PLASMA CORTISOL LEVELS AND CERTAIN METABOLIC PROCESSES IN RELATION TO INDUCED OESTRUS IN BUFFALOES

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Summary

Cortisol levels in plasma are known to be as an indication of reproductive and adrenal status of an animal. In this study it has been examined in relation to the oestrus induction by Progesterone oestrogen therapy in 3rd and 4th parity anoestrus animals. Cortisol was found higher in treated animals and levels raised within 6-12 hrs. after hormone therapy followed by elevation in glucose levels and depletion of total serum proteins. It shows the association of induction, occurrence and expression of oestrus with energy demanding metabolic stress in buffaloes.
(**Key Words**: Buffaloes, Induced Oestrus, Cortisol, Energy Status, Biochemical Parameters)

Introduction

Occurrence and expression of oestrus in buffaloes has been well associated with a significant rise in plasm cortisol levels (Madan, 1984). The latter indicates stimulation of adrenal cortex through hypothalamus (Eigler et al. 1979) which in turn does influence the carbohydrate metabolism in body (Thompson et al., 1982; Faulkner et al., 1980). Present investigation is a successful attempt of induction of oestrus in anoestrus animals. Hence influence of exogenous steroids on cortisol levels and so forth the carbohydrate metabolism has been studied to correlate the occurrence of induced oestrus with adrenal stimulation in relation to energy status of these animals.

Materials and Methods

Eight non-lactating, non-pregnant and long anoestrus Murrah buffaloes were randomly chosen and allocated to a control group of anoestrus animals and a treated group of induced animals.

50 mg progesterone in alcohal was given i/m daily to each animal in treated group for 14 days, followed by 10 mg estradiol valerate on 15th day of treatment.

Thrice blood samples were collected prior to therapy in treated animals. Samples were collected at eight hourly intervals upto 48 hrs subsequent to estradiol injection and almost every 5/6th day between induced oestrus and natural oestrus of a consecutive cycle. The frequency of sample collection in control group was less than in treated animals. Plasma cortisol was estimated using RIA (WHO, 1982) with an assay sensitivity of 240 femtomoles per tube and intrassay variation of 6.1 percent. Other biochemical estimations were carried out as per reference procedures (Folin-Wu, 1920; Lowry et al., 1951).

Results

All the treated animals expressed oestrus with visual signs and an established subsequent natural oestrus cycle with an average cycle length of 24 days.

The estimated metabolites in blood are shown in table 1. The average plasma cortisol levels were elevated in treated animals ($5.34 + 1.63$ ng/ml) relative to untreated animals (3.53 ± 2.08 ng/ml). After estradiol administration the levels of cortisol reached 7.1 ± 3.7 ng/ml in treated animals with in first 8-12 hrs in comparison to the normal cycle levels in untreated animals.

Average plasma glucose levels were 40.3 ± 14.9 mg percent in treated animals throughout the cycle. Glucose levels enhanced upto 76.5 ± 6.0 mg percent within 14 hr after oestradiol administration which decreased within next 6 hrs of study in treated animals.

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TABLE 1. AVERAGE CORTISOL IN RELATION TO ENERGY PRODUCING METABOLITES DURING INDUCED ESTROUS

Groups	Prior to treatment	Zero d (8.0 h)	Zero d (14.0 h)	Zero d (20.0 h)	+ 1 (8.0 h)	+ 1 (20.0 h)	+ 2 (20.0 h)
Cortisol							
Control mean= 3.53 ± 2.08	–				4.8 ± 1.2	4.5 ± 1.4	-
Treated mean= 5.34 ± 1.6	–	7.1 ± 3.7	3.15 ± 0.9	3.8 ± 1.6	4.2 + 2.7	4.9 ± 2.4	3.8 ± 0.9
Glucose							
Control mean= 40.3 ± 14.9	–	–	–	–	40.0 ± 17.7	51.4 ± 18.4	51.2 ± 26.5
Treated mean= 57.24 ± 14.6	58.5 ± 8.7	52.0 ± 16.8	76.5 ± 6.0	66.0 ± 10.5	57.7 ± 34.3	75.3 ± 6.4	58.25 ± 19.4
Protein							
Control mean= 11.17 ± 1.92	–	–	–	–	10.6 ± 0.7	11.45 ± 0.8	12.8 ± 1.7
Treated mean= 11.65 ± 1.9	13.1 ± 1.8	13.3 ± 3.3	12.8 ± 2.7	11.4 ± 2.7	10.5 ± 0.8	10.7 ± 1.7	12.4 ± 2.9

Groups	+ 6 (20.0 h)	+ 16 (20.0 h)	+ 17 (20.0 h)	+ 19 (20.0 h)	+ 20 (20.0 h)	+ 21 (20.0 h)	+ 23 (20.0 h)	+28 (20.0 h)
Cortisol								
Control mean= 3.53 ± 2.08	–	–	1.8 ± 0.7	2.1 ± 1.4	1.5 ± 0.7	2.7 ± 1.3	5.9 ± 3.5	–
Treated mean= 5.34 ± 1.6	2.6 ± 1.2	3.2 ± 0.0	3.7 ± 0.8	7.2 ± 4.5	7.0 ± 2.3	5.4 ± 1.4	7.6 ± 4.8	-
Glucose								
Control mean= 40.3 ± 14.9	69.5 ± 7.4	48.2 ± 18.8	41.8 ± 2.2	24.5 ± 5.6	45.0 ± 13.3	29.0 ± 11.0	21.0 ± 0.0	22.5 ± 3.0
Treated mean= 57.24 ± 14.6	65.6 ± 16.9	75.8 ± 11.6	61.3 ± 16.7	32.2 ± 0.0	48.5 ± 5.7	59.5 ± 24.0	28.0 ± 17.1	43.5 ± 16.5
Protein								
Control mean= 11.17 ± 1.92	13.9 ± 3.1	11.2 ± 5.0	12.5 ± 4.6	11.2 ± 0.3	11.8 ± 1.5	11.75 + 1.8	8.8 ± 1.5	6.9 + 1.4
Treated mean= 11.65 ± 1.9	11.6 ± 4.3	9.8 ± 1.8	11.9 ± 3.4	13.0 ± 3.6	11.5 ± 3.0	15.0 ± 4.3	9.6 ± 2.2	7.4 ± 2.7

Note: i) Prior to treatment: Average of three days collection values.
ii) Zero d: Day on which oestradiol was injected.

Serum protein levels were 11.17 ± 1.92 and 11.65 ± 1.90 g percent, respectively in untreated and treated animals groups on an average. It showed a light decrease in levels (upto 10.5 ± 0.8) after 30-32 hrs of oestradiol administration.

Discussion

The animals expressing induced oestrus in present study showed lower average cortisol levels than reported in cattle i.e. 6.0 + 3.9 ng/ml (Christensen et al. 1971) in normal untreated animals. The deviation in cortisol levels within 12 hrs after oestradiol injection indicate stimulation of adrenal cortex (Higler et al. 1979), perhaps due to hormone therapy. The former might be used as an indication of oestrous incidence as reported earlier (Madan, 1984). In present study glucose levels in plasma were significantly different in treated and untreated animals. The average plasma glucose levels in our study are quite comparable with normally reported values i.e. 38.5-57 mg percent (Hussain et al., 1974) except few values which indicate the anestrus status of animals showing glucose values lower than 30 mg percent (Aminudeen et al., 1984) in buffaloes. Post estradiol rise has been noted in plasma glucose within 6-24 hrs post estrus cortisol rise. This glucose elevation might be attributed to stimulation of adrenals due to estrogen therapy which thereafter introduce more cortisol in circulation influencing carbohydrate metabolism (Thompson et al., 1982; Faulkner et al., 1980) through lypolysis (Reilly and Ford, 1974) glycogenolysis or gluconeogenesis (Heitman and Bergman, 1976). Hence stimulation of adrenals does indicate metabolic stress (Gardner and Wiltliff, 1973) to compensate a sudden requirement of energy by animals. Jindal et al. (1988) have also shown enhanced glycolysis rate through stimulated Lactate Dehydrogenase during post estrus stage in buffaloes. Hence a sudden stimulation of carbohydrate metabolism might be a kind of adaptation against energy draining process of oestrus. No significant difference in total serum protein levels were noted. There was only a slight depression in levels at the time of oestrus. This study reveals that incidence of oestrus in buffaloes is a function of right energy status of an animals. It is well associated with metabolic changes to compensate the energy demand. If so, correct feeding might overcome the anoestrus problem in these animals to improve the fertility status.

Literature Cited

Aminudeen, G., P. K. Pareek and A. K. Ghosal. 1984. Blood profile in normal and anoestrous Rathi cows of arid tract of Rajasthan, Indian J. Anim. Sci. 54:751-754.

Christensen, D. S., J. M. Willhank and M. L. Hopwood 1971. Blood hormone levels during bovine oestrous cycle. J. Anim. Sci. 33 (Abst. 212 A):2 251.

Eigler, N., L. Sacea and R. S. Sherwin. 1979. Synergistic Interactions of Physiologic Increments of Glucagon Epinephrine and cortisol in dogs. J. Clin. Invest. 63:114-123.

Faulkner, A., E. M. Jhomston, J. M. Bassett and G. E. Thompson. 1980. Cold exposure and mammary glucose metabolism in lactating goats. Br. J. Nutr. 43:163-170.

Folin, O. and H. Wu 1920. A simplified and improved method for determination of sugar. J. Biol. Chem. 1:467

Gardner, D. G. and J. L. Wiltliff. 1973. Characterization of a distinct glucocorticoids-binding protein in the lactating mammary gland of rat Biochem. Biophys. Acta 320:617-627.

Heitmam, R. N. and E. N. Bergman. 1976. Glutamate and glucose metabolism in liver and kidney. Fed. Proc. 35:258-263.

Hussain, M. N., D. D. Sharma, S. S. Khirwar and M. V. V. Rao. 1975. Studies on growth rate and Blood constituents of buffalo calves raised on different levels of dietary proteins. Ind. J. Dairy Sci. 28:36-40.

Jindal, R., S. P. S. Gill and P. J. S. Rattan. 1988. Influence of estrus synchronization on the hormonal and biochemical status of blood in buffaloes. In Proceedings of II World buffalo congress held from 12-16 Dec. 1988 in New Delhi.

Lowry, D. M., A. L. Rose brough and R. J. Randell. 1951. Protein measurement by Folin-phenol reagent J. Bio/Chem. 193:265-275.

Madan, M. L. 1984 Studies on physiology of buffaloes and cattle summary research report Dec., 1984. Female Reproduction, estrus cyclicity and cycle length An physiology, NDRI, Karnal. pp 15-17.

Reilly, P. E. B. and E. J. H. Ford. 1974. The effect of dexamethasone on glucose production and on gluconeogenesis from amino acids in sheep. J. Endor. 60:455-461.

Thompson, G. E., J. M. Bassett, D. E. Samson and J. Stee. 1982. The effect of cold exposure of pregnant sheep on foetal plasma nutrients, Hormones and Birth weight Br. J. Nutr. 48:59-64.

W.H.O. Special Programme of Research Development and Research Training in Human Reproduction 1982 Method Mannual. (Ed. Sufi, S. B., A. Donaldson, S. L. Jelf coate) Who Geneva, Switzerland pp. 47.