www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(11): 2416-2419

www.thepharmajournal.com
Received: 07-09-2021
Accepted: 09-10-2021

Amit
Veterinary Surgeon, GVH, Sanwar, Charkhi Dadri, Haryana, India

Komal
Ph.D. Scholar, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Monali Das
M.V.Sc Scholar, Department of ABG, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, India

Spandan Shashwat Dash
M.V.Sc Scholar, Department of AGB, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Archana Sarangi
Ph.D. Scholar, Department of Animal Physiology and Reproduction Division, CIRB, Hisar, Haryana, India

Subhasish Sahu
Scientist, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Devender Singh Bidhan
Associate Professor, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Corresponding Author
Amit
Veterinary Surgeon, GVH, Sanwar, Charkhi Dadri, Haryana, India

A review on the effect of microclimate on growth and behaviour of buffalo

Amit, Komal, Monali Das, Spandan Shashwat Dash, Archana Sarangi, Subhasish Sahu and Devender Singh Bidhan

Abstract
Microclimate has profound effects on performance in animals, do so for buffalo. Besides macroclimate as a predecidng factor in livestock productivity, close ambience of animal dwelling plays further critical role in their performance indices. Effect of microclimate on alterations on growth, feed and water intake, physiological and behavioral parameters of various species of livestock have been well documented. This review paper specifically aims to gather the research findings of microclimatic effect on the growth and behaviour performance of buffalo in a presentable way and draws conclusions for enhanced productivity.

Keywords: microclimate, THI, buffalo, growth parameter, body weight

Introduction
Most of the geographical area of India is in-between the Tropic of Cancer (23.50N) and equator. However, the tropical climate does not end abruptly immediately beyond the Tropic of Cancer but extends some more. From a livestock keeping point of view, we may consider the area as a tropical area upto the latitude 300N. In summer the American ambient temperature rises as high as 48°C during daytime and 30°C during the night. The effects of rise in temperature are further pronounced by increase in day length (13-14 hours). Dairy animals are homeotherms (maintain constant body temperature) and therefore, when the environmental temperature rises, the animals are subjected to heat stress. The result is reduced performance like rise in their rectal temperature, decline in feed intake, increase in water intake, growth reduction, loss in body weight and sometimes even death from extreme heat stress (Hahn and Mader, 1997; Gaughan *et al*., 2000; Lefcourt and Adam, 1996; Mader *et al*., 1999) [20, 19, 21]. The primary purpose of a livestock shed is to reduce the radiant heat load on an animal. The sun, the sky, and the ground are the main zones surrounding the animal from where the radiation that causes the heat stress comes. Thatcher *et al*. (1978) [30]; Collier *et al*. (1982) [7]; and Badinga *et al*. (1985) [2] reported that solar radiation and humidity have been identified as major characteristics contributing to heat stress in mature lactating dairy cows. Solar radiation increases heat gain directly as well as indirectly. Direct sunlight together with heat energy that is reflected from areas exposed to the ground, walls and other exposed surfaces add a tremendous amount of heat load (West, 1995) [36]. Roofing provides the main protection against direct solar radiation in animal housing (Shearer *et al*., 2002) [28]. Since temperature, humidity, wind speed, solar radiation and other climatic factors constituting a specific microclimate around the animals are involved in the heat balance; the health of animals is directly related to modification of such factors in adverse climates. In spite of paucity in available publications, an attempt has been made to evaluate and arrange the available literature so that overall view of the work done related to the objectives of the present study may be evaluated.

Effect on growth
Brody (1945) [6] defined growth as a relatively irreversible change in measured dimensions. Growth is an accelerating phase which is exhibited by true increase in structural mass in terms of hyperplasia and hypertrophy of cells. Growth rate is governed by various factors including genetic makeup of the animal, environment and nutritional status. Environment influences the growth directly and indirectly. The main objective of management of heifers is to obtain optimum growth as per their genetic potential so that they can attain early maturity and subsequently reduced age at first calving.

A. Body weight changes and Average Daily Gain (ADG)
Tripathi *et al.* (1972) [31] reported that heat stress during summer may depress the growth rate of young buffalo calves (6 to 18 months old). They further reported 15 per cent more rapid gain in live weight if relief is given for heat stress by providing shelter and by sprinkling water in comparison with calves not given this advantage. Patel *et al.* (1995) [23] divided eighteen buffalo heifers in 3 groups with cement concrete shed (T_1); thatched roof shed (T_2) and heifers under tree (T_3). Highest Average daily weight gain was observed in T_2 and least in T_3. Singh (2000) reported that buffalo heifers kept in aluminium foil pasted roof and thatched roof gained more body weight as compared to asbestos and white painted roof however the difference was non-significant between treatments. Kamal (2013) [17] revealed that ADG for calves was found to be significantly ($P<0.05$) in agro-net followed by thatch roof, asbestos roof and least under tree in summer season. Barman *et al.* (2017) [4] concluded that the ADG was significantly higher ($P<0.05$) in buffalo calves kept in thatch with a polythene shading roof as compared to other groups.

B. Body measurements
All the body measurements show an increasing trend with advancement of age and increase in body weight but the change depends on the comfortness and wellbeing of animals which is directly affected by the microclimate inside the shed. In the other way, the animals in the thermal comfort zone keep their physiological parameters in normal range so their body energy can be used in increasing body measurements whereas; heat stressed animals divert their body energy to maintain homeothermy. Pradhan *et al.* (1999) [24] found no significant difference in body measurement of crossbred calves, when bathing was given to reduce heat stress in hot humid conditions. Whereas; Singh (2000) revealed that in heifers under asbestos (T_1), the average monthly increase in body height and heart girth was significantly ($P<0.05$) low as compared to aluminium pasted roof (T_3) and thatch roof (T_4) while no significant difference was observed between white painted roof (T_2), T_3 and T_4. Similar trend was observed for body length but the difference was non-significant between treatments. Kamal (2013) [17] concluded that the difference for chest girth and height at withers were found to be non-significant between the treatments and values were higher for agro-net and thatch roof as compare to asbestos while there was significant ($P<0.05$) difference in body length from third fortnight onwards in crossbred calves and values were highest for agro-net shade. Barman *et al.* (2017) [4] observed that the overall changes i.e. body height, body length and heart girth were higher in thatch with polythene shading roof as compared to other shade materials however the difference was non-significant.

Effect on Animal behavior
Study of animal behavior is an important aspect to provide proper care and management to improve the health. It is a physiological process used by animals to adapt itself to external and internal changes. Knowledge of characteristic behavioral signs of increasing heat stress may alert animal handlers to impending heat distress, particularly in areas of potential climatic extremes of high temperatures and humidity. Behavior patterns are not inherited as such but through the process of growth get differentiated under the influence of genetic and environmental factors neither one of which can act independently. Manifestation of behavioral patterns of heifers under special summer management practices can be used as standard for assessing the level of animal welfare.

A. Rumination time
Rumination is important physiological behavior which indicates the sound health, perfect digestion and comfort of animals. The time devoted to rumination is determined by the coarseness of the ruminal content and nature of diet. The appetite of an animal can be assessed by observing its reaction to the offering of feed or by the amount of feed available which has not been eaten. The average rumination time was higher in cattle under a loose housing system. This may be due to the slightly more time the animal spent sitting, idling and lying under the loose housing system. Radostits *et al.* (2007) [25] found that rumination time in cows usually commences 30 to 90 minutes after feed consumption. De Rosa *et al.* (2009) [9] reported that combined feeding and rumination occupy 60 to 65 % of animal time. Wagh (2010) [35] reported that the average rumination time in buffalo under loose housing system was significantly ($P<0.05$) higher than tie-barn housed buffalo. The average rumination time ranged from 540 to 653 min/day in buffalo under tie-barn housing and 560 to 678 min/day under loose housed buffaloes.

B. Time spent standing
Animals spend more time on standing to increase heat loss by increasing the amount of skin exposed to air flow or wind. A lack of comfort may be apparent in reduced time spent laying and a subsequent increase in time spent standing (Haley *et al.* 2001) [13]. Tucker *et al.* (2008) [8] found that time spent standing increased by 10% when heat load increased by 15%. By standing, animals maximize evaporation from their body surface and also benefit from convection due to wind, or there may be the possibility of a warm floor.

C. Lying/Resting behavior
Cows spend nearly half of their lives lying down, so providing a well-designed space for this behavior is important. A reduction in the time cows spend resting can lead to physiological changes associated with stress and can; ultimately, have a negative impact on health (Munksgaard and Lovendahl, 1993) [22]. Cows that spend less time lying down necessarily spend more time standing on concrete Floors, and this is thought to increase or exacerbate lameness. Cows also show increased rumination times (Hassan *et al.* 1993) [14] and blood flow to the udder (Rulquin and Caudal 1992) [26], when they are lying down.

D. Moving
Time spent in moving inside the shed or outside the shed decreases with the comfort as more time is spent in feeding, rumination and sleeping. Vijayakumar (2005) [33] observed that buffalo heifers spent less time in moving when different heat ameliorative measures were given to reduce the heat stress.

E. Time spent in shed/shade seeking behavior
In hot weather, cattle actively seek shade, which may reduce the radiant heat load by 30% or more (Blackshaw and Blackshaw, 1994) [32]. Kendall *et al.* (2006) [18] and Tucker *et al.* (2008) [8] reported cows readily use shade when given access to it and the provision of shade can alleviate negative effects of increased heat load. Schütz *et al.* (2009) [27] found

that dairy cows choose to stand in shade instead of lying in warm conditions even when they were deprived of lying for the previous 12 hrs. Indeed, there is evidence that cattle will engage in aggressive behavior to gain access to shade, especially when the heat load increases.

F. Feeding behavior

During hot summer days cows graze actively, only in the mornings (Zhenkov *et al*. 1996) [39] and spend most time in the yard. Water buffaloes spend 99% of their waking hours ingesting food, ruminating, resting and drinking water; the remaining 1% is devoted to locomotion and other activities (Fundora *et al*. 2007) [10]. In loose housing conditions, the gross feeding time was 15 to 30% longer than that in tied conditions due to physiological feeding breaks and disturbances stemming from social behavior in dairy cows (Czako *et al*. 1984) [8].

G. Time spent near water source

Animals spent more time around the water trough during heat stress to reduce the effects of high heat load by increasing water consumption. Access to cool drinking water improved weight gain in feedlot cattle in summer (Ittner and Kelly, 1951) [15] and several studies have shown that cattle increase their water consumption in summer, particularly when there is no access to shade (Mader *et al*. 1997) [21]. Cattle may also spend more time around the water trough because evaporation from the trough may create a cooler microclimate, compared to the rest of the enclosure. Mader *et al*. (1997) [21] found that the percentage of beef cattle around the water trough was 2-3 times greater for unshaded groups compared to groups that had access to 3.5 m2 shade/animal especially when heat load was at its peak.

H. Drinking behavior

The activation of the thirst centre in the hypothalamus due to high evaporative loss (respiration, sweating, or panting) in heat stress may lead to increase in drinking time. Mader *et al*. (1997) [21] and Widowski (2001) [37] reported that cattle increase their water consumption in summer, particularly when there is no access to shade. Hafez and Lindsay (1965) [11] indicated that it is important to have a clear understanding of an animal's behavior under various environmental conditions for an intelligent analysis of research results on physiology, nutrition, breeding and management. Yazdani and Gupta (2000) [38] suggested that the feeding time recorded at the monthly interval of crossbred calves showed no significant difference between thatch and loose house system. Heat production increases during and after feeding, and shifting a great part of feed intake to night hours when non-evaporative heat loss from the animal to the environment is more efficient, results in lower energy expenditure during the daytime (Aharoni *et al*. 2005) [1]. Vijayakumar *et al*. (2009) [34] studied the effect of heat ameliorative measures on the behavioral responses of 18 buffalo heifers, *viz*. T1, control; T2, provided with only fan; and T3, provided with fan and sprinkling for 10 min at 2h intervals. The results (table 2.2) indicated that certain maintenance behavioral parameters (watering, defecation and urination) differed significantly whereas among the major behavioral patterns and postural parameters, only moving time showed significant difference among the groups.

Barman (2016) [3] divided 24 buffalo calves in four groups kept under different roof modifications *viz*. Asbestos roof (T1), Pre painted CGI Sheet roof (T2), Thatch with polythene shading roof (T3) and Galvanized iron sheet roof (T4) and observed that T3 grouped calves spent comparatively more time in feeding, moving and sleeping whereas, time spent in drinking was significantly ($P<0.01$) higher in T4 and was least in T3 grouped calves. Time spent standing was more ($P<0.01$) in T1 followed by T4 and least in T3 followed by T2 whereas grooming time was significantly higher ($P<0.01$) in T2 followed by T1 and was least in T3 and T4. Licking of inanimate objects and cross sucking was significantly higher ($P<0.01$) in T2 followed by T4. Kamal *et al*. (2016) [16] concluded that the calves kept in agro-net shade spent maximum time ($P<0.05$) in feeding, rumination, resting, sleeping and playing, whereas minimum time spent near the water tank, drinking, standing and moving in comparison with other grouped calves. The time spent in grooming, licking and cross-sucking was significantly higher ($P<0.01$) in asbestos shade and less in agro-net. Furthermore, the calves spent more time involved in each activity in the shade in comparison with the open area in all the groups except in asbestos sheds.

Conclusion

An efficient management of cattle will be incomplete without a well-planned and adequate housing of cattle. Improper planning in the arrangement of animal housing may result in additional labour charges and that curtail the profit of the owner. During erection of a house for dairy cattle, care should be taken to provide comfortable accommodation for individual cattle. No less important is the proper sanitation, durability and arrangements for the production of clean milk under convenient and economic conditions, etc.

Reference

1. Aharoni Brosh YA, Harari Y. Night feeding for high yielding dairy cows in hot weather: effects on intake, milk yield and energy expenditure. Livestock Prod. Sci. 2005;92:207-219.
2. Badinga L, Collier RJ, Thatcher WW, Wilcox CJ. Effects of climatic and management factors on conception rate of dairy cattle in a subtropical environment. J Dairy Sci 1985;68:78-85.
3. Barman RSD. Studies on the effect of different shade materials on the performance of buffalo calves. PhD thesis submitted to Bihar Agricultural University, Bhagalpur, Bihar, 2016.
4. Barman RSD, Chaudhary MK, Anjay Verma RK, Jha DK. Growth performance and feed intake of buffalo calf under different shade materials during summer season. International Journal of Science, Environment and Technology 2017;6(1):640-649.
5. Blackshaw JK, Blackshaw AW. Heat stress in cattle and the effect of shade on production and behavior: a review. Aust. J Exp. Agric 1994;34:285-295.
6. Brody S. 'Bioenergetics and growth' Reinhold, New York, USA, 1945.
7. Collier R, Beede DK, Thatcher WW, Israel LA, Wilcox CJ. Influence of environment and its modification on dairy animal health and production. J Dairy Sci 1982;65:2213-2227.
8. Czako J, Santhe T, Kesthelgi T. Data on the feeding behaviour of dairy cows. Allatt cs-Tak 1984;33(1):56-57.
9. De Rosa G, Grasso F, Braghieri A, Bilancione A, Francia AD, Napolitano F. Behavior and milk production of buffalo cows as affected by housing system. J Dairy Sci.

2009;92:907-912.
10. Fundora O, Tuero O, Gonzalez ME, Rivadineira W, Alfonso F, Zamora A, Vera AM. Comparative study of the feeding behavior of river buffaloes and Siboney de Cuba breed at the fattening stage. Cuban J Agri. Sci 2007;41:231-235.
11. Hafez ESE, Lindsay DR. Behavioural responses in farm animals and their relevance to research techniques. Anim. Breed. Abstr 1965;33:1-16.
12. Hahn GL, Mader TL. Heat waves in relation to thermoregulation, feeding behavior and mortality of feedlot cattle. Proceedings, 5th International Livestock Environment Symposium, ASAE SP01-97, American Society Agricultural Engineers, Minneapolis, MN 1997, 563-571.
13. Haley DB, Passille AM, De-Rushen J. Assessing cow comfort: effect of two tie stall designs on the behaviour of lactating dairy cows. App. Ani. Beh. Sci 2001;71:105-117.
14. Hassan SA, Ward WR, Murray RD. Effects of lameness on the behaviour of cows during summer. Vet. Rec 1993;132:578-580.
15. Ittner NR, Kelly CF. Cattle shades. J Anim. Sci 1951;10:184-194.
16. Kamal R, Dutt T, Patel M, Dey A, Chandran PC, Bharti PK *et al*. Behavioural, biochemical and hormonal responses of heat-stressed crossbred calves to different shade materials, J App. Ani. Res 2016;44(1):347-354.
17. Kamal RK. Effect of different shade material on Performance of Vrindavani calves. PhD thesis submitted to Deemed university IVRI, Izatnagar, U.P, 2013.
18. Kendall PE, Nielsen PP, Webster JR, Verkerk GA, Littlejohn RP, Matthews LR. The effects of providing shade to lactating dairy cows in a temperate climate. Livest. Sci 2006;103:148-157.
19. Lefcourt AM, Adam WR. Radiotelemetry measurement of body temperatures of feedlot steers during summer. J Ani. Sci 1996;74:2633-2640.
20. Mader TL, Dahlquist JM, Hahn GL, Gaughan JB. Shade and wind barrier effects on summer time feedlot cattle performance. J Ani. Sci 1999;77:2065-2072.
21. Mader TL, Fell LR, McPhee MJ. Behavior response of non-Brahman cattle to shade in commerical feedlots. Livest. Environ 1997;5:795-802.
22. Munksgaard L, Lovendahl P. Effects of social and physical stressors on growth hormone levels in dairy cows. Canadian J Anim. Sci 1993;73:847-53.
23. Patel JB, Patel JP, Pande MB. Effect of Different Housing Patterns on Feed and Water Intake in Mehsana Buffalo under Semi-arid conditions. Indian J Anim Sci 1995;65:88-90.
24. Pradhan B, Mitra G, Nayak S, Mohanty SC, Sahoo G. Effect of bathing on growth performance, change in body measurement, voluntary feed and water intake in crossbred calves reared under hot humid conditions. Indian J Anim. Prod. Mgmt 1999;15(4):140-142.
25. Radostits OM, Gay C, Hinchcliff KW, Constable PD. Appendix-2. Reference laboratory values. Veterinary medicine, A textbook of the diseases of cattle, horses, sheep, pig and goats. Tenth edition. Elsevier, Edinburgh London New York 2007, 2049.
26. Rulquin H, Caudal IP. Effects of lying or standing on mammary blood flow and heart rate in dairy cows. Ann. Zootech 1992;41:101.
27. Schütz KE, Rogers AR, Cox NR, Tucker CB. Dairy cows prefer shade that offers greater protection against solar radiation in summer: Shade use, behaviour, and body temperature. Appl. Anim. Behav. Sci 2009;116:28-34.
28. Shearer JK, Bray DR, Bucklin RA. The management of heat stress in dairy cattle: What we have learned in Florida. University of Florida, America 2002.
29. Singh Y. Effect of certain managemental practices on the performance of buffalo heifers. PhD thesis, submitted to C.C.S. Haryana Agricultural University, Hisar, India 2000.
30. Thatcher WW, Roman-Ponce H, Buffington DE. Environmental effects on animal performance. Large Dairy Herd Management. Univ. Presses of Florida, Gainesville 1978, 219-230.
31. Tripathi VN, Thomas CK, Sastry NSR, Pal RN, Gupta LR. Effect of shelter and water sprinkling on buffalo growth. Indian. J Ani. Sci 1972;42:745-748.
32. Tucker CB, Rogers AR, Schütz KE. Effect of solar radiation on dairy cattle behaviour, use of shade and body temperature in a pasture-based system. Appl. Anim. Behav. Sci 2008;109:141-154.
33. Vijayakumar P. Effect of thermal stress management on nutritional, physiological and behavioural responses of buffalo heifers. Ph.D Thesis submitted to Deemed university, IVRI Izatnagar, Bareilly (U.P.) India, 2005.
34. Vijayakumar Pandey HN, Singh M, Dutt T, Tomar AKS. Behavioural response to heat ameliorative measures on buffalo heifers. Indian J of Ani. Sci 2009;79(4):433-436.
35. Wagh. Behaviour and welfare indices in buffalo under loose housing system, M.V.Sc thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur, 2010.
36. West JW. Managing and feeding lactating dairy cows in hot weather. USDA 1995.
37. Widowski T. Shade seeking behaviour of rotationally grazed cows and calves in a moderate climate. In: *Livestock environment* VI. Proceeding of the 6th International Symposium, Louisville, KY. RR. Stowell, R. Bucklin and R.W. Bottcher, ed. ASAE Publication No. 701P0201. ASAE, st. Joseph, MV 2001, 632-639.
38. Yazdani AR, Gupta LR. Effect of Housing and feeding system on Feed Utilization and Physiological Responses in Crossbred Calves. Indian J Dairy Sci 2000;53:88-92.
39. Zhenkov Z, Videv V, Krastev M. The effect of pasture on some productive and biological characteristics of cows under sheds. 11. Behavioural reactions and blood parameters. Zhivotnov Dani nauki 1996;33(4):8-11.