohli, 1978. A note on some haematological studies on male camel (*Camelus dromedaries*) before and during rut. *Indian J. Anim. Sci.*, 48: 325-326.
- Khan, A.A. and I.S. Kohli, 1981. Blood serum cholesterol in male camel (*Camelus dromedaries*) before and during rut. *Indian Vet. J.*, 58: 498-498.
- Leese, A.S., 1927. A Treatise on the One-Humped Camel in Health and Disease. Haynes and Son, Lincolnshire, Pages: 382.
- Marai, I.F.M., A.E.B. Zeidan, A.M. Abdel-Samee, A. Abizaid and A. Fadiel, 2009. Camels reproductive and physiological performance traits as affected by environmental conditions. *Trop. Subtrop. Agroecosyst.*, 10: 129-149.
- Marie, M.E., 1987. Endocrinological bases of sexual function in camels (*Camelus dromedaries*). Ph.D. Thesis, Faculty of Veterinary Medicine, University of Paris, France.
- Moustafa, M.A., 1969. Biochemical analysis of normal camel blood. B.V.Sc. Thesis, Faculty of Veterinary Medicine, Cairo University, Egypt.
- Nasr, H., 1959. The blood picture of adult male camels (*Camelus dromedaries*). *Vet. Med. J.*, 6: 183-183.
- Nassar, S.M., S.A. Mansour and L.A. Lotfi, 1977. Influence of sex on the normal blood picture of adult Egyptian camel (*Camelus dromedarius*). *Assiut Vet. Med. J.*, 4: 43-50.
- Ouajd, S. and B. Kamel, 2009. Physiological particularities of dromedary (*Camelus dromedarius*) and experimental implications. *Scand. J. Lab. Anim. Sci.*, 36: 19-29.
- Patodkar, V.R., A.P. Somkuwar, S. Parekar and N. Khade, 2010. Influence of sex on certain biochemical parameters in nomadic camels (*Camelus dromedaries*) nearby Pune, in Maharashtra. *Vet. World*, 3: 115-117.
- Ragab, A.M., 1975. Haematological and biochemical studies on camels infested with parasitic nematodes of the family Trichostrongylidae. B.V.Sc. Thesis, Faculty of Veterinary Medicine, Cairo University, Egypt.

- Roy, A.K., 2007. Effect of biochemical, hormonal and behavioral factors at the beginning of puberty in young male camels. Proceedings of the International Camel Conference on Recent Trends in Camelids Research and Future Strategies for Saving Camels, February 16-17, 2007, Rajasthan, India, pp: 89-96.
- Saeed, A., M.M. Hussain, I.A. Khan, G. Chand and R.A. El-Yousuf, 2004. Effect of sex and age on blood biochemical in camel. *J. Camel Pract. Res.*, 11: 73-76.
- Snedecor, G.W. and W.G. Cochran, 1967. *Statistical Methods*. 6th Edn., Iowa State University Press, Ames, IA., USA., Pages: 593.
- Tibary, A. and A. Anouassi, 1997. *Therigenology in Camelidae*. 1st Edn., Ministry of Agriculture and Information, United Arab Emirates.
- Wardeh, M.F., 1992. Importance of camels in the Arabic countries. Proceedings of the Training Course on Camel Diseases, April 11-30, 1992, Cairo, Egypt, pp: 107-113.
- Wilson, R.T., 1988. *The Camel*. 2nd Edn., Longman, London, New York.
- Yagil, R. and Z. Etzion, 1980. Hormonal and behavioural patterns in the male camels (*Camelus dromedaries*). *J. Reprod. Fertil.*, 58: 61-65.
- Zarrouk, A., O. Souilem and J.F. Beckers, 2003. Actualities of reproduction in she-camels (*Camelus dromedaries*). *Revue Elev. Med. Vet. Pays Tropi.*, 56: 95-102.