University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Nebraska Beef Cattle Reports | Animal Science Department

1-1-1997

Time of Feeding Influence on Cattle Exposed to Heat

Terry L. Mader
University of Nebraska-Lincoln, tmader1@unl.edu

John Gaughan
University of Queensland-Gatton, j.gaughan@uq.edu.au

Darryl Salvage
University of Queensland-Gatton (UQG), Gatton, Queensland, Australia

Bruce Young
University of Queensland-Gatton (UQG), Gatton, Queensland, Australia

Follow this and additional works at: https://digitalcommons.unl.edu/animalscinbcr

Part of the Animal Sciences Commons

Mader, Terry L.; Gaughan, John; Salvage, Darryl; and Young, Bruce, "Time of Feeding Influence on Cattle Exposed to Heat" (1997). *Nebraska Beef Cattle Reports*. 449.
https://digitalcommons.unl.edu/animalscinbcr/449

This Article is brought to you for free and open access by the Animal Science Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Nebraska Beef Cattle Reports by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Time of Feeding Influence on Cattle Exposed to Heat

Terry Mader
John Gaughan
Darryl Savage
Bruce Young[1]

Managing heat load through manipulation of feeding regime may be effective in maintaining intake of individually fed feedlot cattle exposed to hot environmental conditions.

Summary

The effects of high temperature and time of daily feeding were examined on six individually fed Hereford steers. In general, pulse rate was more indicative of dry matter intake (DMI) than of heat load. Afternoon feeding was not found to be an effective method of maintaining DMI under hot environmental conditions (HOT). As a percent of body weight, steers fed after noon under HOT had significantly lower metabolizable energy intake than other treatments, while steers fed morning or split fed (30% roughage diet fed at 0800 hr and 6% roughage diet fed at 1600 hr) under HOT were able to maintain DMI at a level equal to or greater than steers fed under thermoneutral

(Continued on next page)

conditions. For afternoon feeding to be more effective, night-time cooling below a temperature-humidity index of 74 may be needed if cattle experience excessive heat load the previous day.

Introduction

Thermal load causing an increase in maintenance energy requirement and a reduction in growth rate in beef cattle can represent considerable economic loss to the feedlot industry. Unexpected periods of heat load impose serious problems when cattle are not physiologically adapted to hot conditions. High ambient temperature resulting in an increase in internal body temperature will reduce feed intake and change eating patterns. Since ruminal fermentation of most high grain diets generally peaks within a few hours after consumption, daily morning feeding may result in maximum heat from fermentation during the hottest part of the day. This suggests that cattle consuming the highest energy components of their diets during late evening or at night during summer may better cope with heat load and utilize metabolizable energy more efficiently than those fed in the morning immediately before maximum daily heat load.

This study was undertaken to evaluate responses and feed intake under different feeding regimes in cattle exposed to thermoneutral or hot environmental conditions.

Materials and Methods

A metabolism trial was conducted during the summer at the University of Queensland, Gatton College, Department of Animal Production facilities. Six yearling Hereford steers (mean weight = 616 lb) were randomly assigned to individual stalls (9.8 ft x 3.3 ft) in one of two temperature controlled rooms. Each animal was restrained in its stall by a head halter and had previously been accustomed to being led and being tied. The feeding treatments were: 14% roughage diet (Table 1) provided at 0800 hr daily (morning); the same diet as in morning but fed at 1600 hr (afternoon); and a split feeding regime (SP) in which approximately one-third of the dietary intake was provided from a 30% roughage diet fed at 0800 hr with the remaining dietary intake provided from a 6% roughage diet fed at 1600 hr. Total diet consumed in the split feeding group approximated the composition of the 14% roughage diet of the other two treatments. Water was available ad libitum. The trial was replicated over three time periods with each test period three days long.

Before each test period, steers were accustomed to feeding treatment for seven days under thermoneutral conditions. Feed intakes and refusals were recorded daily throughout the trial. During the test periods, the hot room had the capacity to be heated to temperatures in excess of 100°F through supplementary heat, while the thermoneutral room maintained temperatures between 72°F and 88°F. High temperatures were imposed in the hot room beginning at 1000 hr and ending at 1800 hr. Although test room temperatures were imposed during the day, room temperatures were also influenced by and varied with outside conditions, particularly at night. In the hot room, a gradual cool down to thermoneutral conditions was allowed at night to depict normal cyclical daily temperatures. The thermoneutral room peak temperature averaged 88.5°F during the afternoon, and also followed a natural cyclical temperature pattern.

Table 1. Composition of diets.

	Diet roughage level, %		
	6	14	30
Ingredient, % of DM			
Barley	44.5	40.5	32.5
Sorghum	44.5	40.5	32.5
Alfalfa hay	3.0	7.0	15.0
Oat hay	3.0	7.0	15.0
Supplement[a]	5.0	5.0	5.0
Calculated nutrient content, % of DM			
Calcium	.54	.60	.72
Phosphorous	.45	.44	.41
Roughage	6.0	14.0	30.0
Rumensin, g/ton	25.0	25.0	25.0
NEg, mcal/cwt	61.7	58.9	53.1
ME, mcal/cwt	135.7	131.9	124.5

[a]Fed in dry form and contained protein, minerals, vitamins, and Rumensin.

Feed intake (DMI) and metabolizable energy intake (MEI) were determined daily for each steer. During the three-day test periods, respiratory rate (RR) and pulse rate were measured daily at 0900, 1600, and 2000 hr on each steer; body temperature (BT) was recorded, using a data logger, at ten-minute intervals for the duration of the trial, via an 8-inch rectal probe with a thermistor mounted in the tip. Pulse rate was determined via pulse monitor attached to an ear clip sensor.

Results

Mean temperature in the thermoneutral room over the test period was 78.4°F. Mean hourly relative humidity ranged from 61% to 85% (overall mean = 74%). Mean hourly temperature-humidity index (THI) was 75 and ranged between 71 to 81. Mean temperature in the hot room was 86.4°F. Mean hourly relative humidity was 69% and ranged from 50 to 86%. Mean THI was 82 and ranged from 74 to 90. Mean THI between 1200 and 1800 hr averaged 88 in the hot room and 74 in the thermoneutral room. During this period, mean dry bulb temperature in the hot room was 96.3°F.

Mean respiratory rate measured at 1600 and 2000 hr differed ($P < .10$) between steers fed under thermoneutral vs hot conditions (Table 2). Within feeding regime, respiratory rate was not affected. In contrast, pulse rate was significantly influenced by feeding regime at 1600 hr, in which afternoon fed steers had the lowest pulse rate while SP fed steers had the highest pulse rate. At 0900 hr, pulse rate in the thermoneutral treatment was higher than pulse rate in the hot treatment steer group. Steers exposed to hot environmental conditions had greater body temperature at 1600 and 2000 hr; however, environmental conditions by feeding regimen interactions existed at both times. In general, under thermoneutral conditions, body temperature was the least with morning feeding and greatest with SP feeding. An opposite trend tended to be evident under hot conditions. Even though the interaction was not apparent, these same trends were

Table 2. Mean respiratory rate (RR), pulse rate (PR), and body temperature (BT) measured at 900, 1600, and 2000 hr for cattle fed feedlot diets while being exposed to thermoneutral (TNL) or hot (HOT) environmental conditions (ENV).[a]

ENV:	TNL			HOT		
Feeding regime:	AM	PM	SP	AM	PM	SP
RR, breaths/min						
900 hr	68.4	68.8	76.2	88.0	80.1	81.6
1600 hr[b]	72.8	81.0	88.7	136.2	136.2	130.7
2000 hr[b]	87.0	96.8	101.3	113.7	115.7	114.8
PR, beats/min						
900 hr[b]	95.0	97.3	98.6	92.2	90.9	88.7
1600 hr[c]	94.6	90.3	97.4	96.4	93.3	98.4
2000 hr	97.5	92.3	97.6	97.7	101.4	107.3
BT, °F						
900 hr	101.8	101.8	102.2	102.2	102.2	101.8
1600 hr[bd]	101.8	102.2	102.7	103.5	104.5	104.2
2000 hr[bd]	102.6	102.7	103.5	104.7	104.2	104.2

[a]The AM and PM fed diets contained 14% roughage while SP diet contained 30% roughage during morning feeding and 6% roughage during afternoon feeding.
[b]TNL vs HOT, $P < .10$.
[c]Feeding regimens differ $P < .10$.
[d]ENV by feeding regimens interaction, $P < .10$.

Table 3. Mean, maximum (max), minimum (min) and range in body temperature for cattle fed feedlot diets while being exposed to thermoneutral (TNL) or hot (HOT) environmental conditions (ENV).[a]

ENV:	TNL			HOT		
Feeding regime:	AM	PM	SP	AM	PM	SP
Day 1						
Mean[bc]	102.1	102.3	102.9	103.5	103.2	103.1
Max[b]	103.1	103.4	103.9	105.1	104.6	104.4
Min[bc]	101.0	101.3	101.7	102.4	101.8	101.4
Range	2.1	2.1	2.2	2.8	2.8	2.9
Day 2						
Mean[bc]	102.2	102.5	102.9	103.9	103.5	103.3
Max[b]	103.2	103.7	104.3	105.3	104.8	104.9
Min[bc]	101.1	101.3	101.8	102.3	101.8	101.6
Range[b]	2.2	2.3	2.5	3.0	3.0	3.4
Day 3						
Mean[bc]	102.4	102.5	103.1	104.0	103.6	103.4
Max[bc]	103.4	103.9	104.0	105.7	104.9	105.2
Min[c]	101.3	101.9	102.3	102.3	101.7	101.1
Range[b]	2.1	2.0	1.7	3.3	3.1	4.2
Trial						
Mean[bc]	102.2	102.5	103.0	103.8	103.4	103.2
Max[bc]	103.4	104.0	104.3	105.6	105.0	105.2
Min[bc]	101.1	101.1	101.8	102.1	101.7	101.3
Range[b]	2.4	2.9	2.5	3.5	3.3	3.9

[a]The AM and PM fed diets contained 14% roughage while SP diet contained 30% roughage during morning feeding and 6% roughage during afternoon feeding.
[b]TNL vs HOT, $P < .10$.
[c]ENV by feeding regimen interaction, $P < .10$.

evident for 0900 hr pulse rate.

These same trends were also observed in the daily mean, maximum and minimum body temperature values shown in Table 3. The body temperature values were greatest in the hot morning treatment, but least in the thermoneutral morning treatment on most days and over the entire trial. By day three, and over the entire trial, environmental condition by feeding regimen interactions were found for mean, maximum and minimum body temperature. In general, maximum and minimum body temperature values for the thermoneutral split feeding treatments tended to be greater than respective body temperature values of other thermoneutral treatment, while the body temperature values of the hot split feeding treatment tended to be lower than respective body temperature values of the other hot treatments. As expected, the range in body temperature values were greater in the hot treatment than in the thermoneutral treatment. Ranges in body temperature tended to increase from day one to day three in the hot treatment group only.

Under hot conditions, mean body temperature of afternoon-fed steers tended to remain elevated above split feeding program-fed steers, while maximum body temperature tended to be less for afternoon-fed steers (day 2, day 3, and over the entire trial). Under hot conditions, morning- and afternoon-fed steers tended to have consistently greater minimum body temperature (daily and over entire trial) than split-fed steers. The inability to dissipate body heat and return to a state of normalcy most likely impacts post-heat feeding behavior. Feeding after noon tended to reduce maximum body temperature compared to morning and split feeding, but it did not allow for the lower minimum body temperature that was observed in the split feeding program-fed steer group.

Under both environmental conditions split feeding program-fed steers tended to have the greatest DMI and MEI (Table 4). Under thermoneutral conditions, afternoon fed steers maintained equal intakes to split feeding program-fed steers, which tended to be greater than morning fed steers. However, under hot conditions afternoon-fed steers had intakes as a percent of body weight of 12.3% and 13.6%, respectively, lower than the morning and split feeding program-fed steers. Steers that were split fed under hot conditions appeared to be better able to distribute MEI throughout the 24-hour period, thus minimizing heat load by achieving lower mean and minimum body temperature than other steers fed under hot conditions.

Although pulse rate appeared not to

(Continued on next page)

Table 4. Mean daily dry matter (DMI) and metabolizable energy (MEI) consumed for cattle fed feedlot diets and exposed to thermoneutral (TNL) or hot (HOT) environmental conditions (ENV)[a].

ENV:	TNL			HOT		
Feeding regime:	AM	PM	SP	AM	PM	SP
DMI, lb/day[b]	16.14	16.49	16.49	15.81	14.31	16.67
DMI, % BW[cd]	2.62	2.72	2.72	2.60	2.28	2.64
MEI, mcal/day[b]	21.3	21.8	21.8	20.9	18.9	22.1
MEI, % BW[cd]	3.46	3.59	3.60	3.42	3.00	3.50

[a]The AM and PM fed diets contained 14% roughage while SP diet contained 30% roughage during morning feeding and 6% roughage during afternoon feeding.
[b]Feeding regimens differ, $P < .10$.
[c]Expressed as a % of body weight; TNL vs HOT, $P < .10$.
[d]ENV by feeding regimen interaction, $P < .10$.

be elevated during heat load, the lower pulse rate for the hot group at 0900 h, when the steers were not exposed to heat load, corresponds to the lower DMI (%BW) and MEI (%BW) of the hot group.

Data suggest that under hot conditions, minimum body temperature may have a greater influence on subsequent intake than previous maximum body temperature. Cattle consuming large quantities of feed afternoon may not experience the degree of body temperature reduction normally associated with night-time cooling. In this study, THI in the hot room did not go below 74 (76° F and 80% RH). Nighttime values which are less than these or several hours of conditions near THI of 74 may be needed if cattle are to consume greater portions of their diet at night. By split feeding under hot conditions, DMI tended to be as great or greater than under any thermoneutral diet regimen. Intakes (%BW) were able to be maintained and not reduced, as is usually the case under heat load. Intakes appear to be maintained as a result of lower mean and minimum body temperature. However, additional research is needed regarding split feeding regimen before being considered for use under practical feedlot conditions.

[1]Terry Mader, Professor of Animal Science, Northeast Research and Extension Center, Concord; John Gaughan, Lecturer, Darryl Savage, student, and Bruce Young, Professor and department head, Department of Animal Production, University of Queensland-Gatton (UQG), Gatton, Queensland, Australia.