Effects of shade and feeding zilpaterol hydrochloride to finishing steers on growth performance, carcass quality, heat stress, mobility, and body temperature

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Introduction

- Zilpaterol Hydrochloride first approved for feeding in the US in 2006 (FDA 2006)
  - Zilmax (Merck Animal Health; De Soto, KS)

- Multiple studies for performance and carcass characteristics(Vasconelos et al., 2008; Elam et al., 2009, Motgomery et al., 2009, Hales et al., 2014)
  - 15 kg increase in HCW
  - 1.7 % increase in Dressing %
  - 8 cm^2 increase in LM area
  - 12.6% decrease in yield grade

Why is this research important?

- Since the release of Zilmax some have raised concerns about animal welfare issues
  - Has since been removed from the market by the manufacturer
- Little data on heat stress and animal welfare

Objective

- The objective of this study is to evaluate the effects of supplementing zilpaterol hydrochloride to finishing steers during the last 21 days of the feeding period on performance, carcass characteristics, heat stress, mobility and body temperature

Materials & Methods

- US Meat Animal Research Center near Clay Center, Nebraska
- 480 crossbred beef steers utilized
  - 2 blocks of 240 steers each
  - Heavy weight block harvested in July 15, 2014
  - Light body weight block harvested in Aug 12, 2014
- Four replications per treatment
  - Eight pens (30 hd/pen) per block

Materials & Methods

- 2 × 2 factorial arrangement of treatments
  - Housing type (Shaded or open lot pens)
  - Inclusion of Zilpaterol Hydrochloride (0 or 8.33 mg/kg DM for last 21 days with 3-5 day withdrawal)

Heat stress measurements

- Continuous body temperature (SmartStock; LLC. Pawnee, OK)
  - Rumen bolus
  - Body temperatures taken in ten minute intervals for the duration of treatment period.
- Panting scores and respiration rates
  - Cattle adapted to humans being near pens prior to feeding ZH
  - Taken daily at 13:00
  - Half of pen evaluated each day

Mobility measurements

- Tyson mobility scoring system
  - 0 = no lameness (normal)
  - 1 = slightly stiff gait
  - 2 = fails to keep up with the group
  - 3 = severely lame and reluctant to move
  - 4 = non ambulatory
- Taken 8 times per block
- Split into four time points
  - Before feeding ZH (As animals were pulled from their home pen)
  - End ZH (As animals were pulled from their home pen)
  - Arrival at packing plant (As animals unloaded off the truck)
  - Up to restrainer (As animals made their way to restrainer)

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Worst Case Scenario

- Steers were weighed, blood & feces were collected, and mobility scores were collected starting at 05:30
- Steers were taken back to pens and fed
- Steers were removed from pens at 17:00 and loaded on trucks to be hauled to packing plant
- Steers were held at packing plant overnight for an A shift harvest the next morning

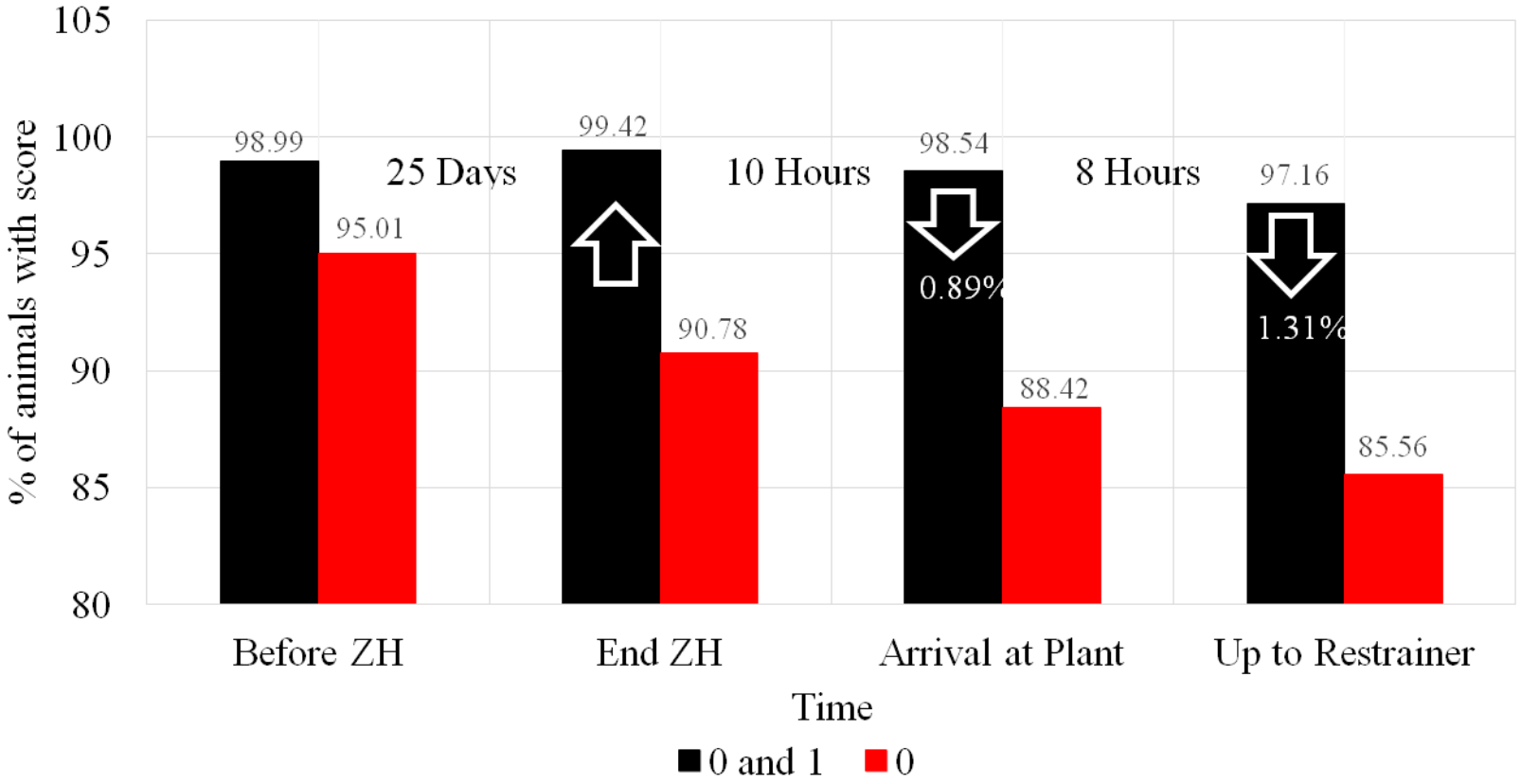
Growth Performance

	Dietary Treatment			Housing Type			
Trait	Control	Zilmax	P-value	Open	Shade	P-value	SEM
Initial BW (kg)	359	360	0.37	360	358	0.24	3
Final BW (kg)	639	643	0.43	645	636	0.08	7
DMI (kg/d)	9.7	9.6	0.61	9.7	9.7	0.55	0.2
ADG (kg)	1.55	1.56	0.56	1.57	1.54	0.10	0.03
G:F	0.159	0.162	0.44	0.162	0.159	0.39	0.002

Carcass Characteristics

	Dietary Treatment			Housing Type			
Trait	Control	Zilmax	P-value	Open	Shade	P-value	SEM
HCW (kg)	+14 kg		<0.01	416	410	0.17	6
Dressing %	+1.7 %		<0.01	64.5	64.6	0.78	0.2
LM Area (cm^2)	+6.4 cm^2		<0.01	92.9	91.0	0.27	0.1
12th Rib Fat (cm)	1.63	1.55	0.15	1.63	1.57	0.39	0.01
Marbling[1]	476	469	0.50	472	473	0.92	7
USDA Yield Grade[2]	-8.57 %		<0.01	3.4	3.4	0.89	0.06

Main effect of Time on Mobility Score



Averaged across all treatments

Respiration rate and panting scores

	Dietary Treatment			Housing Type				
Trait	Control	Zilmax	P-value	Open	Shade	P-value	Interaction	SEM
Respiration Rate (Breaths/Min)	93.2	100.8	0.05	96.3	96.9	0.88	0.69	2.93
Panting Score[1]	0.55	0.68	0.10	0.62	0.62	0.99	0.31	0.05

Body Temperature

	Open		Shade			
Measurement	Control	Zilmax	Control	Zilmax	SEM	Interaction
Average	39.13^{d}	38.98^{a}	39.10^{c}	39.08^{b}	0.01	<0.01
Maximum	40.31^{d}	40.12^{a}	40.26^{c}	40.17^{b}	0.02	<0.01
AOC Pen Ave.	340.14^{c}	237.94^{b}	124.49^{a}	122.74^{a}	0.80	<0.01
AUC From Zero	14752^{d}	14711^{a}	14743^{c}	14738^{b}	2	<0.01

Conclusions

- No differences were found for dry matter intake, ADG, or G:F on a live basis when zilpaterol was fed
- Cattle in the open lot pens tended to have a greater gain than cattle in the shaded pens
- Respiration rates for cattle fed zilpaterol were greater, with no difference due to housing. However, the label of zilpaterol hydrochloride says it will increase respiration rate

Conclusions

- Time on feed affected mobility scores, with observations on the morning of harvest at the packing plant being the worse for all groups of cattle irrespective of treatment
- Cattle fed zilpaterol in both shaded and open pens had lower average & lower maximum, body temperatures

Take Home Message

- Zilpaterol hydrochloride improved carcass characteristics with little impact on heat stress or mobility, suggesting that animal welfare was not affected by feeding ZH during the last 21 d of the feeding period.
- This research was partially funded by the Nebraska Beef Council.

Brief Overview of Feedlot Research at U.S. MARC

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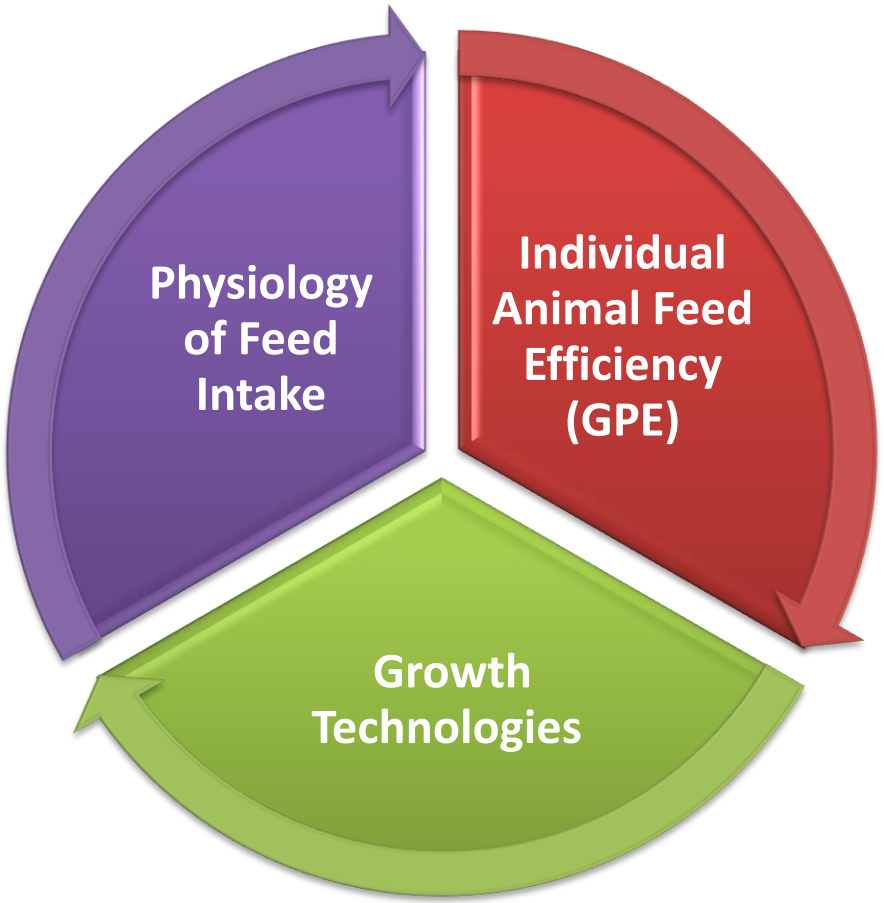
Areas of Feedlot Research

Regulation of Feed Intake



Breed Evaluation
Diet Evaluation
G × E Interaction
Discovery
Extreme Tissue Bank
Microbiome

Implants
β-agonists

Effects of Growth Technologies on Feed Efficiency

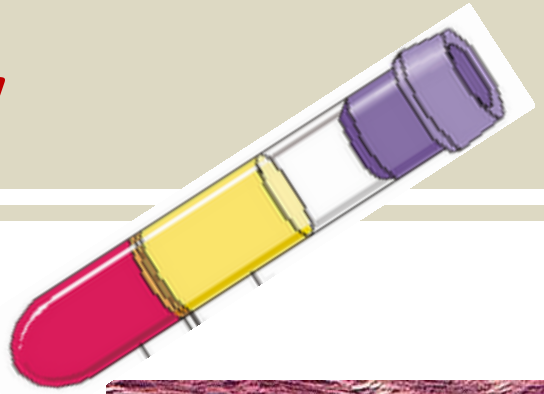
- Determine the effects of moderate and aggressive implant strategies with β-agonists on performance and carcass characteristics
- Test for breed and genomic interactions with these treatments
- 3325 GPE steers used over 7 years
  - 360 Spring-born steers each year
  - 175 Fall-born steers each year
  - Treatments applied in Spring of 2014

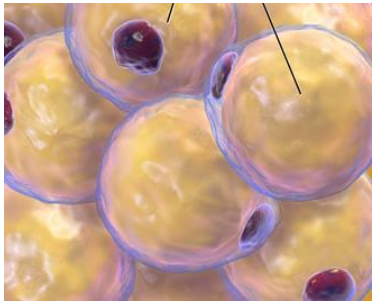
Looking for G × E Interactions

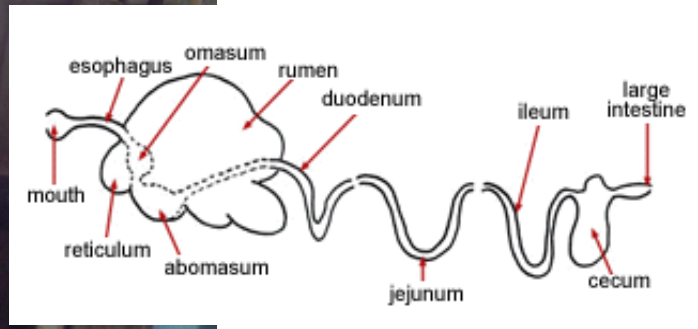
Extreme Steer Tissue Library

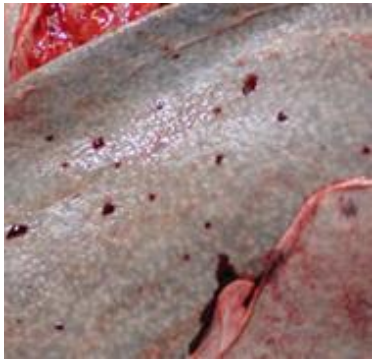
- Purpose: To obtain a tissue bank from steers collected over 2 seasons and 3 years
- Steers with extreme feed intake and gain phenotypes
- To date, we have collected tissue from 64 animals – Spring and Fall born
- Evaluate gene expression in certain tissues as it may relate to phenotype

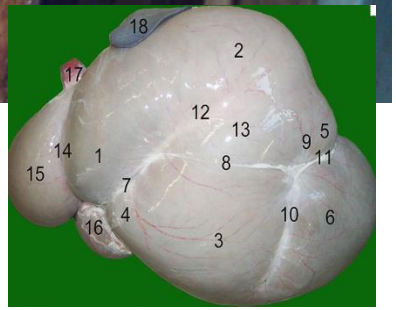
Tissue Library



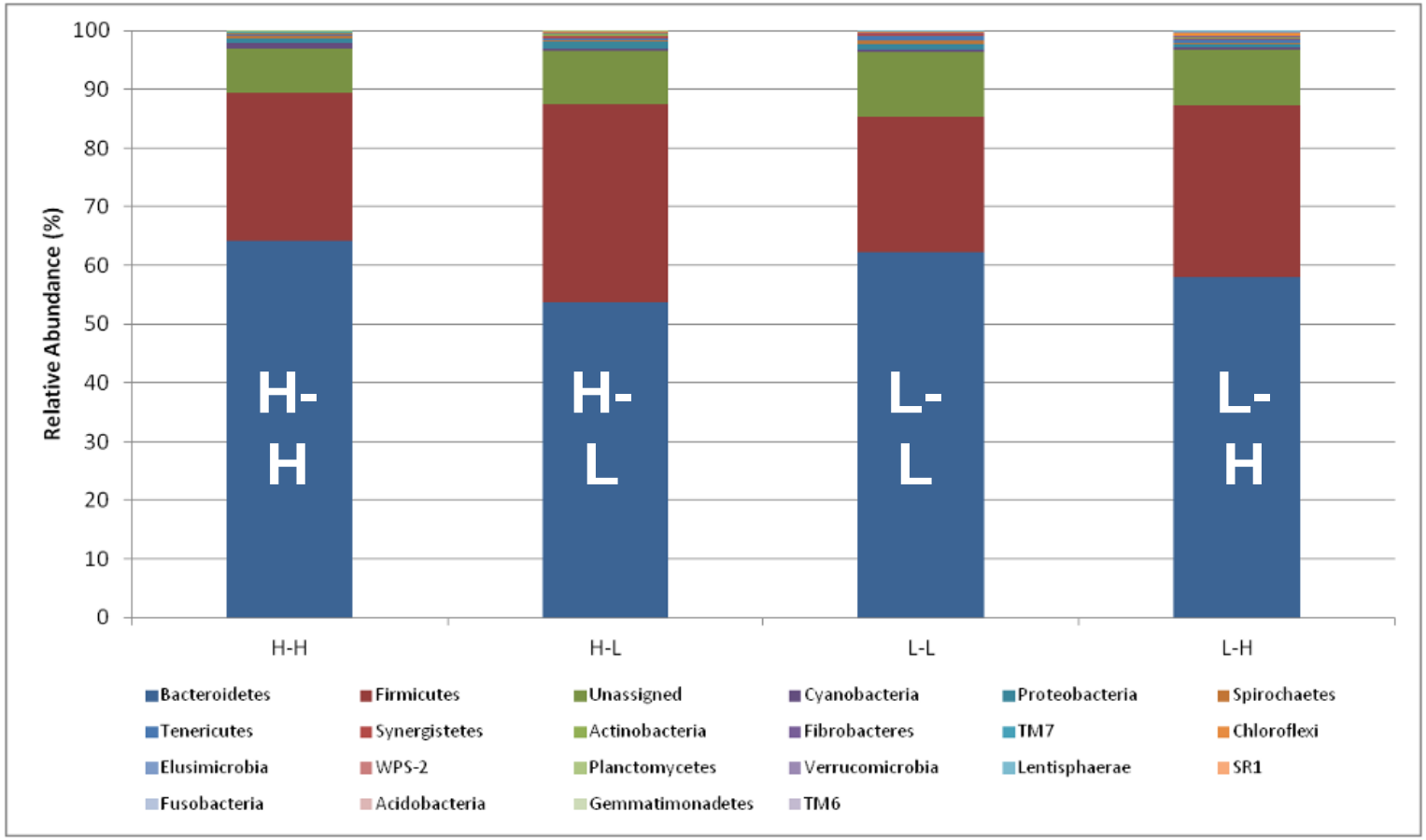








Extreme Steer Microbiome



	Gain	Intake
H:H	High	High
H:L	High	Low
L:L	Low	Low
L:H	Low	High

Differences in specific bacterial groups were often associated with gain

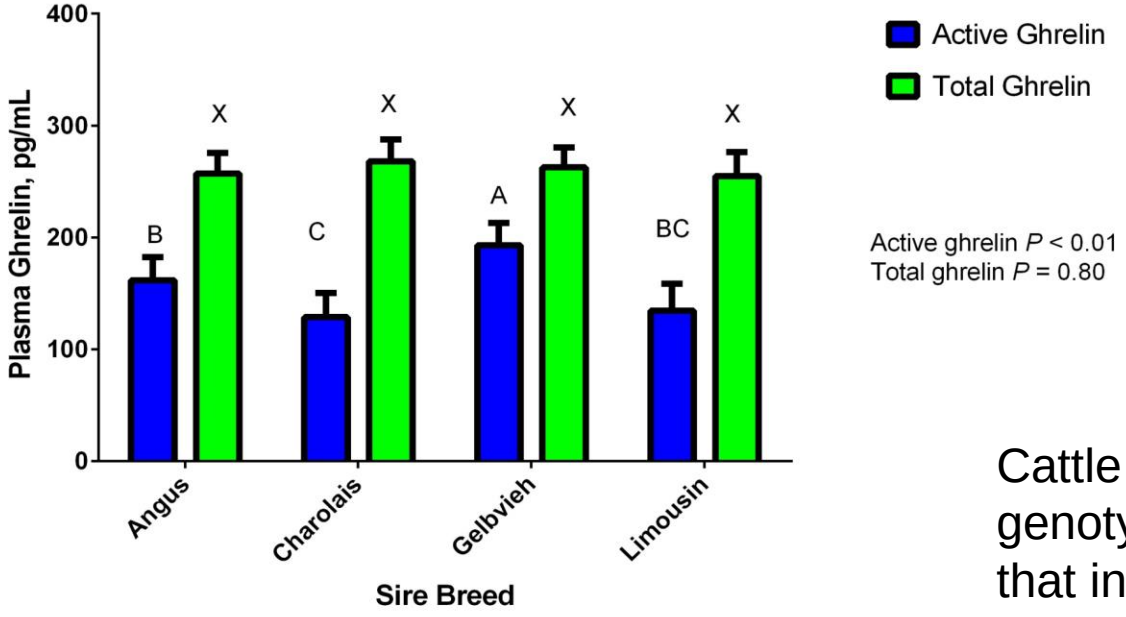
Variation in microbial populations were observed for cattle with extreme phenotypes

Physiology of Feed Efficiency

- Determine the association of hormones and metabolites with feed intake, growth, and efficiency
- Determine genetic influences on circulating concentrations of hormones involved in appetite and growth
- Determine the utility of hormone and metabolite concentrations in predicting feed intake, growth, and efficiency
  - Use in selecting animals

Physiology of Feed Efficiency

- Active ghrelin accounted for 6 % and the ratio of active to total ghrelin accounted for 10 % of the variation in feed intake



Ghrelin is a gut peptide that signals appetite

Cattle currently being genotyped for a gene that inactivates ghrelin

Questions?

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