Documentos
ISSN 1983-974X
Outubro, 2016
216

II SIGEE – Second International Symposium on Greenhouse Gases in Agriculture – Proceedings

Embrapa

ISSN 1983-974X
outubro, 2016

Empresa Brasileira de Pesquisa Agropecuária
Embrapa Gado de Corte
Ministério da Agricultura, Pecuária e Abastecimento

Documentos 216

II SIGEE – Second International Symposium on Greenhouse Gases in Agriculture – Proceedings

Organizadores
Roberto Giolo de Almeida (Coordenador)
Patrícia Perondi Anchão Oliveira
Maurício Saito
Cleber Oliveira Soares
Lucas Galvan
Lucimara Chiari
Fabiana Villa Alves
Davi José Bungenstab

Embrapa
Brasília, DF
2016

Exemplares desta publicação podem ser adquiridos na:

Embrapa Gado de Corte
Av. Rádio Maia, 830, Zona Rural, Campo Grande, MS, 79106-550
Fone: (67) 3368 2000
Fax: (67) 3368 2150
http://www.embrapa.br/gado-de-corte
https://www.embrapa.br/fale-conosco/sac

Supervisão editorial: *Rodrigo Carvalho Alva*
Revisão de texto e Editoração Eletrônica: *Rodrigo Carvalho Alva e Adionir Blem*
Foto da capa: Luiz Antônio Dias Leal

1ª edição
Versão online (2016)

Dados Internacionais de Catalogação na Publicação (CIP)
Embrapa Gado de Corte.

Anais - 2º Simpósio Internacional Sobre Gases de Efeito Estufa na Agropecuária [recurso eletrônico] / Roberto Giolo de Almeida et al. - Campo Grande, MS : Embrapa Gado de Corte, 2016.
502 p. ; 21cm. - (Documentos / Embrapa Gado de Corte, ISSN 1983-974X ; 216).

Sistema requerido: Adobe Acrobat Reader, 4 ou superior.
Modo de acesso: <http://www.cnpgc.embrapa.br/publicacoes/doc/DOC216.pdf>
Título da página da Web (acesso em 16 de outubro de 2016).

1. Gases de efeito estufa. 2. Agropecuária. 3. Emissões de GEE. 4. Embrapa Gado de Corte. I. Almeida, Roberto Giolo de. II. Oliveira, Patrícia Perondi Anchão. III. Saito, Maurício. IV. Soares, Cleber Oliveira. V. Galvan, Lucas. VI. Chiari, Lucimara. VII. Alves, Fabiana Villa. Bungenstab, Davi José.

CDD 636.213

Infrared Thermography in the Assessment of Thermal Comfort of Confined Water Buffaloes in the Amazon Biome

Samanta do Nascimento MONTEIRO[1], João Maria do AMARAL JÚNIOR[2], Marco Antônio Paula de SOUSA[2], Vinícius Costa Gomes de CASTRO[3], Elder Santana Natividade do CARMO[1], Eziquiel de MORAIS[2], Benjamim de Souza NAHÚM[4], Lucieta Guerreiro MARTORANO[5]*

[1] Undergraduate student in Animal Sciences at the Federal Rural University of the Amazon – UFRA/ Belém; [2] Doctorate student of the Graduate Program in Animal Sciences (UFPA/UFRA/EMBRAPA), CAPES fellow; [3] Master's degree student of the Graduate Program in Animal Sciences (UFPA/ UFRA/EMBRAPA), CNPq fellow; [4] Veterinarian physician, researcher B of Embrapa Eastern Amazon; [5] Agronomical Engineer and Meteorologist, PhD in Agrometeorology, researcher A of Embrapa Eastern Amazon and professor of the Graduate Program in Animal Sciences at UEPA.
E-mail: samantanmonteiro@gmail.com*

Introduction

In tropical regions, thermal stress is one of the major issues for animal farming since it compromises productivity and, consequently, milk and meat production and animal husbandry (ABLAS et al., 2007). Being homeothermic, buffaloes subjected to high temperatures and relative air humidity may experience thermal stress (MORAES JÚNIOR et al., 2010), which is able to set off physiological processes. The ability to monitor and identify animals experiencing thermal stress becomes important since these initial analyses are able to define beforehand the best management for the herd. When it comes to physiological variables, data collection must be as reliable as possible, however, not always are the data properly collected. That entails the need to develop more precise methods to analyze animal response to environmental conditions.

The use of infrared thermography is quite broad and the technique may be employed in the animal production system as a non-invasive method to replace traditional ones (SCHAEEFER et al., 2012) in order to measure skin temperature without interfering in the animal's behavioral reactions.

This study aimed to assess thermal responses in water buffaloes using infrared thermography associated with environmental variables and thermal comfort indices.

Material and Methods

The trial was carried out at the animal research unit "Senador Álvaro Adolfo," belonging to Embrapa Eastern Amazon, in the city of Belém-PA, Brazil. The study area features Af2 climate (MARTORANO et al., 1993) with mean rainfall above 60 mm in the least rainy month and annual rainfall around 2,900 mm. The data were collected in a field trial on 24 crossbred Murrah and Mediterranean female buffaloes whose initial age and mean weight were 34 months and 514 ± 69.88 kg, respectively. The animals belong to Embrapa Eastern Amazon's experimental herd and the procedures were approved by the Committee of Animal Ethics (protocol nº 007/2015). The measurements were performed in November 2015 while the animals were managed in tie-stall facilities featuring individual feed and drinking troughs.

The thermographic images were captured 1.5 m away from the animals three times a day (4 AM, 2 PM, and 8 PM) and framed the cranial and tail sections. The left ileum (A), left ischium (B), right ischium (B1), right ileum (A1), sacrum (C), nose (D), upper lip (E), eyeball (F), thigh (G), forehead (H), and region around the tail (I) were tagged in the images (Figure 1 and 2). The infrared camera used (T650-FLIR®) set to emissivity coefficient 0.95 emissivity was employed to measure the animals' surface temperature at different sites of the body.

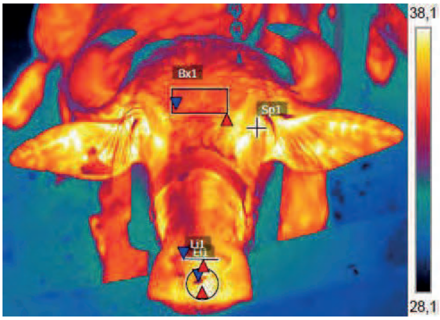

Figure 1. Cranial thermal image with the respective collection sites.

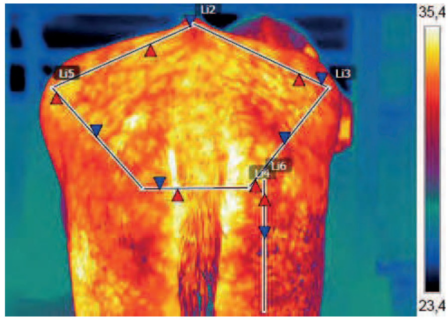

Figure 2. Tail thermal image with the respective collection sites.

Three data loggers (U12-HOBO®) were used to characterize the agrometeorological conditions inside the barn regarding temperature and relative air humidity. The data loggers were installed in agrometeorological cases at the height of the animals' muzzle along the stalls hallway. The data were recorded every 15 min and were downloaded only at the end of the experimental period. The temperature and humidity index (THI) inside the barn was calculated every 15 min and four values were obtained per period of the day assessed based on the model proposed by Thom (1959) according to the following equation: THI = [(0.8 AT) + (RH/100) x (AT-14.4) 46.4], where AT is air temperature (°C) and RH is relative humidity (%).

Results and Conclusions

The mean THI values were 76.5, 84.0, and 80.0, at 4 AM, 2 PM, and 8 PM, respectively. The values observed at 4 AM and 8 PM were below those proposed by Somparn et al. (2004), who stated the animals were under risk at THI $\geq$ 84, i.e., the animals experienced thermal discomfort at 2 PM.

Buffaloes have a less efficient evaporative thermoregulation system than bovines given their limited sweating capacity, which makes them more prone to thermoregulatory issues. One way of dissipating heat is by redirecting blood flow to the body surface, thus increasing skin temperature, which facilitates heat dissipation through non-evaporative mechanisms. It was observed that, as air temperature increases, the animals' body surface temperature also increases, leading to a significant correlation between AT and most anatomical sites, particularly between the forehead and AT (0.94) and THI (0.94) ($p<0.01$) (Table 1).

Table 1. Pearson correlation analyses among the environmental variables and thermal comfort indices with thermographic images of confined water buffaloes.

Variable	A	B	B1	A1	C	D	E	F	G	H	I
AT	0.82	0.81	0.82	0.87	0.85	0.16	0.01	0.55	0.83	0.94	0.77
p-v	**	**	**	**	**	*	ns	**	**	**	**
RH	-0.78	-0.75	-0.75	-0.81	-0.80	-0.12	0.10	-0.55	-0.89	-0.69	-0.78
p-v	**	**	**	**	**	ns	ns	**	**	**	**
THI	0.80	0.81	0.84	0.87	0.84	0.18	0.09	0.53	0.83	0.94	0.79
p-v	**	**	**	**	**	ns	ns	**	**	**	**

Left ileum (A), left ischium (B), right ischium (B1), right ileum (A1), sacrum (C), nose (D), upper lip (E), eyeball (F), thigh (G), forehead (H), around the tail (I), mean air temperature (AT), mean relative humidity (RH), temperature and humidity index (THI).

*significant ($p<0.05$); **significant ($p<0.01$); ns=non-significant ($p>0.05$).

The use of infrared thermography proved sensitive to detect differences in the animals' skin temperature in association with index THI, indicating thermal stress due to heat at 2 PM of confined water buffaloes.

References

ABLAS. D. S.; TITTO, E. A. L.; PEREIRA, A. M. F.; TITTO, C. G.; LEME, T. M. C. Comportamento de bubalinos a pasto frente a disponibilidade de sombra e água para imersão. **Ciênc Anim Bras**, v.8, p.167-175, 2007.

MARTORANO, L. G.; PERREIRA, L. C.; CÉZAR, E. G. M.; PEREIRA, I. C. B. Estudos Climáticos do Estado do Pará, Classificação Climática (KÓPPEN) e Deficiência Hídrica (THORNTHWHITE, MATHER). Belém, **SUDAM/EMBRAPA**, SNLCS. 53p. 1993.

MORAES JÚNIOR, R. J.; GARCIA, A. R.; SANTOS, N. F. A. Conforto ambiental de bezerros bubalinos (*Bubalus bubalis* Linnaeus, 1758) em sistemas silvipastoris na Amazônia Oriental. **Acta Amaz.**, v.40, p.629-640, 2010.

SCHAEEFER, A. L.; COOK, N. J.; BENCH, C. The noninvasive and automated detection of bovine respiratory disease onset in receiver calves using infrared thermography. **Research in Veterinary Science**, v.93, p.928-935, 2012.

SOMPARN, P.; GIBB, M. J.; MARKVICHITR, K. Analysis of climatic risk for cattle and buffalo production in northeast Thailand. **Int. J. Biometeorol**. v.49, p.59-64, 2004.

THOM, E. C. The disconfort index. **Weatherwise**, v.12, p.57-59, 1959.

Acknowledgements

The authors thank PECUS Network (MP1/Embrapa) and Project INFRA/PECUS (MP5/Embrapa) for enabling this research.