2017

# The Effect of Supplementing Mannan Oligosaccharide or Finely Ground Fiber, during the Summer on Body Temperature, Performance, and Blood Metabolites of Finishing Steers

Bradley M. Boyd
*University of Nebraska-Lincoln*, bboyd4@unl.edu

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

Curtis J. Bittner Bittner
*University of Nebraska-Lincoln*, curtis.bittner@unl.edu

Henry Hilscher
*University of Nebraska-Lincoln*

Gene Wijffels
*University of Nebraska-Lincoln*

*See next page for additional authors*

**Authors**
Bradley M. Boyd, Terry L. Mader, Curtis J. Bittner Bittner, Henry Hilscher, Gene Wijffels, John B. Gaughan, Megan Sullivan, Judy Cawdell- Smith, and Galen E. Erickson

# The Effect of Supplementing Mannan Oligosaccharide or Finely Ground Fiber, during the Summer on Body Temperature, Performance, and Blood Metabolites of Finishing Steers

Bradley M. Boyd
Terry L. Mader
Curt Bittner
Henry Hilscher
Gene Wijffels
John B. Gaughan
Megan Sullivan
Judy Cawdell-Smith
Galen E. Erickson

## Summary with Implications

*Crossbred beef steers (12 pens, n=96) were used to determine the effect of adding Agrimos or 5% ground (1 in.) wheat straw compared to a control on body temperature, panting score and performance. There were no differences in final BW, ADG, and DMI among treatments. Feed conversion was increased for cattle fed 5% additional ground straw when compared to control and Agrimos. Hot carcass weight, dressing %, LM area, and marbling score were not different among treatments. Cattle fed the control had greater 12th rib fat depth and USDA yield grade than cattle fed straw or Agrimos. Both average and maximum body temperatures were slightly greater for cattle fed Agrimos than for cattle fed control or added straw. Panting scores were decreased slightly for cattle fed the extra straw when compared to control and Agrimos. The addition of Agrimos or wheat straw to the diet had minimal effects on heat stress measures.*

## Introduction

Feeding prebiotics in an effort to reduce the negative effects of heat stress has primarily been studied in poultry. Studies have shown that feeding mannan oligosaccharide in the diet of poultry helped reduce some of the detrimental effects of heat stress in terms of reducing oxidative damage to the small intestine. In addition to feeding probiotics, feeding increased levels of fiber has been shown to increase the amount of short chain fatty acids present in the cecum which can provide oxidative protection to intestinal cells. The addition of fiber to a finishing diet may also displace some energy therefore reducing metabolic heat load. This is supported by a study where a decrease in steer body temperature with the addition of increased fiber levels to the diet was observed (*1997 Nebraska Beef Cattle Report*, pp. 85–88).

Environmental stress has been a researched topic for the past few decades however, little is known about how feeding a yeast supplement or fine ground wheat straw will affect feedlot steer performance and body temperature. Therefore, the objective of the current study was to determine the effect of feeding a yeast supplement or adding finely ground wheat straw on steer performance, body temperature, panting scores, and blood metabolites.

## Procedure

A finishing study was conducted utilizing crossbred beef steers (96 steers, 12 pens) to study the effects of feeding mannan oligosaccharide (Agrimos; Lallemand Animal Nutrition; Montreal, Canada) and finely ground wheat straw on steer performance, body temperature, panting score, and blood metabolites during summer conditions. Steers were fed at the University of Nebraska-Lincoln (UNL) Eastern Nebraska Research and Extension Center research feedlot near Mead, Nebraska.

Cattle were limit-fed a diet consisting of 50% Sweet Bran (Cargill, Blair, Neb) and 50% alfalfa hay at an estimated 2% of BW for five days prior to an initial BW being collected. Initial BW were collected over a 2 d period on day 0 and 1 of the experiment and averaged. Steers were stratified by initial BW and assigned randomly to pen within strata. Treatment was assigned randomly to pen.

**Table 1. Main effect of treatment on animal performance and carcass characteristics**

| | Control | Straw | Agrimos | SEM | P-Value |
|---|---|---|---|---|---|
| Performance | | | | | |
| Initial BW, lb | 1056 | 1057 | 1056 | 5 | 0.98 |
| Final BW, lb | 1525 | 1501 | 1519 | 13 | 0.38 |
| DMI, lb/d | 27.3 | 28.0 | 27.1 | 0.5 | 0.43 |
| ADG, lb | 3.97 | 3.76 | 3.93 | 0.10 | 0.24 |
| Hot Period DMI[1], lb/d | 26.2 | 27.7 | 26.3 | 0.6 | 0.19 |
| NEg Intake, Mcal/d | 14.50 | 14.02 | 14.38 | 0.25 | 0.39 |
| F:G, | 6.89[b] | 7.46[a] | 6.94[b] | 0.12 | 0.02 |
| Carcass Characteristics | | | | | |
| HCW, lb | 961 | 945 | 957 | 8 | 0.38 |
| Dressing % | 62.3 | 61.7 | 62.0 | 0.3 | 0.36 |
| LM Area, $in^2$ | 13.5 | 13.7 | 13.8 | 0.2 | 0.45 |
| 12th Rib Fat, in | 0.60[b] | 0.51[a] | 0.53[a] | 0.02 | 0.01 |
| Marbling[2] | 474 | 471 | 476 | 8 | 0.38 |
| USDA Yield Grade[3] | 3.9[b] | 3.5[a] | 3.5[a] | 0.3 | 0. 36 |

Values within rows with unique superscripts are different ($P < 0.05$)
[1]Period between 6/25/2015 and 7/27/2015
[2]300 = slight, 400 = Small, 500 = Modest.
[3]Calculated as 2.5 + (2.5 x 12th rib fat) + (0.2 x 2.5[KPH]) + (0.0038 x HCW)–(0.32 x REA)

**Table 2. Main effect of treatment on body temperature and panting measurements**

| | | | | | P-Value | |
|---|---|---|---|---|---|---|
| | Control | Straw | Agrimos | SEM | Trt | Interaction[1] |
| Overall[2] | | | | | | |
| Average | 102.3[a] | 102.3[a] | 102.6[b] | 0.1 | <0.01 | <0.01 |
| Maximum | 105.0[a] | 104.9[a] | 105.5[b] | 0.1 | <0.01 | <0.01 |
| AUC[3] | 2456 | 2455 | 2462 | 1 | 0.18 | 0.95 |
| Panting Score[4] | 1.75[b] | 1.72[a] | 1.76[b] | 0.01 | <0.01 | <0.01 |
| Hot Period[5] | | | | | | |
| Average | 102.5[a] | 102.5[a] | 102.8[b] | 0.05 | <0.01 | <0.01 |
| Maximum | 105.5[a] | 105.4[a] | 105.9[b] | 0.07 | <0.01 | <0.01 |
| AUC[3] | 2460 | 2460 | 2467 | 3 | 0.18 | 0.95 |
| Panting Score[4] | 1.87[ab] | 1.84[a] | 1.90[b] | 0.01 | 0.05 | <0.01 |

Values within rows with different superscripts are different ($P < 0.05$)
[1] Interaction between day and treatment
[2] Mean values for the entire feeding period
[3] Area under the curve = Total magnitude of individual animal body temperature change within each treatment
[4] Panting scores based on 0 to 4 scale with 0 = no panting and 4 = severe distress
[5] Values for the selected warm period between days 31 and 62 of the trial (6/25/2015–7/27/2015)

The trial was conducted during the summer of 2015 utilizing summer yearlings (initial BW = 1055±25 lb). Cattle were on feed for 121 days with the trial starting on May 26, 2015 and cattle harvested on September 23, 2015 at Greater Omaha.

The study was a completely randomized design with three treatments and four replications per treatment. The basal diet consisted of 34.25% high-moisture corn (HMC), 34.25 dry-rolled corn (DRC), 20% modified distillers grains plus solubles, 7.5% sorghum silage, and 4% supplement. Cattle were adapted onto the finishing diet over a 21-d period by reducing alfalfa inclusion in the diet and increasing levels of HMC/DRC blend. The first treatment was a control (CON) consisting of only the basal diet. The second treatment included feeding Agrimos (MOS; Lallemand Animal Nutrition, Montreal, Canada) at 30g/steer daily added into the supplement. The third treatment consisted of feeding ground (1 in.) wheat straw (STRAW) at 5% of the diet DM replacing 5% of the DRC/HMC blend.

Blood samples were collected from each steer via jugular venous puncture. An initial measure was collected on day 23, after cattle were fully adapted to the finishing diet. Blood samples were collected from every steer on days 23, 37, 44, 51, 58, 65, and 79 of the trial. This blood collection schedule resulted in a total of 7 blood collections throughout the duration of the trial.

Environmental temperature, humidity, solar radiation, wind speed and barometric pressure were collected automatically every 30 min throughout the duration of the trial using a Davis Vantage Pro 2 (Davis Instruments Vernon, IL) weather station located on site directly behind the pens. All cattle received a SmartStock (SmartStock; LLC. Pawnee, OK) temperature monitoring rumen bolus during the first blood collection on d 21 of the trial. Boluses were programmed to transmit individual body temperature in twenty minute intervals to a receiver and transmitted to a central computer. In addition to body temperature, panting scores were collected by a trained individual each weekday at 1400. Scores were taken from outside the pen in the feed alley as to not disturb the animals.

Performance and carcass data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc. Carry, N. C.) with pen as the experimental unit. Body temperatures were analyzed using the GLIMMIX procedure of SAS (SAS Institute, Inc.) with pen as the experimental unit. Average, maximum and area under the curve (AUC) were evaluated for body temperature. Panting scores were also analyzed using the GLIMMIX procedure of SAS. A warm period was chosen between June 25, 2015 and July 27, 2015 and body temperatures and panting score were analyzed separately from the previously stated analysis for this timeframe.

## Results

There was no difference ($P \geq 0.19$; Table 1) between treatments for initial BW, final BW, ADG, DMI, warm period DMI, or NEg intake. However, F:G became poorer ($P < 0.05$) for STRAW when compared to CON or MOS cattle. Hot carcass weight, dressing %, LM area, and marbling score were not different ($P \geq 0.36$) between treatments. However, a difference ($P < 0.02$) in 12$^{th}$ rib fat depth and USDA yield grade was observed. Cattle fed CON had the greatest 12$^{th}$ rib fat depth and USDA yield grade when compared to MOS and STRAW cattle which were not different ($P > 0.05$).

Average and maximum body temperature were greatest ($P < 0.05$; Table 2) for cattle fed MOS when compared to CON and STRAW treatments, which were not different ($P > 0.05$). Cattle fed STRAW had reduced panting scores ($P < 0.05$) when compared to cattle fed CON and MOS, which were not different ($P > 0.05$). Average and maximum body temperature were also greater ($P < 0.01$; Table 2) for MOS cattle during the selected warm period. Panting scores also followed a similar pattern and were the greatest ($P < 0.05$) for MOS cattle and least for STRAW, with CON cattle being intermediate. There was no observed difference in area under the curve for body temperature ($P > 0.05$) between treatments. Numerically, cattle fed MOS had greater area under the curve body temperature ($P = 0.18$) suggesting that the addition of MOS to the diet had little impact on physical heat stress experienced by the animal.

There was a treatment × time interaction ($P < 0.05$; Table 3) observed for hemoglobin and hematocrit levels. These interactions would suggest that over time and as environmental conditions changed, there are differences in how these dietary treatments affect how the steers react metabolically. The observed interaction for hemoglobin, and hematocrit levels could be of importance as other research would suggest these metabolites are correlated with environmental temperature. Bilirubin has also been found

**Table 3. Simple effect means for blood measure in the presence of a collection time × diet interaction**

| | | | | | *P*-Value | |
|---|---|---|---|---|---|---|
| Blood Measure | Control | Straw | Agrimos | SEM[1] | Trt | Int[2] |
| Bilirubin, mg/dL | | | | 0.01 | 0.26 | 0.02 |
| d 23 | 0.18[a] | 0.20[a] | 0.19[a] | | | |
| d 37 | 0.15[a] | 0.15[a] | 0.17[a] | | | |
| d 44 | 0.16[a] | 0.18[a] | 0.17[a] | | | |
| d 51 | 0.19[a] | 0.18[a] | 0.19[a] | | | |
| d 58 | 0.17[a] | 0.18[a] | 0.20[b] | | | |
| d 65 | 0.19[a] | 0.19[a] | 0.20[a] | | | |
| d 79 | 0.19[a] | 0.15[b] | 0.18[a] | | | |
| Red blood cell, cells/L | | | | 0.16 | 0.15 | <0.01 |
| d 23 | 8.34[ab] | 8.61[b] | 8.11[a] | | | |
| d 37 | 8.22[a] | 8.21[a] | 7.81[b] | | | |
| d 44 | 8.13[a] | 8.24[a] | 7.92[a] | | | |
| d 51 | 8.03[ab] | 8.24[a] | 7.78[b] | | | |
| d 58 | 8.35[ab] | 8.41[a] | 8.01[b] | | | |
| d 65 | 8.09[a] | 8.35[a] | 8.00[a] | | | |
| d 79 | 8.18[a] | 7.94[a] | 7.92[a] | | | |
| Hematocrit, % | | | | 0.5 | 0.10 | <0.01 |
| d 23 | 37.5[a] | 37.1[ab] | 36.2[b] | | | |
| d 37 | 37.2[a] | 35.8[b] | 35.6[b] | | | |
| d 44 | 37.7[a] | 36.7[a] | 37.0[a] | | | |
| d 51 | 37.5[a] | 37.0[a] | 36.6[a] | | | |
| d 58 | 39.3[a] | 37.9[b] | 37.9[b] | | | |
| d 65 | 37.9[a] | 37.7[a] | 37.8[a] | | | |
| d 79 | 38.6[a] | 36.7[b] | 37.1[b] | | | |
| Hemoglobin, g/dL | | | | 0.2 | 0.07 | <0.01 |
| d 23 | 13.2[a] | 13.0[ab] | 12.7[b] | | | |
| d 37 | 13.4[a] | 12.9[b] | 12.8[b] | | | |
| d 44 | 13.5[a] | 13.2[a] | 13.2[a] | | | |
| d 51 | 13.5[a] | 13.3[a] | 13.1[a] | | | |
| d 58 | 14.1[a] | 13.6[b] | 13.5[b] | | | |
| d 65 | 13.6[a] | 13.5[a] | 13.5[a] | | | |
| d 79 | 14.0[a] | 13.3[b] | 13.4[b] | | | |

Values within rows with unique superscripts differ $P < 0.05$
[1] Pooled SEM, n = 7 collections/mean
[2] Interaction between blood collection and treatment

to change in response to environmental conditions. In the current study, an interaction ($P = 0.02$; Table 3) was observed between treatment and time for bilirubin levels. Bilirubin may be important as injury to the small intestine remains an issue that can result in decreased animal performance due to heat stress and some research would suggest that bilirubin has a protective effect in the small intestine towards oxidative injury.

## Conclusion

In the present study there were no observed performance benefits for cattle supplemented with MOS or STRAW. The addition of MOS to the diet slightly increased body temperature both overall and during the selected warm period. The addition of STRAW increased F:G. However, no other performance traits were affected. While body temperature remained unchanged by the addition of STRAW to the diet, panting scores were decreased slightly when compared to both the CON and MOS diets, possibly suggesting that the addition of finely ground wheat straw to the diet may elevate some of the environmental stress experienced by the steers.

Bradley M. Boyd, graduate student

Terry L. Mader, professor emeritus, University of Nebraska—Lincoln Department of Animal Science

Curt Bittner, research technician

Henry Hilscher, feedlot manager

Gene Wijffels, senior research scientist, CSIRO, Queensland, Australia

John B. Gaughan, associate professor, University of Queensland, Queensland Australia

Megan Sullivan, postdoctoral research fellow, University of Queensland, Queensland, Australia

Judy Cawdell-Smith, Senior Lecturer, University of Queensland, Queensland Australia

Galen E. Erickson, professor, University of Nebraska—Lincoln Department of Animal Science, Lincoln, NE