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**BLOOD BIOCHEMICAL AND HORMONAL
CHANGES IN POSTPARTUM BUFFALOES WITH
SOME REPRODUCTIVE DISORDERS
DURING HOT SEASON**
(With 2 Tables)

By

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التغيرات الكيميائية و الهرمونية في فترة ما بعد الولادة لأنثى الجاموس
التي تعاني من بعض الخلل التناسلي خلال موسم ارتفاع درجة الحرارة

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اشتملت الدراسة علي عدد عشرة حيوانات من انثى الجاموس الحلاب و تتراوح أعمارهم بين (٤-٨) سنوات من مزرعة بمحافظة الفيوم في شهور الصيف حيث درجة الحرارة العالية (٢٩-٤٢ م) و كانت تعاني من بعض الخلل في الوظائف التناسلية (طول فترة ما بعد الولادة-عدم وضوح الشبق و عدم انتظامه-و بالتالي قلة الخصوبه) (المجموعه الاولى). تم متابعة هذه الحيوانات خلال فترة الخريف حيث درجة الحرارة المعتدله و في قمة الخصوبه (انتظام الشبق والتبويض) و اعتبرت مجموعه ضابطه (المجموعه الثانيه). وكانت الحيوانات في كلا الفترتين تحت ظروف غذا ئيه ملائمه. و تم الفحص الاكلينيكي لهذه الحيوانات و قد لوحظ زيادة درجة حرارة الجسم و معدل التنفس في الفترة الاولى عنها في الفترة الثانيه و قد اوضحت التحاليل الكيميائية انخفاض معنوي في مستوي الجلوكوز والبروتين الكلي والبيوتاسيوم و انخفاض غير معنوي في مستوي الكوليستيرول و ارتفاع معنوي في نسبة اليوريا و الصوديوم في الفترة الاولى بالمقارنه بالفترة الثانيه و كذلك اوضحت نتائج التحليل الهرموني ارتفاع معنوي في نسبة الكورتيزول و البروجيسترون وانخفاض معنوي في مستوي الاستروجين و الثيروكسين و التراي ايودوثيرونين و ذلك في الفترة الاولى عن الثانيه و يتضح من ذلك ان التغيرات الكيميائية و الهرمونية تحت تأثير ارتفاع درجة الحرارة من العوامل التي ساعدت علي حدوث هذا الخلل في الوظائف التناسلية.

SUMMARY

This work was carried out on ten apparently healthy lactating buffaloes (4-8 years) belonging to a farm in EL-FAYOM province in hot summer months (39-42°C), and fall season. The animals were considered as two groups, the first group (10 animals) were under effect of environmental heat stress and has some reproductive disorders (long postpartum period, unobserved heat, irregular estrous and delayed conception rate). The second group; the control one, were those animals of the first group but in fall season used in their maximum reproductivity and under suitable ambient environment. The clinical examination indicated increase in respiration rate and rectal temperature in the first group than the second one while the rectal examination showed ovarian inactivities in the animals under stress. On the other hand, biochemical serum analysis showed significant decrease in glucose, total proteins and potassium, insignificant decrease in cholesterol but there were significant elevation in urea and sodium concentrations. The serum hormonal assay revealed significant increased in cortisol and progesterone, insignificant decrease in estrogen and observed decrease in both triiodothyronin (T3) and thyroxine (T4) levels. It is concluded that the endocrinological and biochemical alterations indicate that elevated environmental temperature stressed those animals leading to these reproductive disorders.

Key words: Biochemical, Hormonal, Postpartum Buffaloes.

INTRODUCTION

Hot weather causes environmental heat stress in buffaloes although effects are more severe in hot climates. Buffaloes in areas with relatively moderate climates also are exposed to periods of heat stress (Armstrong, 1994) which disturbs normal reproductive cyclicality. Deviations in hormonal patterns are noted. Clinical and biochemical manifestations brought about by these changes, when ambient temperature above thermoneutrality, lead to discomfort and reduce feed intake which again depress reproduction (Spain and Spiers, 1995). Since reproduction is the ultimate measure of an animal, ability to adapt to an ever changing external milieu as well as forming the basis of life time productivity as long as the stressful events remains a challenge, the

animal will be under stress (Coubrough, 1985) reflecting on females as delayed ovulation, a shortened less intense estrous, reduce conception rate, irregular estrous cycle, changed metabolic rate, increase respiration rate, increase body temperature and reducing feed intake (Britt *et al.*, 1983).

The present study was designed for evaluating the effect of hot summer (environmental heat stress) on some blood biochemical parameters and hormones reflecting on reproductive behavior of lactating buffaloes in postpartum period.

MATERIAL and METHODS

Animals:

The present investigation was based on field studies of 10 apparently healthy, parasitic-free lactating buffaloes belonging to a farm in El-FAYOM province. They were thermal stressed in hot summer months and has some reproductive disorders (as unobserved heat, long postpartum period and delayed conception), they were considered as the first group (heat stressed animals). These were followed up and used in their maximum reproductivity at suitable ambient temperature in the fall season and considered as the second group (control animal). All used animals were under the same nutritional system.

Measurements of behavioral patterns:

Clinical examination included rectal temperature and respiration rate.

Rectal examination was carried for estrous detection as measured by the presence of follicles.

Serum blood samples were taken from the first group every two weeks during hot summer season (40 samples) and once during fall season (10 samples).

Biochemical analysis: Blood serum glucose, total protein, urea and cholesterol were determined using reagent kits (BioMerieux, Marcy-LE toile, France). Serum sodium and potassium were determined by flame photometer (Oser, 1965).

The hormonal profile tests: For determination of cortisol, progesterone, estrogen, triiodothyronine (T3) and thyroxine (T4) were measured by direct radioimmunoassay (RIA) using coat A-count kit (Diagnostic Products Corporation) DPC. These methods have been

characterized and verified to measure each hormone with an extrimly low cross reactivity to other hormones.

Statistical analysis:

It was carried out according to (Snedecor and Corchran, 1982).

RESULTS and DISCUSSION

The animal and it's environment form a system in which both act on and react to each other, high sensible temperature and humidity are associated with seasonal declines in reproductive efficiency (Dupreez *et al.*, 1992). The effect of thermal stress on reproduction is manifested in several physiologic mechanisms and includes debilitating effects on duration and expression of estrous (Drost and Thatcher, 1987).

Clinical measurements revealed increase in rectal temperature (39-42°C) and respiratory rates (38 Resp./min.) compared with buffaloes in thermal comfort state, These data parallel other results (Mohamed, 1997) which could be due to that the animal and it's environment form a system in which both act on and react to each other (Dupreez *et al.*, 1992), an additional explanation was the effect of released adrenaline and nor-adrenaline during heat stress (Carlson, 1994), also heat stress has direct effect on heart muscle and respiratory center increasing the respiratory rates (Blood *et al.*, 1994).

Rectal examination showed that these animals under stress were free from gynaecological diseases other than ovarian inactivities.

Regarding biochemical changes the results reported in this study (Table, 1) revealed significant decrease in glucose levels in stressed animals which could be attributed to the effect of thermal stress in altering the absolute requirements for specific nutrients by affecting the physiological processes and metabolism or by reducing total diet consumption, in lactating dairy buffaloes the dry matter begins to decline and therefore heat generated during body metabolism and in maintaining heat balance(Beede and Collier, 1986). On the other hand, thermal stress may produce a direct negative effect on appetite center of the hypothalamus (Baile and Forbes, 1974). Also the decrease of glucose level may be due to the increased respiratory rate which lead to rapid utilization of blood glucose by respiratory muscles (Hycel, 1973). Total protein level showed a significant decrease in buffaloes under heat stress often have negative nitrogen balances because of reduced intakes, hence, less protein is available for productive functions (Huber *et al.*, 1994).

Also, the reduced energy consumption and increased maintenance requirements during heat stress often results in considerably more protein being metabolized to meet energy requirements of buffaloes than that metabolized at moderate temperature (Beede and Collier, 1986).

Serum urea revealed significant elevation in buffaloes during heat stress, it could be attributed to that this stress disrupts homeostasis of dairy buffaloes caused by evoking regulatory reactions which try to maintain heat balance (Beede and Collier, 1986) and as a results of negative function of acid-base regulation and also alteration in antidiuretic hormones, water, electrolyte turn over, a major adaptation to thermal stress is peripheral vasodilatation and increased blood flow to accommodate evaporative and convective heat loss (Thatcher and Collier, 1982) concomitantly reduced blood flow to internal organ systems such as kidneys and reproductive tract (Roman Ponce *et al.*, 1978). Another explanation is that serum urea elevation may be due to that there was concomitant break down of tissues during gluconeogenesis under effect of increased cortisol (Payne, 1987).

Table 1: Some blood biochemical changes during post-partum in heat stressed and normal buffaloes

Parameters	Group I (heat stress) n=40	Group II (control) n=10
Glucose(mg%)	48.72 \pm 2.2*	56.86 \pm 2.5
Total protein (g%)	10.3 \pm 0.23*	11.21 \pm 0.26
Urea (mg%)	18.57 \pm 0.88*	15.52 \pm 0.86
Potassium (mEq./L)	3.61 \pm 0.15***	5.55 \pm 0.23
Sodium (mEq./L)	154.15 \pm 1.5*	148.3 \pm 2.1
Cholesterol (mg %)	93.92 \pm 5.2	101.43 \pm 4.76

Values are means \pm S.E.

* = P<0.05

** = P<0.01

*** = P<0.001

The results showed significant decrease in serum potassium levels and significant increase in serum sodium which could be related to the relationship among heat stress and plasma aldosterone which controls the reabsorption of sodium and excretion of potassium, hyperactivity of the adrenal cortex and increased production of aldosterone occur during heat stress results in excessive reabsorption of sodium and urinary excretion of potassium (David and Cole, 1986).

Total cholesterol results showed insignificant decrease in heat stressed buffaloes which could be due to the increased lipid metabolisms and the conversion of cholesterol into bile acids and other substances and activation lipoprotein lipase (Capen and Martin, 1989), another explanation that ACTH stimulate steroidogenesis which hydrolyze cholesterol esters stored in lipid droplets and liberated which converted by numbers of enzymes to cortisol (Loraine and Trevor, 1976).

It is necessary to identify the mechanisms by which stress disrupts normal reproduction, the neuroendocrine regulation of follicular development and ovulation requires a complex and delicate interplay between the pituitary gonadotropins and feed back actions of the major follicular steroids, the stress induced secretion of adrenal glucocorticoids, these steroids can affect both synthesis and secretion of gonadotropins (Gary, 1991), the results in Table (2) showed that significant increase in progesterone and cortisol which could be due to the adrenal axis responded to stress by initiating secretion of corticotropin-releasing hormone from neurosecretory neurons in the hypothalamus, this peptide act upon the pituitary corticotropins to stimulate the secretion of adrenocorticotrophic hormone (ACTH) which in turn act on the adrenal cortex to stimulate the synthesis and secretion of adrenal cortical steroids glucocorticoids and progesterone (Moberg, 1987), these steroids account for the majority of the biological changes with respect to reproduction, there is evidence that the glucorticoids can act on all components of the gonadal axis, the secretion of gonadotrophic releasing hormones (Gn RH), the release of gonadotropins, and the synthesis of gonadal steroids (Dobson, 1987), initial cortisol rise with subsequent depression, raised progesterone levels, changes in leutinizing hormone (LH), cortisol blocks the preovulatory secretion of leutinizing hormone (LH) (Li and Wagner, 1983), also it was shown that the high cortisol in plasma at the days of exposure to heat stress may indicate an acute responsive adrenocortical function due to stimulation of peripheral thermoreceptors in the skin resulting in activation of adrenocorticotrophic hormone (ACTH) releasing mechanisms in the hypothalamus (Wagner *et al.*, 1972). It is clear that heat stress has acute effects due to altered endocrine states and feed back mechanism of hypothalamus-pituitary- adrenal axis, the glucocorticoids have comparable inhibitory effect on the basal release of LH and FSH (Gary, 1991). Among the hormones associated with thermal stress are thyroxine (T4) and triiodothyronine (T3), the observation reported in our

study indicated that significant decreased levels of both hormones which could be attributed to that the elevated temperature reduces the thyroid activity leading to decrease thyroxine which was also influenced by amount of feed intake (McGuire *et al.*, 1991), production and release of thyroxine by the thyroid gland is controlled by the anterior pituitary gland through its thyroid stimulating hormone (Swanson and Miller, 1972), there is interrelationship between ovarian function and hypothalamo-pituitary-thyroid axis, also there is considerable evidence that the thyroid plays a role in the regulation of reproductive activity (Shi and Barell, 1994). Thyrotrophic stimulating hormone (TSH) influences reproduction via the production of thyroxine and triiodothyroxine which regulate the metabolic pools of nitrogen producing available energy necessary for the reproductive system (Magdub *et al.*, 1982).

Finally it could be concluded that stress control may be the key stone for the herd health reproductivity, owing to the direct and indirect unfavorable consequences of endocrine and biochemical responses ranging from discomfort to infertility. So management strategies to reduce the effects of heat stress may be in the form of physical modifications of the environment such as shade, ventilation and cooling, nutritional management schemes such as less forage and increase nutrient density in the diet.

Table 2: Some hormonal changes during post-partum in heat stress and normal buffaloes

Parameters	Group I (Heat stress) n=40	Group II (Control) n=10
Cortisol (Ug/dL.)	9.14±1.51*	4.62±1.04
Progesterone (ng/ml.)	3.1±0.56**	0.95±0.1
Estrogen (Pg/ml.)	11.54±2.0*	19.46±2.3
Triiodothyronine(ng/dL)	130.5±5.6*	146.34±4.02
Thyroxine Ug/dL	2.88±0.29*	3.97±0.41

Values are means ± S.E.

*= P<0.05

**= P<0.01

***= p<0.00

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