Effect of microclimate alteration devices and feed additive on stress hormones in Murrah buffaloes

Ramya N, Ch. Harikrishna and N Venumadhav

DOIs: https://doi.org/10.22271/tpi.2021.v10.i2Sc.5714

Abstract
The present study was carried out on twenty four lactating Murrah buffaloes housed in four different groups (six in each group) viz, foggers (T1), fans (T2), fans and feed additive (T3) and control group (C) in LRS, Mamnoor. The stress hormones estimated by the influence of microclimatic alteration devices and feed additive on Murrah buffaloes were Triidothyronine (T3), Thyroxin (T4) and Cortisol. The serum total T3 levels were higher in C group followed by T3, T2 and T1 groups while total T4 levels were higher in C group followed by T2, T1 and T3 groups. The serum cortisol levels were higher in C group followed by T2, T3 and least in T1 group of Murrah buffaloes.

Keywords: buffaloes, cortisol, fans, feed additive, foggers, triidothyronine, thyroxin

1. Introduction
Global warming has been increasing and to this changing climate, homeotherms generally adapt compensatory (thermoregulatory) mechanisms directed at maintaining or restoring thermal balance (West, 1999) [24] and this adaptability results in changes in physiological, haematological, biochemical, hormonal, behavioural, production and reproduction aspects. Heat is lost from the body by radiation, conduction, convection, evaporation of water from skin and respiratory passages and excretion of faeces and urine. Respiratory cooling and evaporation from body surface are negatively correlated with the temperature and relative humidity in the air. Buffaloes are more prone to heat stress because of poor heat tolerance capacity when compared to other domestic ruminants (Moran, 1973) [12] due to scarcely distributed sweat glands, dark body colour and sparse hair on body surface which reduce the capacity of cutaneous evaporation.

Heat stress led to decreased thyroid activity in various species (Dwaraknath et al. 1984, Habeeb et al. 2000 and Rasooli et al. 2004) [8, 9, 17]. Longterm heat stress resulted in reduced serum cortisol in cattle (Rhynes and Ewing, 1973 and Dantzer and Mormede, 1983) [18, 4] while acute heat exposure to buffalo calves and Friesian calves induced significant increase in plasma cortisol concentration (Nessim 2004 and Habeeb et al. 2001) [14, 7], respectively.

2. Materials and Methods
A study was conducted for estimation of stress hormones under the effect of microclimatic alteration devices and feed additive in twenty four lactating Murrah buffaloes available at Livestock Research Station, Mamnoor, Warangal district, Telangana. The average temperature ranges from 15-46°C. All the buffaloes were maintained under standard feeding and managerial conditions. The buffaloes were housed in four different groups (six in each group) viz, foggers (T1) operated from 12.00 noon to 3.00 pm, fans (T2), fans and feed additive in the form of Chromium supplement and yeast culture as an anti-stress agent @ 500g/tonne of feed (T3) and control group of buffaloes were housed under loose housing system (C). Feeding and vaccination were accordingly with the farm schedule.

For estimation of stress hormones i.e, T3, T4 and Cortisol, blood samples (5 ml) were collected from the jugular vein of the experimental animals, randomly into a clean, dry, sterilized test tube without adding anti-coagulant prior to the morning feeding, during the study period. Serum was separated by centrifugation at 2000 xg for 15 min. and stored at –20°C till use. These were analyzed for T3, T4 using CLISA kits (Cat # 9001-16 and Cat # 9003-16, respectively), DIAGNOSTIC AUTOMATION, INC. and serum cortisol hormone was analysed using AccuDiag™ Cortisol ELISA Kit (Cat# 6101-15). The data was analyzed
by using completely Randomized Design (CRD).

3. Results and Discussion
The effect of microclimate alteration devices and feed additive in response to heat stress on hormonal profile of Murrah buffaloes has been presented in Table 1.

Table 1: Effect of microclimate alteration devices and feed additive on hormonal profile in Murrah buffaloes during the study period

| Experimental groups | Tag no. | Total T3 (ng/dl) | Total T4 (µg/dl) | Serum cortisol (µg/dl) |
|---------------------|--------|-----------------|-----------------|-----------------------|
| Control (C)         | 249    | 70.8            | 2.8             | 1.1                   |
|                     | 452    | 69.2            | 2.6             | 1.0                   |
|                     | 539    | 67.6            | 2.5             | 0.9                   |
|                     | 541    | 71.2            | 2.7             | 0.9                   |
|                     | 561    | 69.8            | 2.6             | 1.0                   |
|                     | 557    | 70.6            | 2.7             | 0.9                   |
| Mean ± SE           | 69.87±0.54 | 2.65±0.04 | 0.97±0.03       |
| Foggers (T1)        | 579    | 54.5            | 2.5             | 0.7                   |
|                     | 580    | 57.5            | 2.7             | 0.9                   |
|                     | 581    | 58.5            | 2.3             | 0.6                   |
|                     | 582    | 56.2            | 2.4             | 0.7                   |
|                     | 583    | 57.1            | 2.6             | 0.9                   |
|                     | 584    | 58.4            | 2.5             | 0.6                   |
| Mean ± SE           | 57.03±0.62 | 2.50±0.06 | 0.73±0.06       |
| Fans (T2)           | 460    | 63.9            | 2.6             | 0.8                   |
|                     | 461    | 60.8            | 2.5             | 1.0                   |
|                     | 462    | 66.2            | 2.7             | 0.9                   |
|                     | 463    | 63.6            | 2.6             | 1.0                   |
|                     | 464    | 62.9            | 2.7             | 0.9                   |
|                     | 471    | 65.1            | 2.5             | 0.8                   |
| Mean ± SE           | 63.75±0.76 | 2.60±0.04 | 0.90±0.04       |
| Fans + Feed additive (T3) | 465 | 60.5            | 2.3             | 0.6                   |
|                     | 466    | 69.3            | 2.0             | 1.0                   |
|                     | 467    | 68.7            | 2.1             | 0.9                   |
|                     | 468    | 66.5            | 2.0             | 1.0                   |
|                     | 469    | 64.3            | 2.2             | 0.6                   |
|                     | 470    | 68.1            | 2.0             | 0.9                   |
| Mean ± SE           | 66.23±1.36 | 2.10±0.05 | 0.83±0.08       |

3.1 Effect on Triidothyronine (T3)
Present study revealed that the mean values of serum total T3 in C, T1, T2 and T3 groups of buffaloes were 69.87±0.54, 57.03±0.62, 63.75±0.76 and 66.23±1.36 (ng/dl), respectively and differed significantly (P<0.01). Among all the four groups, total T3 levels were higher in C group followed by T3, T2 and T1 groups (Graph 1). Similar result was found by Chaiyabutr et al. (2008) [3]. This might be due to animals tried to restore the thermal balance without restricting DMI. Also, feed additive had no significant effect on triidothyronine and the same was given by Muneendra et al. (2015) [13].

![Graph 1: T3 (ng/dl) in Murrah buffaloes among the experimental groups](image-url)
3.2 Effect on Thyroxin (T4)

Present study revealed that the mean values of serum total T4 levels were 2.65±0.04, 2.50±0.06, 2.60±0.04 and 2.10±0.05 (µg/dl) in C, T1, T2 and T3 groups of Murrah buffaloes, respectively and were significantly (P<0.01) different. Total T4 levels were higher in C group followed by T2, T1 and T3 groups (Graph 2).

This suggested that heat acclimation did not depress thyroid gland activity and involve adjustments in peripheral monodeiodinative pathways of thyroid hormones (Aceves et al. 1987) [1] or due to lower utilization of T4 at cellular level (Wankar, 2012) [22] or due to metabolic adjustments made by animals in response to thermal stress.

![Graph 2: T4 (µg/dl) and Serum cortisol (µg/dl) in Murrah buffaloes among the experimental groups](image)

3.3 Effect on serum cortisol

The mean values of serum cortisol during the present study in C, T1, T2 and T3 groups were 0.97±0.03, 0.73±0.06, 0.90±0.04 and 0.83±0.08 (µg/dl), respectively and differed significantly (P<0.05). The perusal of Graph 2 showed that the serum cortisol levels were higher in C group followed by T2, T3 and least in T1 group of Murrah buffaloes. This might be due to activation of hypothalamo-pituitary adrenal cortical axis (HPA) in response to heat stress resulting in increased cortisol levels (Silanikove, 2000) [18]. These results were in accordance to the findings of Wise et al. (1988) [24]; Habeeb et al. (2001) [7]; Nessim et al. (2003) [15]; Nessim (2004) [14]; Starling et al. (2005) [20]; Sunil et al. (2010) [21]; Khongdee et al. (2011) [10]; Wankar (2012) [22] and Silva et al. (2014) [19].

T3 group of buffaloes exhibited lower serum cortisol levels when compared to C group because of effect of feed additive in response to heat stress. Similar results were given by Jeanne (1995) [9]; Kumar et al. (2013) [11] and Muneendra et al. (2015) [13].

T1 group exhibited the least serum cortisol levels when compared to C group because of effect of foggers in response to heat stress providing comfort to Murrah buffaloes. These results were consistent with those found by Brijesh et al. (2016) [12].

4. Conclusion

The inclusion of microclimate alteration devices and feed additive were beneficial for providing comfort to the Murrah buffaloes in adapting to the changing climate.

5. References

1. Aceves CC, Romero L, Sahagun C, Valverde R. Thyroid hormone profile in dairy cattle acclimated to cold or hot environmental temperatures. Acta Endocrinologica (Copenh) 1987:114:201-207.
2. Brijesh Yadav, Vijay Pandey, Sarvajeet Yadav, Yajuvendra Singh, Vinod Kumar, Rajneesh Sirohi. Effect of misting and wallowing cooling systems on milk yield, blood and physiological variables during heat stress in lactating Murrah buffalo. Journal of Animal Science and Technology 2016:58:2.
3. Chaiyabutr N, Chanponsang S, Suadsong S. Effects of evaporative cooling on the regulation of body water and milk production in crossbred Holstein cattle in a tropical environment. International Journal of Biometeorology 2008;52:575-585.
4. Dantzer R, Mormede P. Stress in farm animals: A need for reevaluation. J Anim. Sci 1983;57:6-18.
5. Dwaraknath PIC, Agarwal SP, Agarwal VK, Dixit NIC, Sharma JI. Hormonal profiles in buffalo bulls. In: The Use of Nuclear Techniques to improve Domestic Buffalo Production in Asia, in Proceedings of Isotope & Radiation Applications of Agricultural Development, Manila, Philippines 1984.
6. Habeeb AAM, Aboulnaga AJ, Kamal TH. Heat induced changes in body water concentration, Ts, cortisol, glucose and cholesterol levels and their relationships with thermoneutral bodyweight gain in Friesian calves. Proceedings of 2nd International Conference on Animal Production and Health in Semi-arid Areas El-Arish, North Sinai, Egypt 2001, 97-108.
7. Habeeb AAM, Aboulnaga AJ, Kamal TH. Heat-induced changes in body water concentration, Ts, cortisol, glucose and cholesterol levels and their relationships with thermoneutral bodyweight gain in Friesian calves. In: Proceedings of 2nd international conference on animal production and health in semi-arid areas, El-Arish, North Sinai 2001, 97-108.
8. Habeeb AAM, Ibrahim MK, Yousef HM. Blood and milk contents of triiodothyronine (T3) and cortisol in lactating buffaloes and changes in milk yield and composition as a function of lactation number and ambient temperature. Arabian Journal of Nuclear Sciences Application 2000;33:313-322.
9. Jeanne Burton L. Supplemental chromium: its benefits to the bovine immune system. Animal feed science and technology 1995;53(2):117-133.
10. Khongdee T, Sripoon S, Vajrabukka C. The effects of high temperature and wallow on physiological responses of swamp buffaloes (Bubalus bubalis) during winter season in Thailand. Journal of Thermal Biology 2011;36(7):417-21.
11. Kumar Suresh, Singh SV, Upadhyay RC, Hooda OK, Singh AK, Maibam Uttarani et al. Effect of Chromium propionate supplementation on thermal stress alleviation in Sahiwal calves. XXII Annual Conference of Society of Animal Physiologists of India and National Symposium on Physiological and Nutri-genomic interventions to augment Food security and Animal welfare. Nov. 19-21 (Abstr.) 2013.
12. Moran JB. Heat tolerance of Brahman cross, buffalo, banteng and shorthorn steers during exposure to sun and as a result of exercise. Australian Journal of Agriculture Research 1973;24:775-782.
13. Muneendra Kumar, Harjit Kaur, Rijusmita Sarma Deka, Veena Mani, Amrish Kumar Tyagi, Gulab Chandra. Dietary inorganic chromium in summer-exposed buffalo calves (Bubalus bubalis): Effects on biomarkers of heat
stress, immune status, and endocrine variables. Biological Trace Element Research 2015;167(1):18-27.
14. Nessim MG. Heat-induced biological changes as heat tolerance indices related to growth performance in buffaloes. Ph.D. Thesis, Faculty of Agriculture, Animal Shams University, Cairo, Egypt 2004.
15. Nessim MZ, Kamal TH, Abdalla EB, Kotby A. Egypt. Journal of Basic and Applied Zoology 2003;2(2):221-231.
16. Rasooli A, Nouri M, Khadjeh GH, Rasekh A. The influence of seasonal variations on thyroid activity and some biochemical parameters of cattle. Iranian J Vet. Res 2004;5(2):1383-1391.
17. Rhyes W, Ewing L. Plasma corticosteroids in Hereford bulls exposed to high ambient temperature. J Anim. Sci 1973;36:369.
18. Silanikove N. Effects of heat stress on the welfare of extensively managed domestic ruminants. Livestock Production Science 2000;67:1-18.
19. Silva JA, Araújo RD, Júnior AAD, de Brito L, Santos NDFAD, Viana RB. Hormonal changes in female buffaloes under shading in tropical climate of Eastern Amazon. Revista Brasileira de Zootecnia 2014;43(1):44-8.
20. Starling JMC, Silva RG, Negrão JA, Maia ASC, Bueno AR. Variação estacional dos hormônios tireoideanos e do cortisol em ovinos em ambiente tropical. Revista Brasileira de Zootecnia 2005;34:2064-2073.
21. Sunil Kumar BV, Singh G, Meur SK. Effects of addition of electrolyte and ascorbic acid in feed during heat stress in buffaloes. Asian Australasian Journal of Animal Sciences 2010;23(7):880-888.
22. Wankar AK. Physio-biochemical responses and gas emission during thermal stress in buffaloes. PhD, Thesis, Deemed University, IVRI, Izatnagar, India 2012.
23. West JW. Nutritional strategies for managing the heat-stressed dairy cow. Journal of Animal Science 1999;2:21-35.
24. Wise ME, Armstrong DV, Huber JT, Hunter R, Wiersma F. Hormonal alterations in the lactating dairy cow in response to thermal stress. Journal of Dairy Science 1988;71(9):2480-2485.