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Effect of Exogenous Thyroxine Supplementation to Reduce the Incidence of Hypothermia in Dairy Calves

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ABSTRACT

Higher serum lipids concentration in blood is the major cause of hypothermia due to lesser utilization of lipids by the buffalo calves for generation of body heat (thermogenesis). A study of effect of exogenous thyroxine supplementation on hormonal status in murrah buffalo and crossbreed cow calves has been evaluated. The study was conducted on 12 healthy buffalo calves and 12 cow calves at Livestock Farm (calf unit), Adhartal, N.D.V.S.U., Jabalpur, Madhya Pradesh. Oral supplementation of thyroxine (0.167 mg/kg body weight), in powder form mixed along with 5 gram jaggery on 15 day interval starting from age of 16-days, 31-days and 46-days. The findings lead to these conclusions that thyroxine supplementation was found mobilisation of lipids and high density lipoprotein cholesterol for heat production to maintain homeostasis. The increased thyroxine level in buffalo calves helped to maintain their body temperature and increased basal metabolic rate, thus helped in their survival and reduced mortality.

Keywords: Thyroxine, buffalo and cow calves, cortisol

Buffaloes contribute significantly as the main livestock species for milk and meat production. They govern the economy of many countries including India. In countries, where buffaloes predominate, their improved production could significantly enhance the economy and the living standards of farmers (Madan and Prakash, 2007).

Thyroid hormones are general metabolic hormones required by the neonates to build up their immune competence along with other homeostatic activities. The HDL cholesterol was higher in the buffalo calves up to a week of postnatal life and declined thereafter in comparison to the cow calves of the same age (Jain *et al.* 2007). Higher serum lipids further potentiate the cause of hypothermia due to underutilization of lipids by the buffalo calves.

Hypothermia might be an important factor for higher mortality of the buffalo calves, particularly during winter season. Poor utilization of the lipids might be the triggering element for hypothermia in neonatal buffalo calves. Exogenous supplementation of thyroxine helps in maintenance of BMR of calves by its calorigenic effects by uncoupling of oxidative phosphorylation process. Therefore, elevated body temperature will lead to sustenance of calves during initial two months of age. Hence, the present study was desinged to explore the effect of exogenous thyroxine supplementation on T_3, T_4, cortisol concentrations in calves and to reduce the incidence of hypothermia in dairy calves.

MATERIALS AND METHODS

The study was conducted on a total of 12 apparently healthy buffalo calves and 12 cow calves at Livestock Farm (calf unit), Adhartal, N.D.V.S.U., Jabalpur (M.P.). The experiment was designed in total four groups of animals (I-IV), control group of buffalo calves and cow calves, thyroxine supplemented buffalo and cow calves, respectively (Table 1). Each group included six animals. The thyroxine was administered orally once a day @ 0.167 mg/kg body weight in powder form mixed along with 5 gram jaggery on 15th day, 30th day and 45th day (days from their birth) to the experimental calves. The blood samples were collected on 16th, 31st and 46th day in sterilized test tube without anticoagulant for separation and collection of serum. The concentration of thyroid hormone (T_3 and T_4) and cortisol hormone were estimated by using commercially available standardized ELISA kits. The experimental data were analysed by analysis of variance using hierarchical design as per the method described by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

In the present investigation the higher rectal temperature as shown in Table 2, figure 1 of thyroxine treated calves is clearly related to the calorigenic effect of exogenously supplemented thyroxine, which maintains a critical role in the control of body temperature by stimulation of thermogenesis and regulation of cellular metabolism (Abdelatif and Saeed, 2009). The similar findings were also reported by Seitz *et al.* (1985). Some calorigenic effect of thyroxine (T_4) is also due to the metabolism of fatty acids as well as increase in the activity of the membrane bound Na^+-K^+ ATPase in many tissues (Josef Fontana, 2014).

The T_4 level also increased significantly ($P<0.05$) in both treatment groups of buffalo calves (9.12 ± 0.65) and cow calves (13.49 ± 0.98) as compared to control groups of buffalo calves (4.34 ± 0.18) and cow calves (5.48 ± 0.31), respectively. This significant ($P<0.05$) increase in the T_3 and T_4 concentration as depicted in Table 3 (figure 2) and Table 4 (figure 3), respectively in treatment groups may be due to increased thyroid stimulating hormone (TSH) or thyrotropin releasing hormone (TRH) as reported by Davicco *et al.* (1982) and Enright *et al.* (1993), respectively.

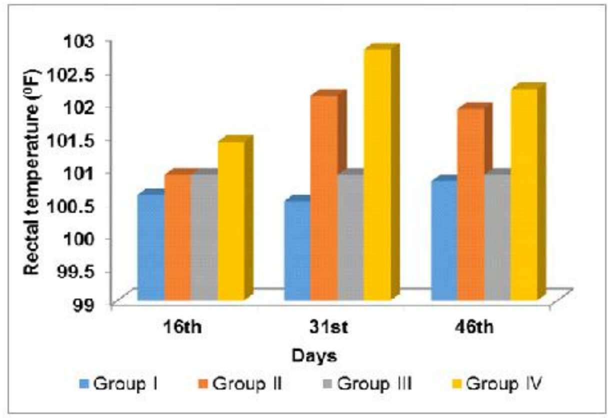

Fig. 1. Rectal temperature (°F) did not increase significantly in thyroxine supplemented buffalo calves and cow calves than control groups of buffalo calves and cow calves, respectively

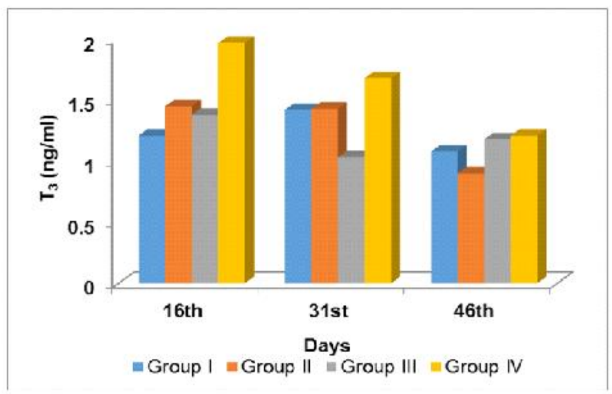

Fig. 2. T_3 (ng/ml) increased significantly ($P<0.05$) in both treatment group of buffalo calves and cow calves as compared to control groups of buffalo calves and cow calves, respectively

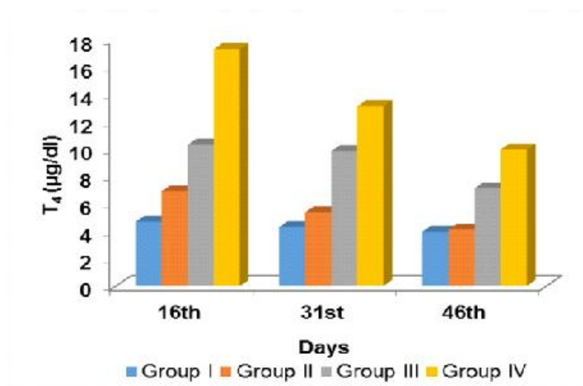

Fig. 3. T_4 (µg/dl) increased significantly ($P<0.05$) in both treatment group of buffalo calves and cow calves as compared to control groups of buffalo calves and cow calves, respectively

Table 1. Experimental design

Groups	Experimentation	Class of animals	Number of animals
I	Control	Buffalo calves	6
II	Control	Cow calves	6
III	Treatment with Thyroxine Sodium @ 0.167 mg/kg body weight	Buffalo calves	6
IV	Treatment with Thyroxine Sodium @ 0.167 mg/kg body weight	Cow calves	6

Table 2: Rectal temperature (^{O}F) at different intervals in different groups of calves

	Group			
Days	I	II	III	IV
16th	$100.58{\pm}0.39^{d}$	$100.95{\pm}0.29^{cd}$	$100.95{\pm}0.24^{cd}$	$101.40{\pm}0.39^{bcd}$
31st	$100.45{\pm}0.31^{d}$	$102.07{\pm}0.29^{ab}$	$100.90{\pm}0.17^{cd}$	$102.78{\pm}0.50^{a}$
46th	$100.80{\pm}0.29^{cd}$	$101.95{\pm}0.43^{abc}$	$100.90{\pm}0.33^{cd}$	$102.20{\pm}0.36^{ab}$
Overall	$100.61{\pm}0.18^{B}$	$101.66{\pm}0.22^{A}$	$100.92{\pm}0.14^{B}$	$102.13{\pm}0.26^{A}$

Mean values bearing different superscripts in rows and columns (lower case) and in last row (upper case), differ significantly ($P < 0.05$).

Table 3: T_3 (ng/ml) at different intervals in different groups of calves

	Group			
Days	I	II	III	IV
16th	1.21 ± 0.14^{bc}	1.45 ± 0.19^{bc}	1.38 ± 0.14^{bc}	1.97 ± 0.13^{a}
31st	1.42 ± 0.25^{bc}	1.43 ± 0.19^{bc}	1.03 ± 0.14^{c}	1.68 ± 0.24^{ab}
46th	1.08 ± 0.12^{c}	0.90 ± 0.10^{c}	1.18 ± 0.17^{bc}	1.21 ± 0.18^{bc}
Overall	1.24 ± 0.10^{B}	1.26 ± 0.11^{B}	1.20 ± 0.08^{B}	1.62 ± 0.12^{A}

Mean values bearing different superscripts in rows and columns (lower case) and in last row (upper case), differ significantly ($P < 0.05$).

Table 4: T_4 (µg/dl) at different intervals in different groups of calves

	Group			
Days	I	II	III	IV
16th	4.70 ± 0.22^{de}	6.92 ± 0.30^{d}	10.34 ± 0.94^{c}	17.33 ± 1.62^{a}
31st	4.31 ± 0.43^{e}	5.39 ± 0.31^{de}	9.88 ± 1.08^{c}	13.15 ± 0.94^{b}
46th	3.99 ± 0.25^{e}	4.13 ± 0.09^{e}	7.16 ± 1.05^{d}	10.00 ± 0.99^{c}
Overall	4.34 ± 0.18^{C}	5.48 ± 0.31^{C}	9.12 ± 0.65^{B}	13.49 ± 0.98^{A}

Mean values bearing different superscripts in rows and columns (lower case) and in last row (upper case), differ significantly ($P < 0.05$).

Table 5: Cortisol (µg/dl) at different intervals in different groups of calves

	Group			
Days	I	II	III	IV
16th	3.81 ± 0.68^{cd}	5.42 ± 0.37^{b}	8.75 ± 0.91^{a}	3.03 ± 0.49^{d}
31st	5.99 ± 0.56^{b}	3.71 ± 0.45^{cd}	2.94 ± 0.27^{d}	2.66 ± 0.19^{d}
46th	4.80 ± 0.84^{bc}	3.03 ± 0.36^{d}	2.58 ± 0.23^{d}	3.55 ± 0.32^{cd}
Overall	4.87 ± 0.43	4.05 ± 0.32	4.76 ± 0.75	3.08 ± 0.21

Mean values bearing different superscripts in rows and columns differ significantly ($P < 0.05$).

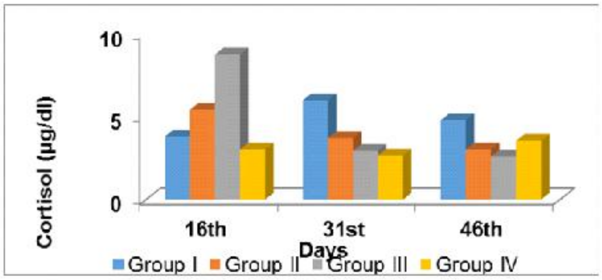

Fig. 4. Cortisol (µg/dl) level did not differ significantly in treatment groups as compared to that of control groups, respectively

The higher levels of T_3 and T_4 in buffalo calves and cow calves immediately after birth might be a protective mechanism evolved in the neonatal calves (Sharma *et al.* 1986; Jain *et al.* 2006). The neonatal calves usually have to face new environment, where they require more energy and more heat for their activity and maintenance of body temperature.

The thyroid hormones are required to increase the basal metabolic rate (BMR) of such calves. The level of thyroid hormones, however, was lower in buffalo calves than cow calves throughout the study. The results indicate the comparative lower metabolism of buffalo calves than that of cow calves. The lower values of T_4 than T_3 in the bovines might be due to greater binding of the T_4 with binding protein in the plasma (Kumar and Rattan, 1992).

The similarity of the metabolic effects might have been related to an increased conversion of T_4 to T_3 in peripheral tissues, resulting in a high production of metabolically active T_3 during the first 2 days of life. In the T_4 treated animals, the metabolic response might have appeared after a latency period. In the present investigation T_3 and T_4 level almost increased in thyroxine supplemented buffalo calves and cow calves both. This finding is also supported by Davis *et al.* (1988).

The higher cortisol level, around a month in new born, is physiologically required to combat the stress of new environment, which calves are facing in neonatal period (Agarwal *et al.* 1985). The stress of the calves subsequently gets ameliorated due to acclimatization, thus, reducing the amount of stress as well as levels of cortisol. Its elevated levels immediately after birth and upto around a month postpartum might be a protective mechanism as this hormone is responsible for gluconeogenesis.

In the present study cortisol level as shown in Table 5 (figure 4) did not differ significantly in thyroxine supplemented buffalo (4.76 ± 0.75) and cow calves (3.08 ± 0.21) as compared to that of control groups of buffalo (4.87 ± 0.43) and cow calves (4.05 ± 0.32). Supplementation of sodium-L-thyroxine showed no response to plasma cortisol concentration due to its weaker binding to plasma proteins and its higher fractional disappearance rate. Similar findings were also reported by Falconer and Jacks (1975).

CONCLUSION

The findings lead to these conclusions that thyroxine supplementation was found mobilisation of lipids and high density lipoprotein cholesterol of buffalo calves produced heat and reduces the incidence of hypothermia to maintain homeostasis in them. The increased thyroxine level in buffalo calves helped to maintain their body temperature and increased basal metabolic rate, thus helped in their survival and reduced mortality.

REFERENCES

Abdelatif, A.M. and Saeed, I.H. 2009. Effect of altered thyroid status in the domestic rabbit (*Lepus cuniculus*) on thermoregulation, heart rate and immune responses. *G.V.*, **3**(6): 447-456.

Agarwal, S.P., V.K. Agarwal, I.J. Sharma and P.K. Dwaraknath. 1985. Change in serum cortisol levels of male buffalo calves from birth to maturity. *Indian J. Anim. Sci.,* **55**(12): 1001-1005.

Davicco, M.J., E. Vigouroux, C. Dardillat and J.P. Barlet. 1982. Thyroxine, triiodothyronine and iodide in different breeds of newborn calves. *Reprod. Nutr. Dev.,* **22**(2): 355-362.

Davis, S.R., R.J. Collier, J.P. McNamara, H.H. Head and W. Sussman. 1988. Effects of thyroxine and growth hormone treatment of dairy cows on milk yield, cardiac output and mammary blood flow. *J. Anim. Sci.,* **66**: 70-79.

Enright, W.J., D.J. Prendiville, L.J. Spicer, P.R. Stricker, A.P. Moloney, T.F. Mowles and R.M. Campbell. 1993. Effects of growth hormone-releasing factor and (or) thyrotropin-releasing hormone on growth, feed efficiency, carcass characteristics and blood hormones and metabolites in beef heifers. *J. Anim. Sci.,* **71**: 2395-2405.

Falconer, I.R. and F. Jacks. 1975. Effect of adrenal hormones on thyroid secretion and thyroid hormones on adrenal secretion in the sheep. *J. Physiol.*, **250**: 261-273.

Fontana, J., 2014. Functions of cells and human body. Patrik Mada 3rd Faculty of Medicine, Charles University in Prague, Czech Republic.

Haber, R.S. and Loeb, J.N. 1982. Effect of 3,5,3-triiodothyronine treatment on potassium efflux from isolated rat diaphragm: role of increased permeability in the thermogenicresponse. *Endocrinology*, **111**(4): 1217-1223.

Jain, A.K., I.J. Sharma, R.K. Tripathi, R.G. Agrawal and M.A. Quadri. 2006. Status of thyroid hormones and development of internal defence of neonatal buffalo calves and cow calves from precolostral feeding through 91 days. *Buffalo Bulletin,* **25**(4): 73-78.

Jain, A.K., R.K. Tripathi, I.J. Sharma, M.A. Quadri and R.G. Agrawal. 2007. Relationship of serum lipids with development of hypothermia in neonatal bovines. *Buffalo Bulletin,* **26**(3): 67-71.

Kumar, R. and P.J.S. Rattan. 1992. Plasma thyroid and adrenocortical hormones during different developmental stages in buffalo heifers. *Indian J. Anmi. Sci.,* **62**(8): 747-748.

Madan, M.L. and B.S. Prakash. 2007. Reproductive endocrinology. *J. Reprod. Fertil. Suppl.,* **64**: 261-281.

Seitz, H.J., Muller, M.J. and Soboll, S. 1985. Rapid thyroid hormone effect on mitochondrial and cytosolic ATP/ADP ratio in the intact liver cell. *Biochem. J.,* **227**(1): 149-153.

Sharma, I.J., S.P. Agarwal, S.P. Shukla and P.K. Dwaraknath. 1986. A comparative study of hormonal and seminal characteristics of crossbred bull and buffalo bulls. Ind. *Vet. J.,* **63**: 636-638.

Snedecor, G.W. and W.G. Cochram. 1980. Statistical Methods, 7th ed. The Iowa State University Press, Ames, Iowa, USA, p. 593.