Ovarian activity, biochemical changes and histological status of the dromedary she-camel as affected by different seasons of the year

M.A. El-Harairy[1], A.E.B. Zeidan[2], A.A. Afify[2], H.A. Amer[3], and A.M. Amer[1]
1. Department of Animal Production, Faculty of Agriculture, Mansoura University, Egypt.
2. Animal Production Research Institute, Dokki, Giza, Egypt.
3. Department of Theriogenology, Faculty of Veterinary Medicine, Zagazig University, Egypt.
dr_mona_zaki@yahoo.co.uk

Abstract: The present study aimed to investigate the effect of different seasons of the year on body thermoregulation (rectal temperature, respiration rate and pulse rate), blood hematology (hemoglobin, packed-cell volume, red blood cells and white blood cells counts), blood components (total protein, albumin, globulin, aspartate-aminotransferase, alanine-aminotransferase, alkaline phosphatase, acid phosphatase, cholesterol, sodium, potassium, calcium, total phosphorus, testosterone and oestradiol-17β hormone concentrations of the dromedary she–camel. Histological changes of the right and left ovaries were also recorded. The obtained results showed that, rectal temperature and respiration rate in the dromedary she-camels increased significantly (P<0.05) during summer as compared to the other seasons. However, pulse rate showed significantly (P<0.05) lower during winter than other seasons. The highest (P<0.05) values of hemoglobin, packed-cell volume and red blood cells count were recorded during summer, while the lowest (P<0.05) value of the white blood cell's was recorded during autumn season. Total protein, albumin and globulin concentrations (mg/dI) were increased insignificantly during summer season as compared to other seasons. Aspartate-aminotransferase, alanine-aminotrasferase enzymes, sodium and calcium concentrations of the dromedary she–camels increased significantly (P<0.05) during summer, while potassium and total phosphorus concentrations (mg/dl) increased significantly (P<0.05) during spring as compared to other seasons. The lowest (P<0.05) value of alkaline phosphatase and acid phosphatase enzymes were recorded during winter season. Testosterone, oesterdiol-17β hormone and cholesterol concentrations were significantly (P<0.05) higher during winter than other seasons of the year. The histological examination of the left and right ovaries in different seasons of the year revealed higher activity in spring and winter than summer and autumn seasons. The left ovary showed more growing and mature follicles and higher activity than the right one. *In conclusion,* the female dromedary camels display ovarian activity during the non-breeding season. So, the environmental temperature, relative humidity and daylight length seemed to play the major role in the regulation of seasonal ovarian activity in the female dromedary camels. [Nature and Science. 2010;8(5):54-65]. (ISSN: 1545-0740).

Key words: Seasons, She-camel-ovaries, testosterone, oesterdiol-17β, cholesterol

1. Introduction

Reproduction is an important factor in economics of the animal production. The camel is a domesticated animal whose full agricultural reproductive potential has not yet been achieved. It is fully adapted to the rigours of the extreme diurnal variations of temperature of the arid zones of Africa and Asia and therefore requires little expenditure in terms of housing or shelter. The *dromedarius* and *bactrianus* camels are both regarded as seasonal breeders (Wilson, 1984). The impression gained is that decreasing day length is the stimulus to seasonally, but it is obvious that, in dromedary camels near the equator factors such as rainfall, nutrition and management (Wilson, 1984), may override the effect of photoperiod (Merkt *et al.,* 1990) and allow breeding to occur throughout the year (Arthur *et al.,* 1982). The breeding season of camels varies geographically, since the environmental factors affect temporally the pattern of reproduction in this species (Gombe and Okela, 1977). Camels are induced ovulators and exhibit follicular cycles with follicles developing and regressing successively and ovulation will occur only when mating takes place (Elias *et al.*, 1984 and Ismail, 1987). Daylight ratio and temperature are the two main climatic factors influencing the annual sexual cycles. However, numerous investigations have shown that the most efficient climatic factors are the variation in the daylight ratio (Hafez, 1987), although the length of daylight seems to be the primary stimulus for seasonally in reproduction. On the other hand, the respective activity of the left and right ovary has attracted interest from different scientists because of the fact that, the majority of pregnancies are established in the left horn of the uterus (El-Wishy, 1987and Shalash, 1987). The blood components are

the mirror which reflects the healthy condition of animals. So, the biochemical studies under different fluctuating climatic conditions are very important for clinicians in the field during interpretation of their findings. Minerals and trace elements has long been known to be important in animal nutrition as they may be dietary essential and vital to enzyme processes of living cells or have some metabolic activity, bone formation and reproductive performance. However, very few studies have demonstrated the endocrinological and physiological bases of seasonality in the female camels. The present study aimed to investigate the effect of different seasons of the year on body thermoregulation, blood hematology and blood components of the dromedary she–camel. Histological status of the right and left ovaries, were also studied.

2. Materials and Methods

The present study was conducted in the Laboratory of Physiology in the Department of Animal Production, Faculty of Agriculture, Mansoura University, in co-operation with Animal Production Research Institute, Egypt. The present work was carried out in the Private Camels Farm, Belbies City, Sharkiya Governorate, located in the North Eastern part of the Nile Delta (30ºN).

The present work aimed to investigate the effect of seasons of the year on body thermoregulation (rectal temperature, respiration rate and pulse rate), blood hematology (hemoglobin, packed-cell volume, counts of red blood cells and white blood cells), blood components (total protein, albumin, globulin, aspartate-aminotransferase: AST, alanine-aminotransferase: ALT, Alkaline phosphatease: ALP and acid phosphatase: ACP, sodium, potassium, calcium, total phosphorus, testosterone and oestradiol-17β hormones). A total number of 220 clinically healthy she-camels were used in this study. The age of these camels varied from 5 to 10 years and their weights were approximately 500 kg.

Minimum and maximum values of air temperature (ºC), relative humidity (%), temperature–humidity index (THI) and length of daylight (hours) of different seasons of the year are shown in Table 1. The temperature – humidity index (THI) was estimated according to the following formulae:

THI=Td-(0.55-0.55×RH) (Td -58.00) where Td= dry bulb temperature in Fahrenheit and RH = relative humidity percentage in decimals as the method described by West (2003).

Thermal parameters:

Rectal temperature, respiration rate and pulse rate were measured three times daily at 0800, 1200 and 1500h during different seasons of the year. Rectal temperature (ºC) was obtained gently by inserting the digital liquid thermometer for 15 –20 cm in the rectum for two minutes. Respiration rate (r.p.m.) was determined by counting the frequency of flank movement per one minute. Pulse rate (p.p.m.) was determined by counting the frequency of the jugular vain with hand per minute. All possible precautions were taken in consideration to avoid disturbing the animal, including counting the respiration breaths and pulse rate just before measuring the body temperature.

Blood hematology:

Blood samples were collected from each animal in dry clean screw caped tube and divided into two portions. The first portion was taken to determine hemoglobin concentration (g/dl),packed-cell volume (%), counts of red blood cells($x10^6/mm^3$) and white blood cells ($x10^3/mm^3$).The second portion was centrifuged at 600*g* for 15 minutes for the separation of serum and stored in a deep freezer at –20°C for assaying of total protein , albumin, globulin, AST, ALT, ALP, ACP, sodium, potassium, calcium, total phosphorus, testosterone and estradiol-17 β concentrations.

Hemoglobin concentration was determined in fresh blood samples using haemoglobinometer according to Tietz (1982). Packed–cell volume (%) was estimated by haematocrit capillary tube and centrifuged at 600 *g* for 20 minutes. Haematocrit value was read and recorded according to Wintrobe (1965). Red blood cell's (RBC's)and white blood cell's (WBC's) were counted in fresh blood sample using haemocytometer and counted at x40 objective of phase contrast microscope according to Hawakey and Dunnett (1989).

Blood serum components:

Total protein was determined colourimetrically according to Biuret method as described by Welchselbaum (1946). Albumin concentration was determined colourimetrically according to Weis (1965).Globulin level was calculated by subtraction of albumin content from the total protein value.

Aspartate-aminotransferase (AST), alanine-aminotransferase (ALT) activities were determined colourimetrically using the method described by Reitman and Frankle (1957). Alkaline phosphatease (ALP) and acid phosphatase (ACP) activities were determined colourimetrically using commercial kits purchased from Bio-Merieux (Marcy L'Eltoile, Charbonnieres, Les Bains, France) according to Graham and Pace (1967).

Sodium, calcium, potassium and total phosphorus concentrations were determined colourimetrically according to the method described by Kuttner and Liechtenstein (1930), Trinder (1951), Sunderman Jr. and Sundarman (1958) and Gindler (1972).

Testosterone and oesterdiol-17β concentrations were determined in blood serum by Radiommunoassay Technique (RIA) of Coat-Ab-Count Kits (Diagnostic Products Corporation-Los Angles, USA) according to Abraham (1977) and Pratt (1978).

Histological changes in the ovaries:

For histological studies, the ovaries, were taken and put in formalin solution (10%) to preserved, then it passes in ordinary histological set (by putting small pieces of the fresh tissue in the proper fixative as 10%formalin saline). Then the fixed tissues are washed in running tap water to remove fixative from them, and then the water was removed by treatment with ethyl alcohol (70, 90 and 100%). These ascending grades of alcohol prevent shrinkage of tissues and it removes the water completely from the fixed tissues. Then the tissues are treated with clearing agents as xylol or benzol to remove alcohol and to allow the fixed tissues to be miscible with paraffin which will be used in the next step. Then the tissues are put in melting soft paraffin wax at 50 °C in then oven. The paraffin will penetrate in between the cells of the tissues. This process of paraffin in filtration is a necessary step to harden the tissues before their embedding. The tissues are then embedded in the center of melted and hard paraffin. The paraffin was then allowed to be cooled-down in order to form a block of hard paraffin with tissues in its center. The block of hard paraffin with the tissues in its center was then cut into thin sections by mean of a rotatory micro tome. The thin paraffin sections are then put on clean glass slides smeared with albumen glycerin to flow beneath the sections and the then we warm the slides on hot plate. Thereafter the sections were preserved for several hours in the incubator to dray. The sections are now fixed on the slides and are ready to be stained by haematoxlin and eosin (H&E) according to Carleton and Drurg (1967). After the staining, the slide was examined by binuclear microscope and photographed by magnification x10 and 40.

Statistical analysis:

Data were statistically analyzed using least squares Analysis of Variance according to Snedecor and Cochran (1982). Percentage values were transformed to arc-sin values before being statistically analyzed. Duncan's New Multiple Range test (Duncan, 1955) was used for the multiple comparisons.

3. Result Analysis

Data presented in Table (2) showed that the effect of different seasons of the year on rectal temperature and respiration rate was significant ($P<0.05$), being higher during summer than in winter, spring and autumn seasons. The highest ($P<0.05$) value of the rectal temperature was recorded during summer and the lowest ($P<0.05$) value during winter season. However, the effects of different seasons of the year on pulse rate was also significant ($P<0.05$), being lower during winter than summer, autumn and spring seasons. The highest ($P<0.05$) value of the pulse rate was recorded during summer and the lowest ($P<0.05$) value during winter season. The overall mean of pulse rate was 51.66.

Data presented in Table (3) showed that hemoglobin percentage (Hb %) in the dromedary she-camel during summer and autumn was significantly ($P<0.05$) higher than spring and winter seasons. The highest ($P<0.05$) value of hemoglobin was recorded during summer and the lowest ($P<0.05$) value during winter season.

Table (1): Mean air temperature (°C), daylight length, relative humidity (%) and temperature-humidity index (THI) values, during the different seasons of the year.

Seasons of the year	Air temperature (°C)		Relative humidity (%)		Temperature-humidity index (THI)		Length of daylight (hours)
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
Winter	8.86±0.21	19.15±0.35	48.62±0.35	4.33±1.15	45.11	64.81	11.55
Spring	13.6±0.18	24.16±0.18	37.41±0.43	2.64±1.21	56.08	70.93	14.13
Summer	20.84±0.32	34.3±0.46	38.83±0.48	53.66±0.95	65.64	84.63	15.24
Autumn	15.43±0.12	28.62±0.42	42.67±0.62	58.42±1.32	59.21	77.68	13.00

Table (2): Rectal temperature, respiration rate and pulse rate in the dromedary she–camels, during different seasons of the year.

Items	Season of the year			
	Spring	Summer	Autumn	Winter
Rectal temperature (˚C)	37.46 ± 0.16 [b]	38.83 ± 0.67 [a]	36.80 ± 0.37 [b]	36.33 ± 0.33 [b]
Respiration rate(r.p.m.)	14.66 ± 0.63 [b]	23.66 ± 0.47 [a]	14.70 ± 0.43 [b]	12.73± 0.29 [b]
Pulse rate (p.p.m.)	52.26 ± 0.31 [a]	52.41 ± 0.44 [a]	52.30 ± 0.43 [a]	49.66± 0.4 [b]

Means bearing different letters within the same row, differ significantly (P<0.05).

Table (3): Blood hematology in the she-camels, during different seasons of the year.

Items	Season of the year			
	Spring	Summer	Autumn	Winter
Hemoglobin (g/dl)	10.93 ± 0.43 [b]	12.30± 0.29 [a]	12.10 ± 0.45 [a]	10.36 ± 0.35 [b]
Packed-cell volume (%)	31.28 ± 0.33 [b]	34.24±1.46 [a]	30.64 ± 1.02 [b]	30.43 ± 0.84 [b]
White blood cell's ($x10^3/mm^3$)	12.16± 0.41 [a]	11.35 ± 0.61 [a]	9.12 ± 0.36 [b]	10.78 ± 0.34 [a]
Red blood cell's ($x10^6/mm^3$)	10.25 ± 0.24 [bc]	11.84 ± 0.21 [a]	11.23±0.67 [ab]	9.37± 0.34 [c]

Means bearing different letters within the same row, differ significantly (P<0.05)

Table (4): Some blood serum components in the dromedary she-camels, during different seasons of the year.

Item	Seasons of the year			
	Spring	Summer	Autumn	Winter
Total protein (mg/dl)	8.53 ± 0.83 [a]	8.80 ± 0.21 [a]	8.43 ± 0.26 [a]	8.36 ± 0.33 [a]
Albumin (mg/dl)	5.50 ± 0.61 [a]	5.54 ± 0.12 [a]	5.24 ± 0.43 [a]	5.22 ± 0.21 [a]
Globulin (mg/dl)	3.03 ± 0.14 [a]	3.26 ± 0.49 [a]	3.19 ± 0.65 [a]	3.14 ± 0.17 [a]
AST(U/L)	16.53 ± 1.77 [b]	26.51 ± 1.59 [a]	15.54 ± 1.29 [b]	17.35 ± 1.52 [b]
ALT(U/L)	5.16 ± 0.66 [b]	7.33 ± 0.64 [a]	5.79 ± 0.26 [b]	5.04 ± 0.71 [b]
ALP(U/L)	88.48± 1.61 [a]	88.64 ± 1.99 [a]	86.43 ± 1.83 [a]	67.40 ± 1.30 [b]
ACP(U/L)	25.20 ± 0.27 [b]	27.43 ± 0.86 [a]	25.08 ±0.49 [b]	22.76 ± 0.61 [c]
Cholesterol (mg/dl)	72.10 ±2.10 [b]	72.66 ± 1.45 [b]	74.33 ± 2.09 [b]	78.65± 1.04 [a]
Sodium (mg/dl)	128.66 ± 3.37 [c]	137.10 ± 4.05 [a]	125.66 ± 2.13 [c]	133.20± 2.32 [b]
Calcium (mg/dl)	10.21 ± 0.43 [b]	11.30 ± 0.52 [a]	6.86 ± 0.87 [d]	8.63 ± 1.04 [c]
Potassium (mg/dl)	6.60 [a] ± 0.42	4.43 [b] ± 0.12	4.90 [b] ± 0.33	4.93 [b] ± 0.15
Total phosphorus	6.23 [a] ± 0.48	5.10 [b] ± 0.34	5.21 [b] ± 0.89	5.14 [b] ± 0.27
Testosterone (pg/ml)	7.30[c] ± 0.63	5.80 [d] ± 0.43	10.70[b] ± 0.32	31.20[a] ± 1.48
Oestradiol -17ß	56.15[b] ± 1.25	20.13 [d] ± 1.02	28.16 [c] ± 1.31	62.18[a] ± 1.16

a,b,c and d means bearing deferent letters within the same row, differ significantly (P<0.05).
AST: Aspartate-aminotransferase.
ALT: Alanine-aminotransferase.
ALP: Alkaline phosphatase.
ACP: Acid phosphatase.

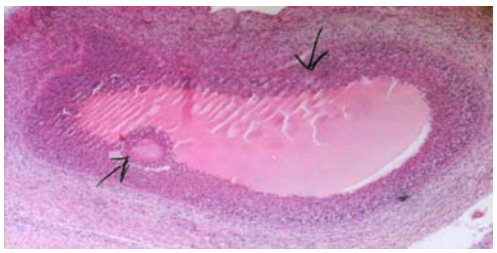

Plate 1. Cross section in the left ovary of she-camel during winter showing mature graffian follicles (Stained by H & E x 40).

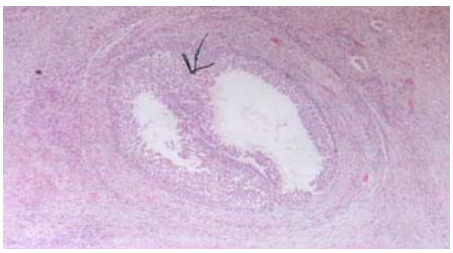

Plate 2. Cross section in the left ovary of she-camel during spring showing growing follicles (Stained by H & E x 40).

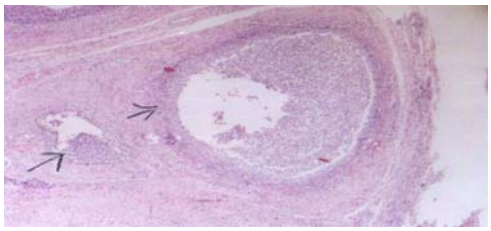

Plate 3. Cross section in the left ovary of she-camel during autumn showing a growing follicle (Stained by H & E x 40).

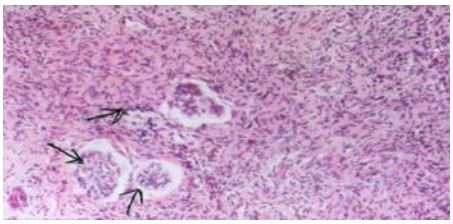

Plate 4. Cross section in the cortex of left ovary of she-camel during summer primordial follicles (Stained by H & E x 40).

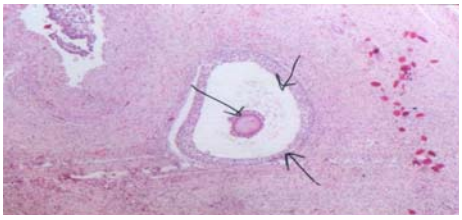

Plate 5. Cross section in right ovary of she-camel during winter showing degenerated follicles (Stained by H & E x 40).

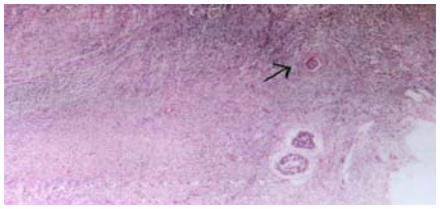

Plate 6. Cross section in right ovary of she-camel during spring showing secondary follicles (Stained by H & E x 40).

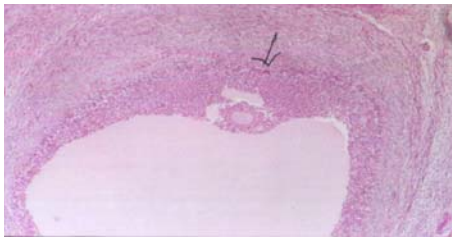

Plate 7. Cross section in right ovary of she-camel during autumn showing mature follicles (Stained by H & E x 40).

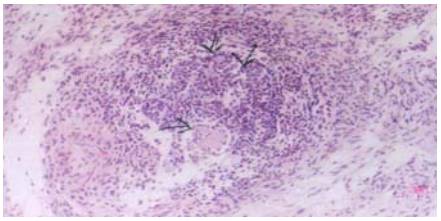

Plate 8. Cross section in right ovary of she-camel during summer showing primordial follicles (Stained by H & E x

The effects of the different seasons of the year on packed-cell volume (PCV) of the dromedary she-camel were significant (P<0.05). Packed-cell volume in the dromedary she-camel was significantly (P<0.05) higher during summer and significantly (P<0.05) lower during winter season. The overall mean of PCV during all seasons was 31.65 %, The white blood cells count ($x10^3/mm^3$) of the dromedary she-camel was significantly (P<0.05) higher during spring, summer and winter than autumn season`. The highest (P<0.05) count of white blood cells (WBC's) was recorded during spring and the lowest (P<0.05) count during autumn season. The values of WBC's tended to be were higher during summer than winter season. The white blood cells count ($x10^3/mm^3$) of the dromedary she-camel was significantly (P<0.05) higher during spring, summer and winter than autumn season. The highest (P<0.05) count of white blood cells (WBC's) was recorded during spring and the lowest (P<0.05) count during autumn season. The values of WBC's tended to be were higher during summer than winter season. The effects of seasons of the year on red blood cells count($x10^6/mm^3$) of the dromedary she-camel was highly significant (P<0.05) being the higher during summer and autumn than winter and spring seasons. The highest (P<0.05) value of red blood cells (RBC's) was recorded during summer and the lowest (P<0.05) value during winter season.

Data presented in Table (4) showed that, the effects of the different seasons of the year on total protein concentration of the dromedary she-camels were insignificant. The highest value of the total protein was recorded during summer and the lowest value during winter season. The effect of seasons of the year on albumin and globulin concentrations of the dromedary she-camels was insignificant. The highest values of the albumin and globulin were recorded during summer, and the lowest values were recorded during winter and spring seasons, respectively. The effects of different seasons of the year on cholesterol concentration of the dromedary she-camels were significantly (P<0.05) higher during winter than summer, spring and autumn seasons. The highest (P<0.05) value of cholesterol was recorded during winter and the lowest (P<0.05) value during summer season.

The effects of different seasons of the year on AST and ALT enzymes activity of the dromedary she-camels were significantly (P<0.05) higher during summer than winter, autumn and spring seasons. The highest (P<0.05) values of AST and ALT enzymes were recorded during summer and the lowest (P<0.05) values during autumn and winter seasons, respectively. The effect of different seasons of the year on alkaline phosphates (ALP) activity of the dromedary she-camels was significantly (P<0.05) higher during summer, spring and autumn than winter season. The highest (P<0.05) value of ALP activity was recorded during summer and the lowest (P<0.05) value during winter season. With regard to acid phosphatase (ACP), the effect of different seasons of the year on acid phosphatase concentration of the dromedary she-camels was significantly (P<0.05) higher during summer than winter, autumn and spring seasons. The highest (P<0.05) value of ACP was recorded during summer and the lowest (P<0.05) value was recorded during winter season.

The effect of different seasons of the year on sodium concentration of the dromedary she-camels was significantly (P<0.05) higher during summer than spring, winter and autumn seasons. The highest (P<0.05) value of sodium was recorded during summer and the lowest (P<0.05) value during autumn season. In respect to calcium, the effect of seasons of the year on calcium concentration of the dromedary she-camels was significantly higher (P<0.05) during summer and spring than winter and autumn seasons. The highest (P <0.05) value of calcium concentration of the dromedary she camel was recorded during summer and the lowest (P<0.05) during autumn season. According to the results of the present work, there was a marked increase in calcium of she-camel during summer and autumn.

The effect of different seasons of the year on potassium concentration of the dromedary she-camels was significantly higher (P<0.05) during spring, winter, and autumn than summer seasons. The highest (P<0.05) value of potassium was recorded during winter and the lowest (P<0.05) value during summer season. With regard to total phosphorus, the effect of different seasons of the year on phosphorus concentration of the dromedary she-camels was significantly (P<0.05) higher during spring than other seasons. The highest (P< 0.05) value of the phosphorus was recorded during spring and the lowest (P< 0.05) value during summer season. The obtained results in showed that the effect of different seasons of the year on testosterone hormone concentration of the dromedary she-camels was significantly (P<0.05) higher during winter than spring, summer and autumn seasons. The highest (P<0.05) value of the testosterone concentration was recorded during winter and the lowest (P<0.05) value daring summer season.

The effect of different seasons of the year on testosterone hormone concentration of the dromedary she-camels was significantly (P<0.05) higher during winter than spring, summer and autumn seasons. The highest (P<0.05) value of the testosterone concentration was recorded during winter and the

lowest (P<0.05) value daring summer season. With regard to ostradiol-17β hormone, the effects of different seasons of the year on oestradiol-17β hormone concentration of the dromedary she-camels were significantly (P<0.05) higher during winter than spring, summer and autumn seasons. The highest (P<0.05) value of the oestradiol-17β hormone was recorded during winter and the lowest (P<0.05) value during summer season.

The histological examination in the left and right ovaries of the dromedary she–camel at different seasons of the year revealed that, camel's ovary showed higher activity in spring and winter than summer and autumn seasons (Plates 1 to 8). The photographs show more ovarian follicles at different stages, primary, secondary, growing, mature and graffian follicles as well as corpora lutea, also corpora hemorrhagic are present. Many follicles were present in the breeding season (winter). The follicles are very clear cell obvious and cell division are also present. The interstitial tissues cells were clear and highly active and many ovulations occur rapidly at the peak of the breeding (spring and winter) compared to the non-breeding season (summer). It was observed that, the ovary in non-breeding season (summer) in comparison with that of other seasons, showed less activity, lower follicle number and higher interstitial tissue, so the ovary in the summer is considered in dormant phase. In respect to ovary side, the left ovary contains growing and mature follicles more than the right one. It can be noticed that, there are no much differences between the left and right ovaries activity in the same season, while the differences became greater among different seasons**.**

3. Discussion

In this study, the effect of different seasons of the year on rectal temperature and respiration rate was significant, being higher during summer than in winter, spring and autumn seasons. The highest value of the rectal temperature was recorded during summer and the lowest value during winter season. Similar trend was observed by Guirgis *et al*. (1992) who found that season had a significant effect on rectal temperature of the dromedary she-camel in Egypt (low in winter and high in summer). The increase in rectal temperature during the hot summer conditions may be minimized temperature gradient between the body and the environment, that resulted in reduce of body heat gain (Abdel-Samee and Marai, 1997), this could be minimized the heat-stress on animals. However, the effects of different seasons of the year on pulse rate were also significant, being lower during winter than summer, autumn and spring seasons. The highest value of the pulse rate was recorded during summer and the lowest (P<0.05) value during winter season. These results are in agreement with those of Zeidan *et al.* (2008). However, Abdel-Samee and Marai (1997) showed that, the pulse rate (counts/minuts) was insignificantly declined as a function of heat stress. The overall mean of pulse rate was 51.66, however, Sarwar *et al.* (1998) reported that, mean pulse rate was 43.46 (counts/minutes) for dromedaries (*Camelus dromedarius*) during the summer season.

Hemoglobin percentage (Hb %) in the dromedary she-camel during summer and autumn was significantly higher than spring and winter seasons. The highest value of hemoglobin was recorded during summer and the lowest value during winter season. These trends are in agreement with those of Zeidan and Abbas (2004). The increase of hemoglobin during non-breeding season may be due to that iron and copper essential for hemoglobin synthesis, since camels during breeding season lose their appetite and body condition with diarrhea (Schalm *et al*., 1975). The effects of the different seasons of the year on packed-cell volume (PCV) of the dromedary she-camel were significant. Packed-cell volume in the dromedary she-camel was significantly higher during summer and significantly lower during winter season. The overall mean of PCV during all seasons was 31.65 %, which was similar to that reported by Nyangao *et al.* (1997) who found that, mean PCV was 27.1, while Rezakhani *et al.* (1997) and Zeidan and Abbas (2004) found that, PCV was 28.94% in dromedary camel. The white blood cells count ($x10^3/mm^3$) of the dromedary she-camel was significantly higher during spring, summer and winter than autumn season`. The highest count of white blood cells (WBC's) was recorded during spring and the lowest count during autumn season. The values of WBC's tended to be were higher during summer than winter season. These results are in agreement with those obtained by Kataria *et al*. (2002) and Zeidan and Abbas (2004). However, disagree with those reported by Rezakhani *et al*. (1997).

The effects of seasons of the year on red blood cells count($x10^6/mm^3$) of the dromedary she-camel was highly significant being the higher during summer and autumn than winter and spring seasons. The highest value of red blood cells (RBC's) was recorded during summer and the lowest value during winter season. The mean value of RBC's was higher during summer than winter, similar to that reported by Zeidan and Abbas (2004). The reduction of blood hematological parameters during winter may be due to reduced oxygen intake caused by increasing ambient temperature, thus reducing metabolic heat

production. In addition, Ashour *et al*. (1995) suggested that, heat-stress decreased the level of adrenocorticotrphic hormone (ACTH) which in turn decreases the value of hemoglobin, RBC's, WBC's and PCV, due to the stimulatory effect of ACTH on erythropoiesis.

The highest value of the total protein was recorded during summer and the lowest value during winter season. These results are in agreement with those of Abdel-Samee and Marai (1997) who recorded that the total protein, in camels did not show significant change during different seasons of the year. However, these results disagreed with those obtained by Amin (1993) and Ahmadi (2001) who found significant increase in total protein concentration during summer as compared to the other seasons in camels. The increase of total protein during summer may be attributed to exposure to heat-stress which represented the potent stimulus for growth releasing hormones (Maxwell and Kleemon, 1980) which lead increase plasma protein that considered important in maintaining plasma water (Horowiz and Adler, 1983) or due to haemoconcentration during summer. Moreover, physiological hypothyroidism during summer was accompanied by protein deposit for retaining plasma water (Ganong, 1979). They stated the effect of seasons of the year on total proteins revealed a significant increase during summer in camels.

Non significant effect of seasons of the year on albumin and globulin concentrations of the dromedary she-camels was observed. The highest values of the albumin and globulin were recorded during summer, and the lowest values were recorded during winter and spring seasons, respectively. These results are in agreement with those of Gupta (1994) and Abdel-Samee and Marai (1997) who found that the albumin and globulin concentrations in camels did not show significant change between the seasons. These results for blood components may be reflect the greater ability of camels to adapt to heat stress.

The effects of different seasons of the year on cholesterol concentration of the dromedary she-camels were significantly higher during winter than summer, spring and autumn seasons. The highest value of cholesterol was recorded during winter and the lowest value during summer season. These results are in agreement with those of Nazifi and Gheisari (1999) and Zeidan *et al.* (2008) who found that, the concentration of serum cholesterol was significantly higher in winter than in summer months.

Significantly higher effects of different seasons of the year on AST and ALT enzymes activity of the dromedary she-camels were observed during summer than winter, autumn and spring seasons. The highest values of AST and ALT enzymes were recorded during summer and the lowest values during autumn and winter seasons, respectively. Mobilization of the liver functions may be partially affected by heat-stress during non-breeding season (Abd El-Samee and Marai, 1997). However, these results disagreed with those of Ahmadi (2001) who found that, the effects of seasons of the year on AST and ALT concentrations of the male dromedary camels were significantly higher during summer than spring, winter and autumn seasons.

The effect of different seasons of the year on alkaline phosphates (ALP) activity of the dromedary she-camels was significantly higher during summer, spring and autumn than winter season. The highest value of ALP activity was recorded during summer and the lowest value during winter season. These results are in agreement with those of Sarhan (2007) and Zeidan *et al*. (2008) who reported that, alkaline phosphatase concentration was higher during non-breeding than breeding season.

With regard to acid phosphatase (ACP), the effect of different seasons of the year on acid phosphatase concentration of the dromedary she-camels was significantly higher during summer than winter, autumn and spring seasons. The highest value of ACP was recorded during summer and the lowest value was recorded during winter season. These results are in agreement with those of Kataria *et al.* (1991) who showed that, activities of ACP was significantly higher during extremely hot conditions (May-June) than in extreme cold (December-January) .

Generally, the blood enzymes are easily and often influenced by the external environment including feeding practices, type of shelter and many other aspects of herd management, since they are intimately related to metabolism. Accordingly, seasonal changes of the enzymes are very important and must be considered. In addition, it is also important to control carefully all experimental conditions, especially environmental ones when measuring the enzyme activity in any animal (Boots *et al.,* 1969).

The effect of different seasons of the year on sodium concentration of the dromedary she-camels was significantly higher during summer than spring, winter and autumn seasons. The highest value of sodium was recorded during summer and the lowest value during autumn season. These results are in agreement with those of Ahmadi (2001) and Zeidan *et al*. (2008) who found that, the highest value of sodium was recorded during summer. Amin (1993) confirmed that the normal sodium values of adult male camel were 158.10, 162.60, 139.25 and 135.20m. Equiv/L during spring, summer, autumn

and winter seasons, respectively. These results may be attributed to the combined effect of both absorption and reabsorption of sodium and chloride from the alimentary tract and kidney, under the effect of aldosterone which had higher level in the summer and this was accompanied by an increase of plasma sodium level (Yagil and Etzion, 1979).

In respect to calcium, the effect of seasons of the year on calcium concentration of the dromedary she-camels was significantly higher during summer and spring than winter and autumn seasons. The highest value of calcium concentration of the dromedary she camel was recorded during summer and the lowest during autumn season. According to the results of the present work, there was a marked increase in calcium of she-camel during summer and autumn. Similarly, Abbas and Musa (1989) reported that there was a marked increase is calcium of the camel during spring and summer, while this increase was highly significant during spring in compared with that during winter season.

The effect of different seasons of the year on potassium concentration of the dromedary she-camels was significantly higher during spring, winter, and autumn than summer seasons. The highest value of potassium was recorded during winter and the lowest value during summer season. These results are in agreement with those of Zeidan and Abbas (2004) who reported that, potassium concentration was higher during breeding than non-breeding season. Amin (1993) confirmed that the average value of potassium in adult male camel were 4.48, 3.95, 4.61 and 5.22 m Equiv./L during spring, summer, autumn and winter seasons, respectively. The decrease of potassium concentration during summer may be attributed to an increase of aldosterone secretion in hot and dry climate which enhanced by remain-angiotensin system in response to changes in effective circulating fluid volume where aldosterone balance largely plasma potassium, through its effect on renal resorption of sodium in exchange for potassium and hydrogen ion (Kaneko,1980).

With regard to total phosphorus, the effect of different seasons of the year on phosphorus concentration of the dromedary she-camels was significantly higher during spring than other seasons. The highest value of the phosphorus was recorded during spring and the lowest value during summer season. Similarly, Abrams (1951) found that phosphorus level was higher in camel during the green season (winter) than the dry one (summer).

The effect of different seasons of the year on testosterone hormone concentration of the dromedary she-camels was significantly higher during winter than spring, summer and autumn seasons. The highest value of the testosterone concentration was recorded during winter and the lowest value daring summer season. These results are in agreement with those of Abd El-Azim (1996) who found that the testosterone levels increased during winter and decreased during summer season. The increase of testosterone may be due to the increase of androgen level is parallel to the increase of sexual activity in winter and spring seasons. In addition, the decrease of androgen production during the non-breeding season could be explained by the effect of environmental cause as phosphoperiodism, rainfall, temperature and humidity. Bedrak *et al.* (1983) recorded a significant low levels in testosterone during the non-breeding season which holds good with the results of the present study attributed that to the low gonadotropins and high prolactin levels in the blood. At the same time, the low gonadotropins level in the non-breeding season could be explained by the inhibitory effect of prolactin secretion (Gold and Ganong, 1967). The seasonal rhythm of prolactin secretion is influenced by photoperiodism in which concentrations being high under long days and low under short days (Almeida and Lincoln, 1984).

With regard to ostradiol-17β hormone, the effects of different seasons of the year on oestradiol-17β hormone concentration of the dromedary she-camels were significantly higher during winter than spring, summer and autumn seasons. The highest value of the oestradiol-17β hormone was recorded during winter and the lowest value during summer season. These results are in agreement with those of Agarwal *et al.* (1987) who found that the oestradiol-17β levels elevated during breeding and low non-breeding seasons, Abd El-Azim (1996) in dromedary camel showed that the highest level of oestradiol-17β hormone was recorded in winter and spring and the lowest level in autumn and summer. These results may be attributed to the involvement of estrogens in modulation of sexual behaviour (McEwen, 1976) and testosterone secretion (Eiler and Graves, 1977). It is hypothesized that decreasing light hours and probably low temperature might be instrumental in triggering the hypothalamic hypophysical axis as it observed in other short day breeders like sheep (Turrek and Campbell, 1979). In addition, Bedrak *et al.* (1983) observed that the relative activity of several enzymes associated with testosterone and its conversion to estrogen in the blood plasma of dromedary camel was significantly lower during the non mating season than that of the mating one.

The histological examination in the left and right ovaries of the dromedary she – camel at different seasons of the year revealed that, camel's ovary showed higher activity in spring and winter than summer and autumn seasons. The photographs show

more ovarian follicles at different stages, primary, secondary, growing, mature and graffian follicles as well as corpora lutea, also corpora hemorrhagic are present. Many follicles were present in the breeding season (winter). The follicles are very clear cell obvious and cell division are also present. The interstitial tissues cells were clear and highly active and many ovulations occur rapidly at the peak of the breeding (spring and winter) compared to the non-breeding season (summer). It was observed that, the ovary in non-breeding season (summer) in comparison with that of other seasons, showed less activity, lower follicle number and higher interstitial tissue, so the ovary in the summer is considered in dormant phase. Similar trends were recorded by Amer (2004), Sarhan (2007) and Zeidan *et al.* (2008). In respect to ovary side, the left ovary contains growing and mature follicles more than the right one. It can be noticed that, there are no much differences between the left and right ovaries activity in the same season, while the differences became greater among different seasons. Similar trend was reported by Amer (2004) and Zeidan *et al.* (2008). The respective activity of the left and right ovary has attracted interest form different scientists because of the fact that the majority of pregnancies are established in the left horn of the uterus. Many authors have tried to explain the predominance of left- horn pregnancies in the camel date by a difference in follicular activity and incidence of ovulation between the left ovary and the right ovary or by an increased incidence of ovulation between the left ovary and the right ovary or by an increased incidence of embryo mortality for the right ovary horn pregnancies (El- Wishy, 1987, Shalash 1987 and Zeidan *et al.,* 2008)

4. Conclusion

The female dromedary camels (*Camelus dromedarius*) display ovarian activity during the non-breeding season. Body temperature, blood components, hormonal patterns and histological status in the ovarian she-camel showed better, during the breeding season in winter (short daylight) than the non- breeding season in summer (long daylight). In addition, the left ovary appears more active than the right one. So, the environmental temperature, relative humidity and daylight length seemed to play the major role in the regulation of seasonal ovarian activity in the female dromedary camels. Further detailed studies are required to compare the reproductive efficiency of the dromedary she-camels during the non–breeding season, under Egyptian environmental conditions.

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