SEASONAL VARIATIONS IN SOME HORMONES AND HEMATOLOGICAL PARAMETERS OF FEMALE EGYPTIAN BUFFALO

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ABSTRACT

The aim of this investigation is to study the effect seasonal variations in Egypt on hematological parameters, reproductive and metabolic hormones of Egyptian buffalo-cows. This study lasts one year extended from December 2009 to November 2010 and conducted on sixty buffalo-cows. Monthly selected group of 5 buffalo-cows which were at estrus phase then blood sampling through tail vein puncture in the 2nd day after natural service, divided in two samples one with anticoagulant for hematological analysis and the other without anticoagulant for serum separation. Results of this investigation revealed that the highest atmospheric temperature was in hot summer (32.61±1.12 C^{o}) versus to (26.18±1.67 C^{o}) in spring and (19.92±0.70 C^{o}) in winter season, while the highest relative humidity % was in winter season (43.50±1.60%) versus to (32.50±2.29%) in summer season. The rise in temperature-Humidity index from (63.73±1.29) in winter to (78.53±1.58) in summer indicates sever heat stress which associated with significant reduction in total red blood cell count (3.20±0.15x10^{6}), hemoglobin concentration (8.83±0.43 g/dl), packed cell volume (30.73±0.12%), serum progesterone hormone concentration (0.56±0.03 ng/mll), estradiol17-B concentration (16.8±0.64 ng/ml), triiodothyronin (T3) concentration (2.33±0.33 ng/ml) and thyroxin hormone (T4) concentration (21.66±1.66 ng/ml), while hot summer resulted in significant increase in mean cell volume (96.55±2.25 fl), mean cell hemoglobin (30.81±1.33 pg), total white blood cell count (10.63±0.97x10^{3}), neutrophils % (41.00±2.64%), lymphocytes % (58.77±0.97%), serum prolactin hormone (PRL) concentration (23.45±1.72 ng/ml) and cortisol hormone concentration (4.47±0.33 ng/ml) compared to winter season. There was no significant seasonal variation in mean cell hemoglobin concentration (MCHC).

It was concluded that In Egypt there was a seasonal variation in atmospheric temperature, relative humidity, temperature humidity index (THI) and the rise in THI above the upper critical level (72 units) for lactating buffalo-cows in Egypt is the major constraint on buffalo-cows hematological parameters and hormonal secretion whish affects animal reproduction. Hence we should improve climatic conditions in side the dairy farm to eliminate or reduce summer infertility.

Key words: *Egypt, Season, Buffalo-cows, hematology, hormones.*

INTRODUCTION

Buffalo is the back bone of animal production in Egypt. Egypt has a total number of 3.92 million heads of buffalo (FAO, 2005) which plays a major role in the rural agricultural practice. However this species is reputed for low reproductive potentials as indicated by late age of maturity, seasonality, ovarian inactivity, endometritis, long calving intervals and silent heat **(Ahmed, 2006)**. The incidence of silent heat was low in winter and very high in summer months**(Kassim and Nany, 1999)**.

The seasonal changes in thermal environment influence the physiological responses of animals. Since The performance of animals is a product of interaction between environment and genotype **(Kadzera et al., 2002)**. Buffaloes are seasonally poly estrous and are reproductively less active in summer. During summer, when ambient temperature and photoperiod are at their maximum, prolactin level are highest **(Kaker et al., 1982)** and plasma progesterone hormone (P4) levels are lowest **(Rao and Pandey, 1982)**. High ambient temperature may also contribute to seasonality by depressing the male libido.

MATERIALS AND METHODS

1- Climatic data recording :

Temperature- humidity meter was used to record monthly atmospheric temperature (AT Co) and relative humidity % at buffalo dairy farm at day of blood sampling, then calculated temperature humidity index (THI) as described by (Ravagnolo et al., 2000) using the following formula:

THI = (9/5 temp c^o+32) - (11/2-11/2xRH/100) x (9/5 temp c^o- 26).

2- Experimental animals:

The study was conducted on sixty normal, lactating, cycling (met estrus) Egyptian buffalo-cows which have the same average body weight of 350-400 kg, and about 4.5-5 years old (3^{rd} lactation stage), they maintained at Bilquas, Al-Khazendar dairy farm.

3- Blood sampling and analysis:

Blood samples (about 5-6ml) were collected monthly through tail vein puncture at 10 a.m from each buffalo-cow in the 2^{nd} day to natural service. Immediately 2ml blood delivered into EDTA tube (as anticoagulant) used for hematological analysis. The remaining 3ml of blood sample without anticoagulant for serum separation after centrifugation at 3000 rpm for 15 minutes, serum sample aspirated by automatic pipette and transferred into clean, dry, labeled tubes and kept at -20 C^o till hormonal analysis.

3.a- Hematological examination:

The hematological examination were done as following: manual total erythrocytes and leucocytes count by using hemocytometer according to **(Feldman et al., 2000)**. Determination of hemoglobin concentration spectrophotometerically using cyanemethemoglobin method according to **(Drabkin, 1949)**. Determination of packed cell volume by microhematocrite method according to **(Barbra, 1988)**. Calculation of red blood indices according to **(Feldman et al., 2000)** and differential leucocytes count by staining blood film with giemsa Wright stain according to **(Coles, 1986 and Andreasen; Latimer 1990)**.

3.b- Hormonal analysis:

Ovarian reproductive hormones (progesterone and estradiol 17-beta were determined according to **(Tietz, 1994)**. Metabolic hormones (Prolactin (PRL was determined according to **(Tietz, 1992)**, Triiodothyronin (T3) was determined according to **(Wild, 1994)**, Thyroxine (T4) was derermined according to **(Midgeley John, 2001)** and Cortisol hormone was determined according to **(Buritis et al., 1994)**. These hormones were estimated in serum by ELISA (Enzyme Linked Immunosorbent Assay) and different types of kits.

4- Statistical analysis:

All the results were expressed as means ±SD. Statistical analysis of data carried out by using the computer program **(SPSS, 1994)** and Duncan's Multiple Range Test (DMRT) for testing the significance differences between variables **(M-Stat, 2009)**. Moreover, the correlation (r) was determined between parameters at different seasons during a year. Results were considered significant only at the level of P (<0.05) or less.

RESULTS

1- Climatic data:

Results represented in (Table 1 & Fig. 1) revealed that the highest temperature during summer season, followed by autumn and decreased during spring season while the lowest degree was during winter season. Relative humidity was at the highest percent during winter season, followed by autumn and the lowest percent was during spring and summer season. THI units were highest during summer, followed by autumn and spring season, while the lowest THI units were during winter. Correlation matrix between ambient temperature and relative humidity was highly strong negative correlation r = (-0.713), between temperature and THI was highly strong positive correlation r = (0.998), while between RH% and THI was highly strong negative correlation r = (-0.708).

2- Hematological parameters:

Results represented in (Table 2 & Fig. 2) revealed that hot summer season resulted in decrease in all eythrocytic parameters including total erythrocytes count $x10^6$), hemoglobin concentration (g/dl) and packed cell volume (%) in comparison to mean values obtained during winter season. Mean cell volume (MCV fl) and mean cell hemoglobin (MCH pg) values were increased during summer season than other seasons of the year, while Mean cell hemoglobin concentration (MCHC %) revealed non significant difference between four seasons of the year (Table 2 & Fig.3).

Total and differential leucocytes count:

Results represented in (Table 3 & Fig. 4) revealed that the total number of leucocytes count ($x10^3$), neutrophils count (%) and lymphocytes count (%) (Table 3 & Fig. 5) were higher during hot, summer season, while the lowest mean value was at winter season. Correlation between WBC count and THI was highly strong positive correlation r = (0.959). Correlation between neutrophils count and THI was highly strong positive correlation r = (0.966). Correlation between lymphocytes count and THI was highly strong positive correlation r = (0.820).

3- Hormonal analysis:

Results for Progesterone hormone (P4) mean level as represented in (Table 4 & Fig. 6) and for estradiol 17-beta hormone as represented in (Table 4 & Fig. 7) revealed that the highest mean values were at winter season, followed by spring and autumn seasons. The lowest value obtained was at summer season. Correlation between P4 and THI was highly strong negative correlation r = (-0.784).

Correlation between estradiol 17-b and THI was highly strong negative correlation r = (-0.927).

Results for Prolactin hormone (PRL), Triiodothyronin (T3), Thyroxine (T4) and cortisol hormone as represented in (Table 5& Fig. 8) revealed that hot summer season resulted in reduction in mean values of T3 and T4 hormones, while increase values of both prolactin and cortisol hormones versus to the mean values obtained for other seasons. Correlation between PRL and THI was highly strong positive correlation r = (0.961). Correlation between T3 and THI was highly strong negative correlation r = (-0.946) and also between T4 and THI was highly strong negative correlation r = (-0.921). Correlation between cortisol hormone concentration and THI was moderate positive correlation r = (0.550).

DISCUSSION

Reproductive functions of female as in male buffaloes are affected by seasonal changes, moreover it was noted that seasonal variation in reproductive functions is more pronounced in the buffalo than in cow **(El-Wishy and El-Sawaf, 1971).** It is universally accepted to evaluate the environment climatic parameters through THI **(West, 2003, Sompam, 2004 and Vale, 2007)**. The upper critical limit for high producing cows was reported to be 72 **(Johnson, 1987)**. From this investigation founded that Egyptian buffalo cows under the thermal comfort zone during both winter and spring seasons as the THI was under 72), under mild heat stress during autumn season as THI was under 75 it was (72.95) and they exposed to sever heat stress during summer season as the THI above 78 (78.53), this result agree with that reported by **(Armstrong, 1993, Vale, 2007; Aggarwal and Singh, 2010)**. The animals exposed to sever heat stress during hot-summer season under subtropical conditions of Egypt this because the over heat load and increase core body temperature that resulted from over heat production from lactation process **(Koubkova et al., 2002 and West, 2003)** and highest ambient temperature with high relative humidity **(Marai and Habeb, 2010)** that results in reduction in the temperature gradient between the environment and the animals skin surface and makes more difficult heat dissipation.

Results obtained for hematological parameters revealed that rise in ambient temperature, THI and stress condition during summer season was associated with decrease in all average means of RBC count, Hb concentration and PCV values in Egyptian dairy buffalo-cows than those of winter and spring seasons, this reduction may be due many reasons, may be due to hemodillution effect and destruction of erythrocytes this result agree with that reported by **(Marai et al., 1997; Fagiolo et al., 2004)**, or this reduction as a responsive trial for reducing metabolic heat production to keep heat balance of animals body under hot condition while increased values during winter season due to high oxygen demand and increased spleen release of red blood cells and this agree with **(Solouma, 1999; Ashour, 2001)**, or may be due to under nutrition during summer season and copper deficiency **(Sharma et al., 2008)**, or due combined stress of both high temperature and high milking intensity were more blood pass to mammary gland for milk synthesis **(Johnson, 1987; El-Nouty et al., 1990)** or due to depression of thyroid secretion during hot summer season which associated with decreased erythropoiesis **(Dainiak et al., 1987)** and this confirmed from correlation matrix result between T3 and RBC count was highly strong positive correlation ((r) = 0.999) and between T4 and RBC count was also highly strong positive correlation ((r) = 0.953). The results obtained for hematological parameters are disagree with that reported by **(Toharmat et al., 1998; Ahmed and Alhaidary, 2004)** as they reported that high environmental temperature increase erythrocyte parameters. And from **Anwar and Chaudhari, (1984)** who reported that no significant effect of season on RBC count, Hb conc. and PCV value and this difference in result may be due to difference in animals locality and difference in atmospheric temperature or animal species.

Data obtained for red blood cell indices show that MCV and MCH have a higher values during hot summer season than that of spring and winter and this result agree with that reported by **(Kumer and Pachauri, 2000; Okab et al., 2007)** and disagree from **(El-Nouty et al., 1990)** who reported that MCV and MCH values increased in cold environment during winter season than spring and hot summer season. Leucocytes count and neutrophil cells show a higher number under hot conditions of summer season as compared to other seasons and this as responsive trial, resistance phase to heat stress condition and due to thermo lymphatic involution that resulted in a state of leucocytosis evoked by neutrophilia, this result similar to that reported by **(Majeed et al., 1985)**. And disagree with **(Maglia et al., 2005)** who reported that WBC count decreased in dairy cows exposed to heat period, and from **(Hassan et al., 1987)** who reported that seasonal changes had no effect on leukocyte count nor neutrophils.

Results obtained for serum concentration of progesterone hormone (P4) of Egyptian buffalo-cows are within the range values reported by other researchers **(Kaulfuss et al., 2006; Roy and Prakash, 2007)** in which progesterone levels were maximum during winter and autumn seasons in comparison to hotter summer and spring season and this may be attributed to the higher growth and development of corpus luteum (CL) in autumn and winter than during spring and summer due to the effect of heat stress that acts by indirect way through inhibiting the secretion of gonadotropins to a greater degree and thus leuteinizing hormone (LH) which suppress CL development or acts directly on the ovary to decrease its sensivity to gonadotropin stimulation which suppress CL development. But does not agree with that reported by **Singh and Chaudhary, (1992)** who reported higher P4 concentration during spring and summer. This controversy of results of the later authors may be due to the difference in these localities, or due to type of heat stress (acute or chronic).

The results obtained for serum concentration of Estradiol 17-B of Egyptian buffalo-cows are within the range values reported by other previous authors **(Roth et al., 2000 and Megahed et al., 2008)** in which Estradiol levels were maximum during winter and spring seasons in comparison to hotter summer and autumn season and this may be attributed to the effect of high environmental temperature and heat stress that acts by indirect way through inhibiting secretion of gonadotropins to a greater degree and thus leuteinizing hormone (LH) and reduced the dominance of the selected follicle and more medium sized subordinate follicle survive and thus reducing follicular steroidogenesis through reduction of availability of androgen precursors for estradiol synthesis. But does not agree with seasonal changes reported by **Anwar and Megahed (1997)** who reported higher Estradiol concentration during summer and this difference in results may be due to localities differences or dry matter intake or difference in animal species.

The result of present study showed an increase in serum prolactin (PRL) hormone during summer season than those of spring, autumn and winter season. These findings were similar to the data of **(Lupoli et al., 2001; Roy and Prakash, 2007)**. The increment in serum prolactin during hot summer season noticed in this study may indicate that the environmental stress or changing in day length may alter the hypothalamic pituitary control and resulted in its increase **(Koprowski and Taucker, 1978)**. Also postpartum cows have a higher prolactin hormone concentration for lactation and milk synthesis **(Karge and Schams, 1973)** and most of prolactin concentration is transferred to circulation **(Malven and McMurtry, 1974)** and its concentration is duplicated in blood with stress of hot season **(Schams and Reinhardt, 1974)** that resulted in hyper prolactinaemia that inhibit follicular development and resulted in summer postpartum anestrus.

From results obtained for Thyroid hormones (T3 & T4) observed that the highest level for T3 and T4 was in winter, while the lowest level was in summer. Higher thyroid activity (T3, T4) in winter and lowest activity in summer had been reported in buffalo **(Habeeb et al., 2000)**. Summer reduction in thyroid activity is probably an attempt to reduce metabolic rate and muscle activity occurring and over all heat production to be reduced **(Abdalla et al., 1991)**, also may be related to in adequate nutrient intake during summer season **(Naser et al., 2006)**. Winter elevation of thyroid activity resulted from that the best factor stimulated thyroid stimulating hormone (TSH) from anterior pituitary gland was exposure to cold which stimulated both hypothalamus and anterior pituitary gland to increase levels of (thyroid releasing hormone) TRH and TSH **(Guyton and Hall, 1996)**.

The result of present study showed an increase in serum cortisol hormone concentration during hot summer season than spring, autumn and winter season. These findings were similar to the data of **(Zlengkang et al., 1994 ; Yousef et al., 1997 and Habeeb et al., 2001)**. The increment in serum cortisol concentration noticed in this study may be attributed heat induced activation of hypothalamic-pituitary-adrenal axis and subsequent increase in plasma glucocorticoid concentration mainly cortisol as it's the most indicator to stressful climatic conditions which has a thermoregulatory protective mechanism preventing metabolic heat production which enable animals to tolerate stressful conditions **(Collier et al., 1982)**. In contrast **Abdel-Samee et al., (2000)** reported lower cortisol concentration in hot season than cool season and **Abdel-Samee and Marai, (1997)** reported that no significantly changes in cortisol among different seasons. These contradictions may be attributed to the high variation in the basal cortisol concentration and to differences in duration of exposure to high environmental temperature **(Hundson et al., 1975)**.

CONCLUSIONS

It was concluded that In Egypt there was a seasonal variation in atmospheric temperature, relative humidity, temperature humidity index (THI) and the rise in THI above the upper critical level (72 units) for lactating buffalo-cows in Egypt is the major constraint on buffalo-cows hematological parameters and hormonal secretion whish affects animal reproduction. Hence we should improve climatic conditions in side the dairy farm to eliminate or reduce summer infertility.

Table (1): Atmospheric Temperature (C°), relative humidity (RH) % and Temperature Humidity Index (THI) at dairy farm during different seasons.

Seasons	Temperature (C°)	Relative humidity %	THI
Winter	19.92±0.70 [c]	43.50±1.60 [a]	63.73±1.29 [d]
Spring	26.18±1.67 [b]	30.00±2.08 [d]	71.32±1.67 [c]
Summer	32.61±1.12 [a]	32.50±2.29 [c]	78.53±1.58 [a]
Autumn	27.13±1.32 [b]	38.33±1.85 [b]	72.95±1.41 [b]

Values with different letters in the same column are significant at ($P<0.05$).

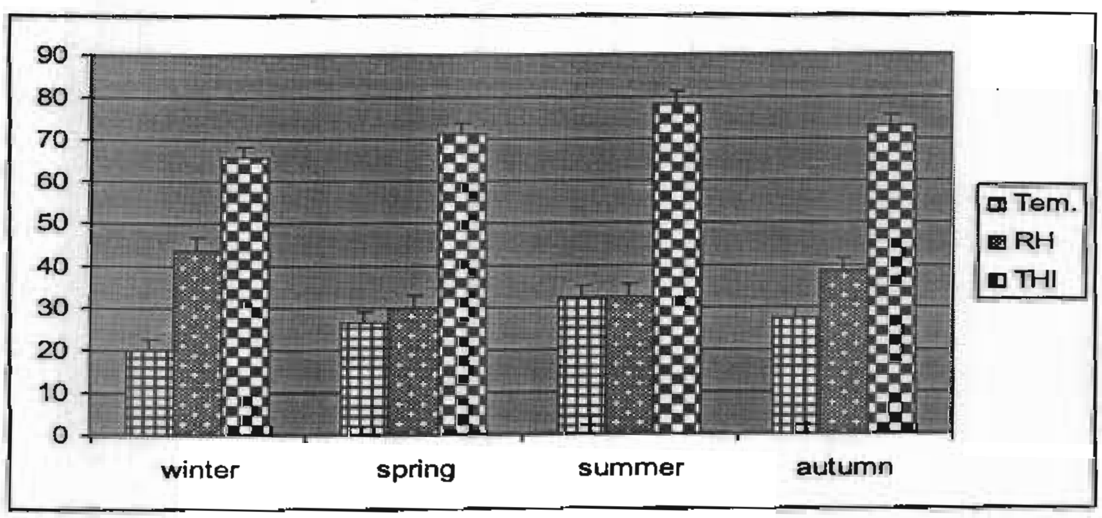

Fig. (1): Atmospheric Temperature (C°), relative humidity (RH) % and Temperature Humidity Index (THI) during different seasons.

Table (2): Red blood cell (RBC) counts, hemoglobin (Hb), packed cell volume (PCV) and red blood indices (MCV, MCH and MCHC) in dairybuffalo-cows during different seasons.

Seasons	RBC(×10⁶)	Hb(g/dl)	PCV %	MCV (fl)	MCH (pg)	MCHC (%)
Winter	6.83 ± 0.11 ᵃ	12.58 ± 0.11 ᵃ	39.44 ± 0.32 ᵃ	57.77 ± 0.57 ᶜ	17.56 ± 0.30 ᶜ	30.61 ± 0.55 ᵃ
Spring	5.98 ± 0.61 ᵃᵇ	9.77 ± 0.23 ᶜ	32.71 ± 1.94 ᵇ	55.44± 1.88 ᶜ	16.47 ± 1.39 ᶜ	29.74 ± 1.30 ᵃ
Summer	3.20 ± 0.15 ᶜ	8.83 ± 0.43 ᵈ	30.73 ± 0.12 ᶜ	96.55± 2.25 ᵃ	30.81 ± 1.33 ᵃ	31.96 ± 0.89 ᵃ
Autumn	5.16 ± 0.92 ᵇ	10.65 ± 0.23 ᵇ	32.92 ± 2.55 ᵇ	66.83± 2.71 ᵇ	22.63 ± 2.42 ᵇ	32.43 ± 2.54 ᵃ

Values with different letters in the same column are significant at (P<0.05).

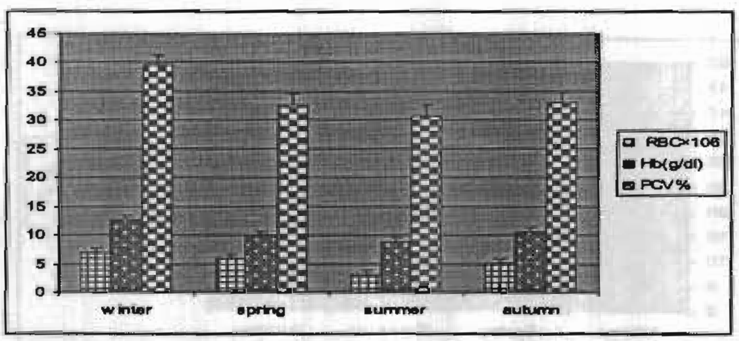

Fig. (2) : Red blood cell count, hemoglobin and Packed cell volume (PCV) in dairy buffalo-cows during During different seasons.

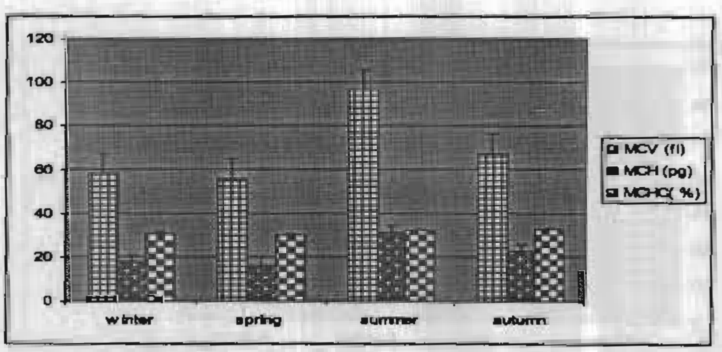

Fig. (3) : Red blood indices (MCV, MCH and MCHC) in dairy buffalo-cows Different seasons.

Table (3): White blood cell count, granular WBC and a granular WBC in dairy buffalo-cow during different seasons.

Seasons	WBC(×10³)	Neutrophils %	Eosinophils %	Basophils %	Lymphocytes %	Monocytes %
Winter	4.90±0.20	31.00±0.57c	3.66±0.66a	2.66±0.33a	40.29±0.20 d	4.46±0.27 a
Spring	7.29±1.31	36.66±0.88b	3.00±0.57a	2.66±0.33a	53.02±1.31 b	4.56±0.53 a
Summer	10.63±0.97	41.00±2.64a	3.01±0.57a	2.66±0.66a	58.77±0.97 a	4.60±0.20 a
Autumn	7.04±1.10	35.33±2.90b	3.66±0.66a	3.33±0.88a	43.56±1.10 c	4.83±0.33 a

Values with different letters in the same column are significant at $(P<0.05)$.

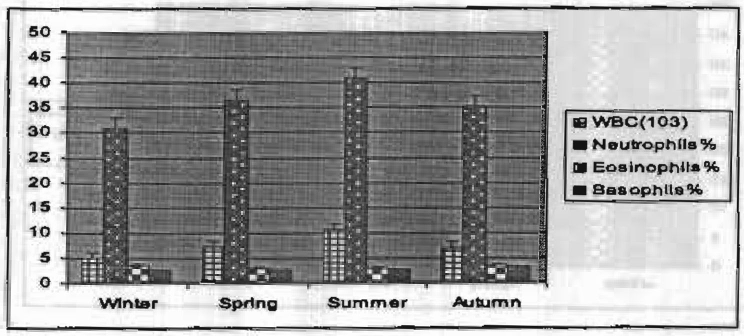

Fig. (4): WBC count and granular WBC (Neutrophils, Eosinophils and Basophils) in Dairy buffalo-cows during different seasons

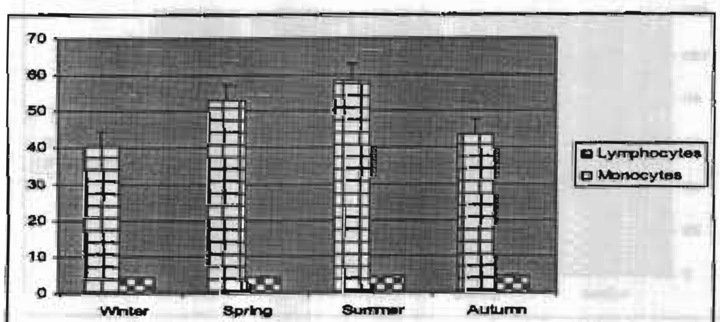

Fig. (5) : A granular WBC count (Lymphocytes andMonocytes) in dairy buffalo-cows during different seasons

Table (4): Serum progesterone hormone (P4) and estradiol 17-beta in dairy buffalo-cows during different seasons.

Seasons	Progesterone hormone (ng/ml)	Estradiol 17-B (ng/ml)
Winter	0.91±0.04 [a]	27.00±2.00 [a]
Spring	0.89±0.11 [a]	25.33±2.72 [a]
Summer	0.56±0.03 [b]	16.8±0.64 [c]
Autumn	0.85±0.02 [a]	19.33±2.10 [b]

Values with different letters in the same column are significant at ($P<0.05$).

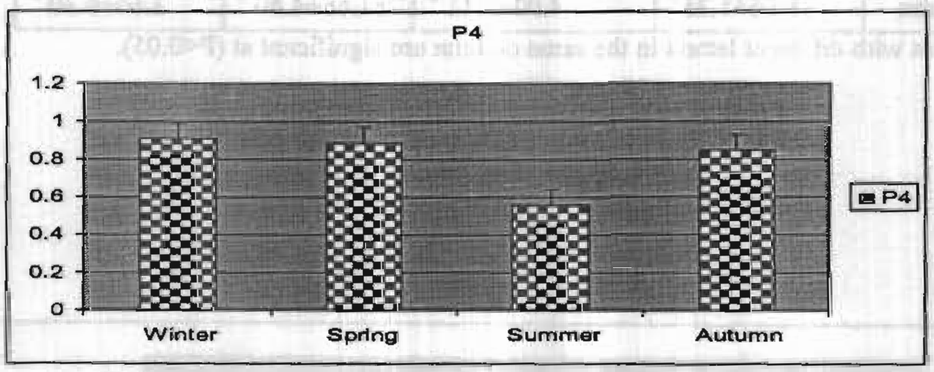

Fig. (6) : Serum progesterone hormone concentration (P4) in dairy buffalo-cows during different seasons.

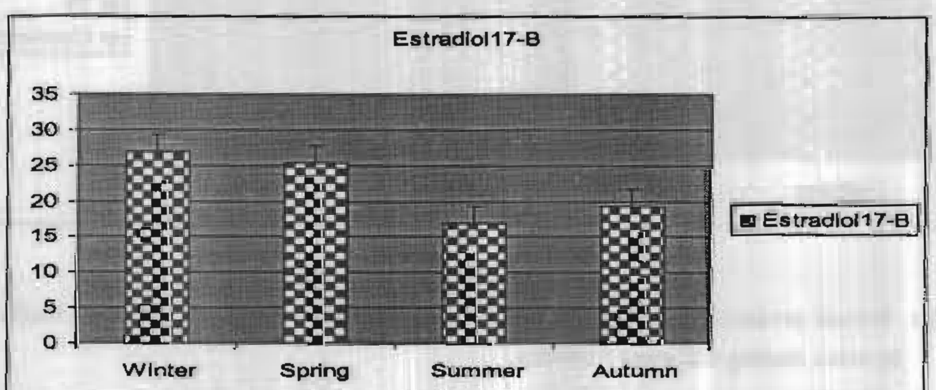

Fig. (7) : Serum estradiol 17-beta hormone (E2) in dairy buffalo-cows during different seasons.

Table (5): Serum prolactin, thyroid hormones (T3& T4) and cortisol in Egyptian buffalo-cows during different Seasons.

Seasons	Prolactin (ng/ml)	(T3) (ng/ml)	T4 (ng/ml)	Cortisol (ng/ml)
Winter	5.91 ±1.40[d]	6.82±o.16 [a]	76.66±6.66 [a]	2.00±0.50 [c]
Spring	10.58±1.26[c]	5.73±o.88 [a]	56.66±6.66 [c]	6.24±0.40 [a]
Summer	23.45±1.72[a]	2.33±o.33 [b]	21.66±1.66 [d]	4.47±0.33 [a]
Autumn	18.06±1.25[b]	4.92±1.11 [a]	61.66±4.40 [b]	3.60±0.30 [b]

Values with different letters in the same column are significant at (P<0.05).

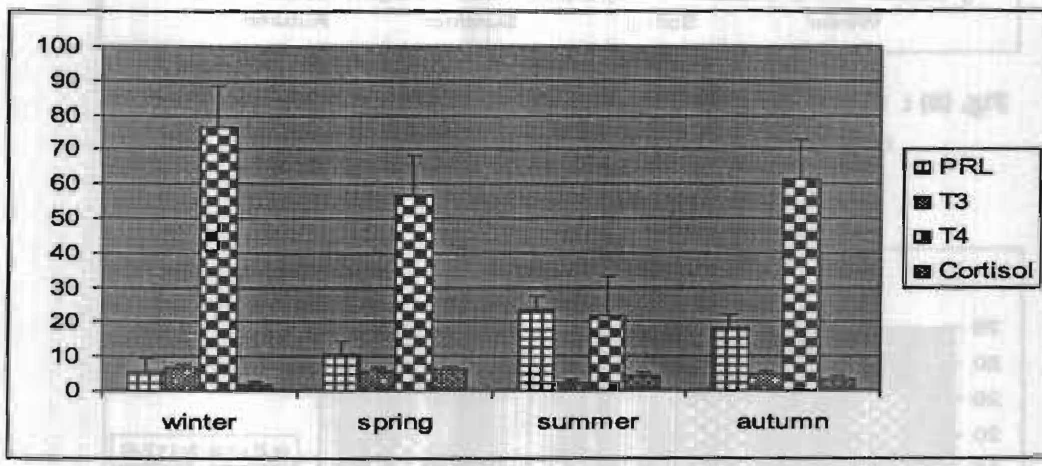

Fig. (8) : Serum prolactin, thyroid hormones (T3& T4) and cortisol in Egyptian buffalo-cows during different Seasons.

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الملخص العربى

التغيرات الموسمية لبعض هرمونات ومكونات الدم في إناث الجاموس المصرى

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يهدف هذا العمل إلى دراسة تأثير التغيرات الموسمية المناخية في مصر على معاملات الدم ,هرمونات التنا سل واللايض الغذائي لإناث الجاموس المصري.إستمرت هذة الدراسة سنة كاملة إمتدت من من شهر ديسمبر ٢٠٠٩ إلي نوفمبر٢٠١٠ و أجريت علي عدد ستين من إناث الجاموس الحلاب والشائع. شهريا يتم إختيار مجموعة من إناث الجاموس فى مرحلة الشبق ثم يتم تجميع عينات الدم من وريد الزيل في اليوم الثانى للتلقيح الطبيعي للإناث. أظهرت نتائج البحث أن درجة الحرارة تكون مرتفعة جدا فى فصل الصيف (١٦ر٣٢ ± ١٢ر١ درجة سليزية) مقارنة ب (١٨ر٢٦ ± ٦٧ر١ درجة سليزية) في الربيع و(٩٢ر١٩ ± ٧٠ر٠ درجة سليزية) في فصل الشتاء ,بينما متوسط الرطوبة النسبية يكون مرتفع في الشتاء (٥٠ر٤٣ ± ٦٠ر١٪) عنة في فصل الصيف (٥٠ر٣٢ ± ٢٩ر٢٪) وبحساب معامل الإرتباط بين الحرارة والرطوبة وجد أن إرتفاع قيمتة من (٧٣ر٦٣±٢٩ر١) فى فصل الشتاء إلى(٥٣ر٧٨±٥٨ر١) في فصل الصيف يعنى زيادة العبأ الحرارى الواقع على الحيوان في فصل الصيف والذي يتسبب في نقص في كل من: العدد الكلى لخلايا كرات الدم الحمراء قد تصل إلى (٢٠ر٣±١٥ر٠ × ٦١٠)، تركيز الهيموجلوبين (٤٣ر٠±٨٣ر٨ جم/ديسى لتر) ونسبة تركيز الخلايا المعبأة (١٢ر٠±٧٣ر٣٠٪) تركيز هرمون البروجيستيرون في مصل الدم (٥٦ر٠±٠٣ر٠ نجم/مل) ,تركيز هرمون الإستروجين (٦٤ر٠ ± ١٦٠٨نجم/مل) ,تركيز هرمون الثراى أيودوثيرونين (٣٣ر٢±٣٣ر٠نجم/مل)، وأيضا تركيز هرمون الثيروكسين (٦٦ر٢١±٦٦ر١نجم/مل). بينما يؤدى فصل الصيف إلى إرتفاع معنوى في كل من: متوسط حجم الخلية الحمراء (٥٥ر٩٦±٢٥ر٢ فيمتو لتر) ,متوسط محتوي الخلية من الهيموجلوبين (٨١ر٣٠±٣٣ر١ بيكوجرام)، العدد الكلى لخلايا كرات الدم البيضاء بمتوسط (٩٧ر٠±٦٣ر١٠×٣١٠) ,نسبة الخلايا المتعادلة بمتوسط (٦٤ر٢±٠٠ر٤١٪) ,نسبة الخلايا الليمفاوية بمتوسط (٧٧ر٥٨±٩٧ر٠٪) ,تركيز هرمون البرولاكتين بمتوسط يصل إلي حوالى (٤٥ر٢٣±٧٢ر١نجم/مل) و أيضا تركيز هرمون الكورتيزول في مصل الدم وجد أنة يزداد في فصل الصيف بمتوسط (٤٧ر٤±٣٣ر٠نجم/مل) و لايوجد إختلاف موسمي في متوسط تركيز الخلية الحمراء من الهيموجلوبين.

لذا نستنتج من هذة النتائج أنة في مصر يوجد تغيرات موسمية في كل من درجة الحرارة ,الرطوبة النسبية ,معامل الإرتباط بين الحرارة والرطوبة و أن إرتفاع معامل الإرتباط بين الحرارة والرطوبة فى فصل الصيف لأكبر من ٧٨ وحدة يعنى زيادة العبأ الحراري الذى يمثل مخاطر أساسية على مكونات الدم ومعدل إفراز الهرمونات والذي ينعكس على الكفأة التناسلية للإناث الجاموس لذلك يجب تحسين درجات الحرارة داخل المزرعة وخاصة فى فصل الصيف و يجب إستخدام طرق التبريد لجسم الحيوان مثل إستخدام رشاشات الماء و أن تظل الحيوانات تحت المظلات لتفادى أو لتقليل نقص الخصوبة للإناث في فصل الصيف.