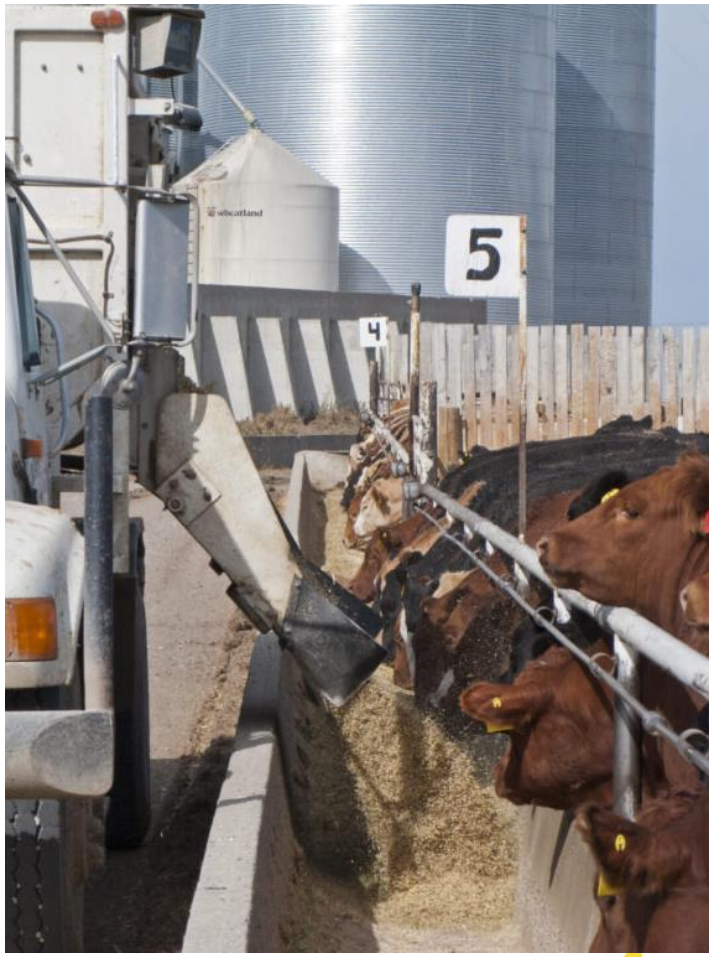
Tackling Sorting Issues in Feedlot Diets

Catherine Seidle, MSc, PAg
Livestock and Feed Extension Specialist
Moose Jaw

Saskatchewan

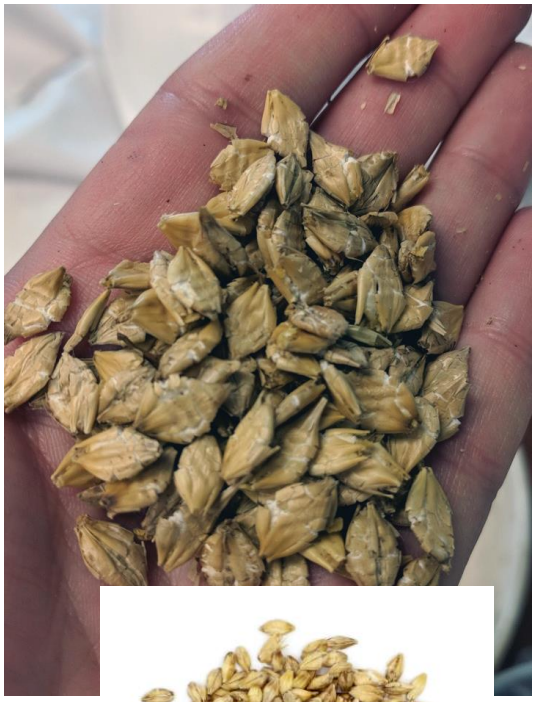
What are common properties of feedlot diets?

- High proportion of grain (>80% DM)
- Low proportion of forage (<15% DM)
- Byproducts (wet or dry)
  - DDGS
  - Whey permeate
- Mineral & vitamin premix including additives
- For example:
  - 88% barley
  - 10% silage
  - 2% mineral & vitamin premix



How is the barley processed?

- Temper-rolling
  - Common in larger feedlots
- Steam-flaking
  - Becoming more popular with the use of corn in some years
- Dry-rolling
  - Common in smaller feedlots, less required infrastructure



Including moisture in processing barley

- Advantages:
  - Less fine particle and dust production
  - More uniform processing outcome
  - Process more aggressively
- Disadvantages:
  - High infrastructure costs
  - Requirement for daily processing
  - Processing during extreme cold may not be possible
  - Stability of product

What's the problem with dry diets?

- Often:
  - Dry diets that separate easily
  - Particle size are not the same
    - Forages vs. grain
- Sorting the TMR often occurs

Feed Sorting Behaviour

- Natural behaviour by cattle to sort their diet
  - Feed palatability
  - Forage content
  - Particle size
- Producers assume that if all the feed is consumed that each animal ate the same diet
  - Not true → not eating the formulated diet

Cattle will sort to manage rumen pH

- Study with dairy cows found that cows experiencing a low pH sorted for fiber (Yang and Beauchemin 2006)
  - Attempting to stimulate chewing and bicarbonate production to buffer the rumen
- Study with dairy heifers found that cattle that experienced low pH once will sort or reduce DMI to avoid another incidence of low pH (Marchesini et al. 2013)

Why do we want to reduce sorting?

- Want every bite to be the same for every animal in the pen
  - Consistent intake of ionophores, medications, other additives
  - Consistent intake = consistent growth
- If sorting can occur
  - Dominant animals = more forage, lower energy diets
  - Low-ranking animals = more grain, higher energy diets
    - Higher incidence of bloat/acidosis

So, what's the solution?

Feed sorting tendencies

+

Dry easily sortable diets

=

Need a **binder** to make the diet "sticky"

What is a binder?

- Anything that can be added to the TMR to prevent the diet from separating into its individual ingredients
- By-products
  - Molasses
  - Liquid whey
  - Distiller's solubles
- Or water!

How has water been used in a TMR?

- Common practice in dairy operations
- Water binds the ingredients during mixing limiting the ability of the cattle to sort the TMR
- Tends to increase feed intake and promote the consumption of a diet closer to the one provided
- Limited research in adding water for beef cattle diets

Cue… my Masters Project!

- Adding water to a barley-based **finishing feedlot** diet on:
  - Dietary sorting
  - Feed intake
  - Digestibility
  - Ruminal fermentation
  - Growth performance
  - Carcass characteristics

Two Studies

- Metabolism study
  - 8 steers in individual pens
  - Livestock Research Barn, U of S
- Feedlot study
  - 120 steers in small pens
    - 6 steers/pen
    - 5 pens/treatment
  - AAFC Lacombe, AB

Treatments

Four treatments where water was added as a percentage of the barley grain weight:

a) 0% added water (control; CON)
b) 10% added water (10W)
c) 20% added water (20W)
d) 30% added water (30W)

Why these treatments?

- 0% added water = Standard feedlot diet
- 10% added water = Tempered barley
- 20% added water
- 30% added water = High moisture grain (typically corn)

Diets

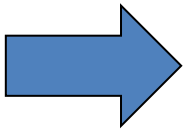
	CON	10W	20W	30W
Ingredients, % as fed				
Dry-rolled barley grain	77.3	72.3	67.8	63.9
Barley silage	19.1	17.8	16.8	15.8
Mineral & vitamin supplement	3.4	3.2	3.0	2.8
Titanium dioxide	0.16	0.15	0.14	0.13
Water	0.00	6.5	12.3	17.3
TOTAL Dietary DM (%)	79.4	74.2	69.7	65.6

	CON	10W	20W	30W
Ingredients, % as fed				
Dry-rolled barley grain	78.7	74.6	70.0	66.0
Barley silage	18.4	17.2	16.1	15.2
Mineral & vitamin supplement	1.9	1.8	1.7	1.6
Water	0.00	6.5	12.2	17.2
TOTAL Dietary DM (%)	78.7	73.6	69.1	65.1

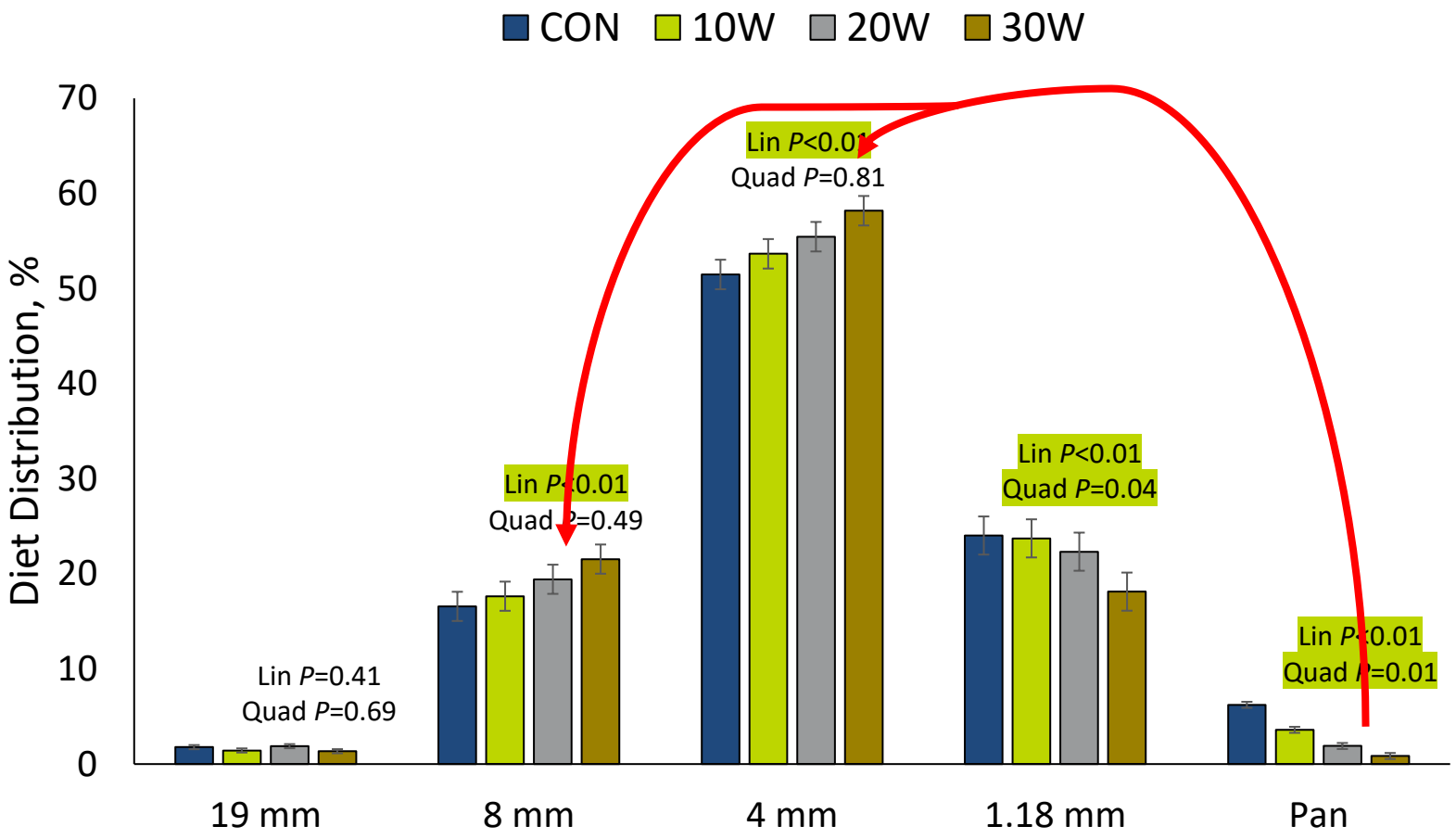
How water was added

- At the time of mixing, added by weight
- Pen study – mixed by hand
- Feedlot study – added with a garden hose, mixed for 5 minutes for each treatment

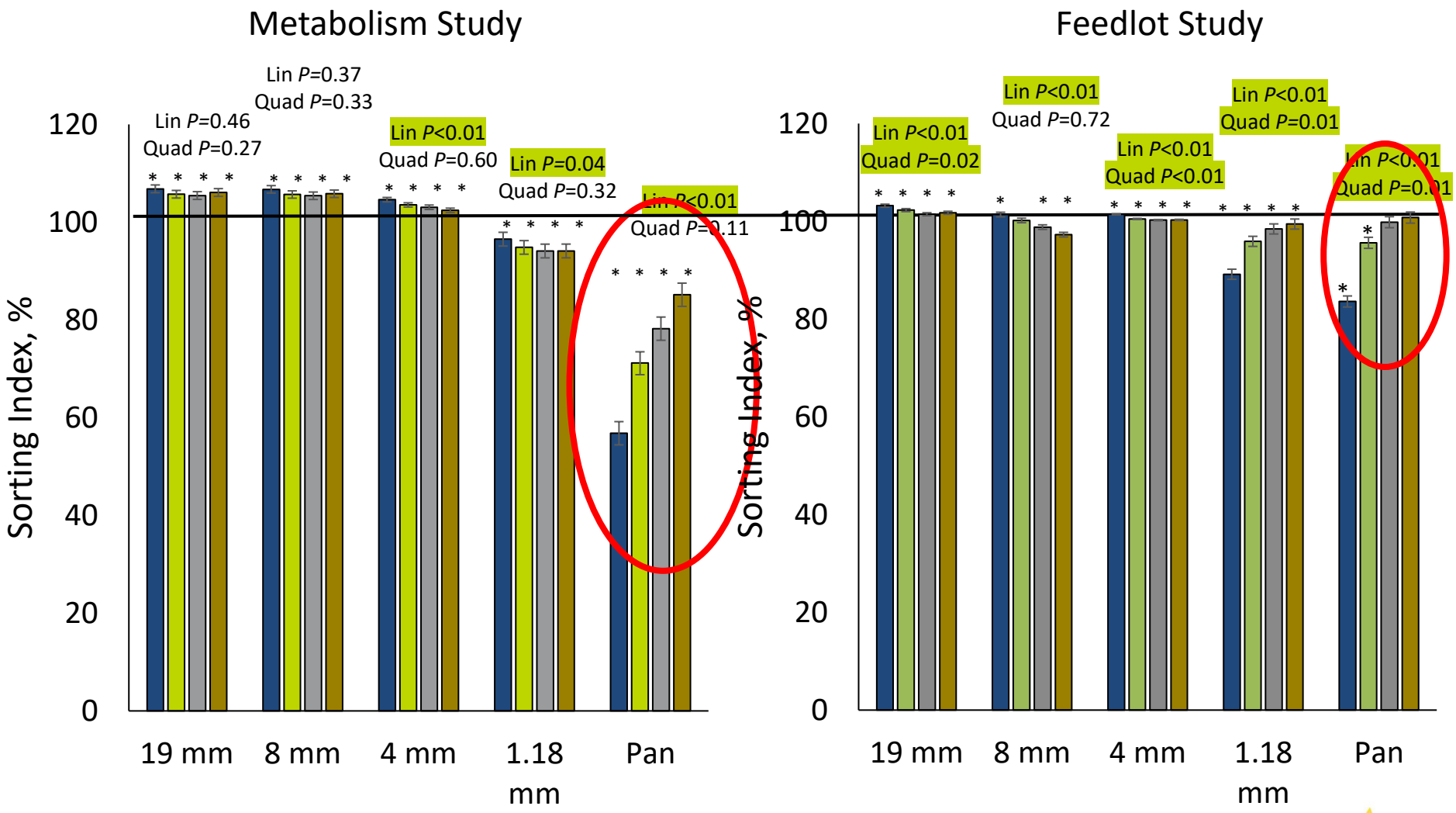
Did it effect particle size in the diet?



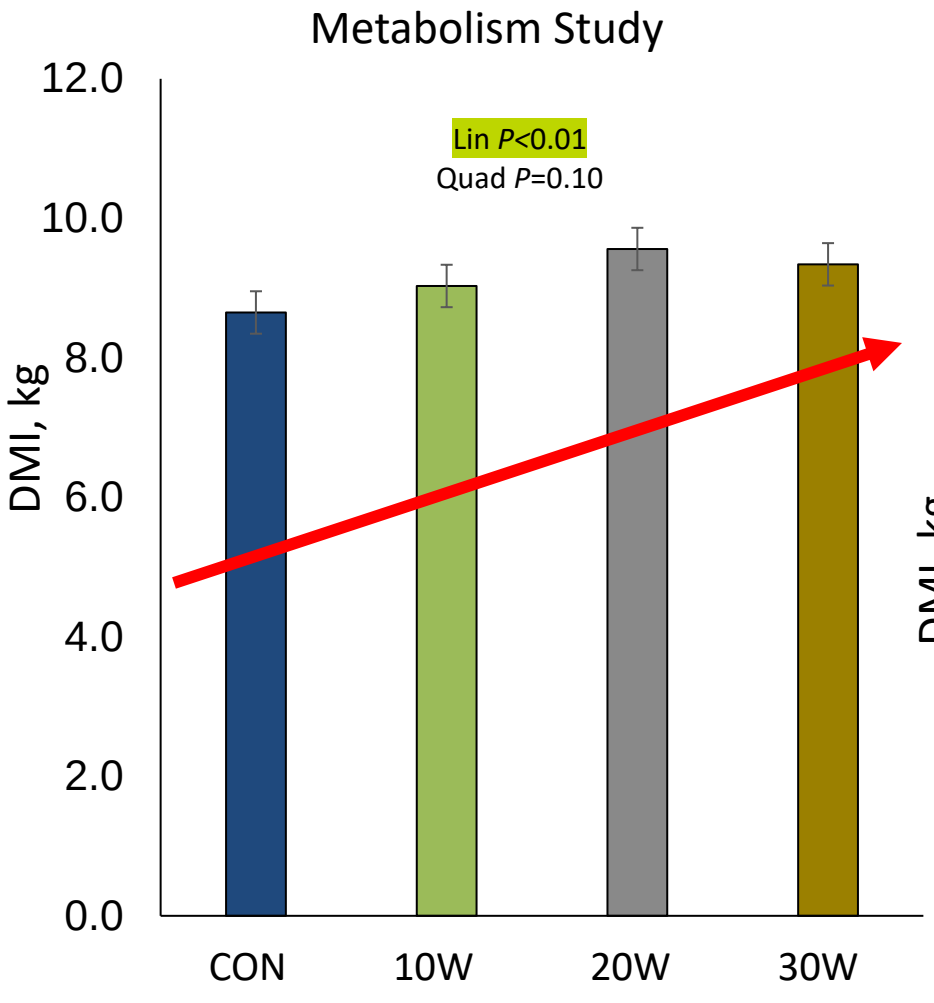
What does this look like as a percentage?

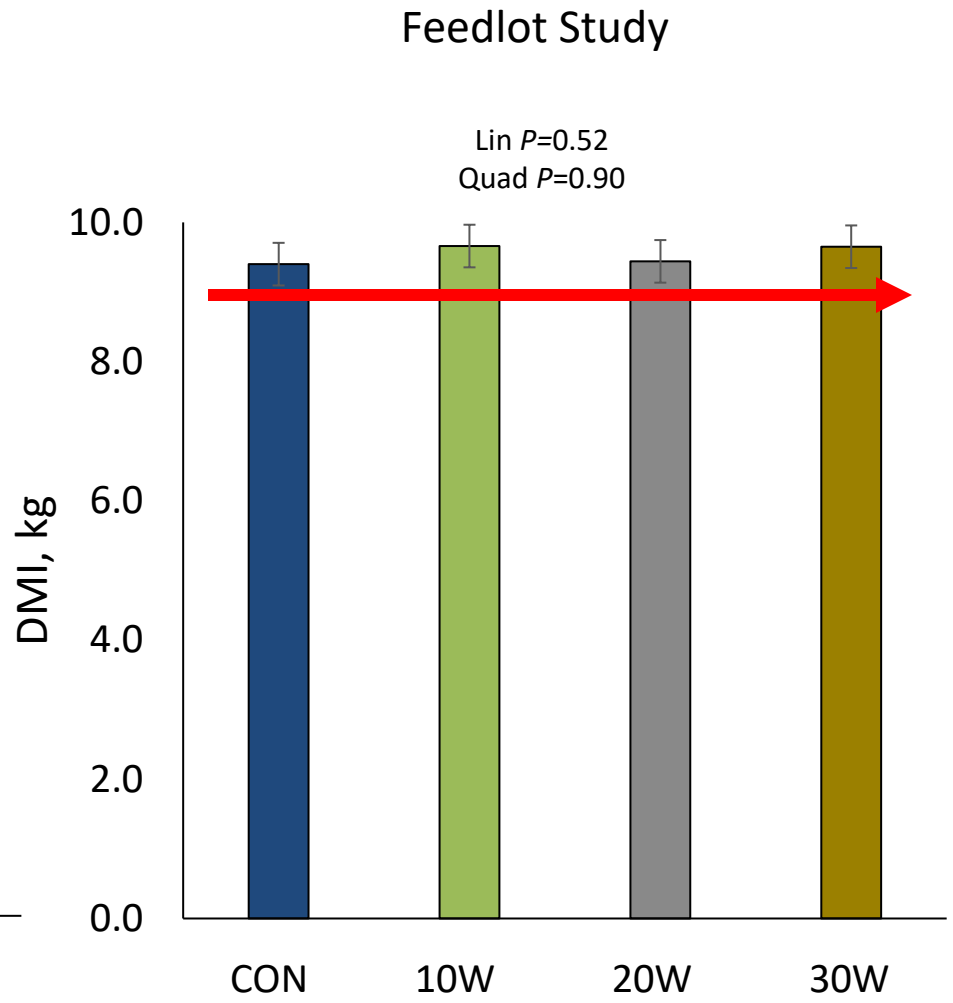


Sorting Index



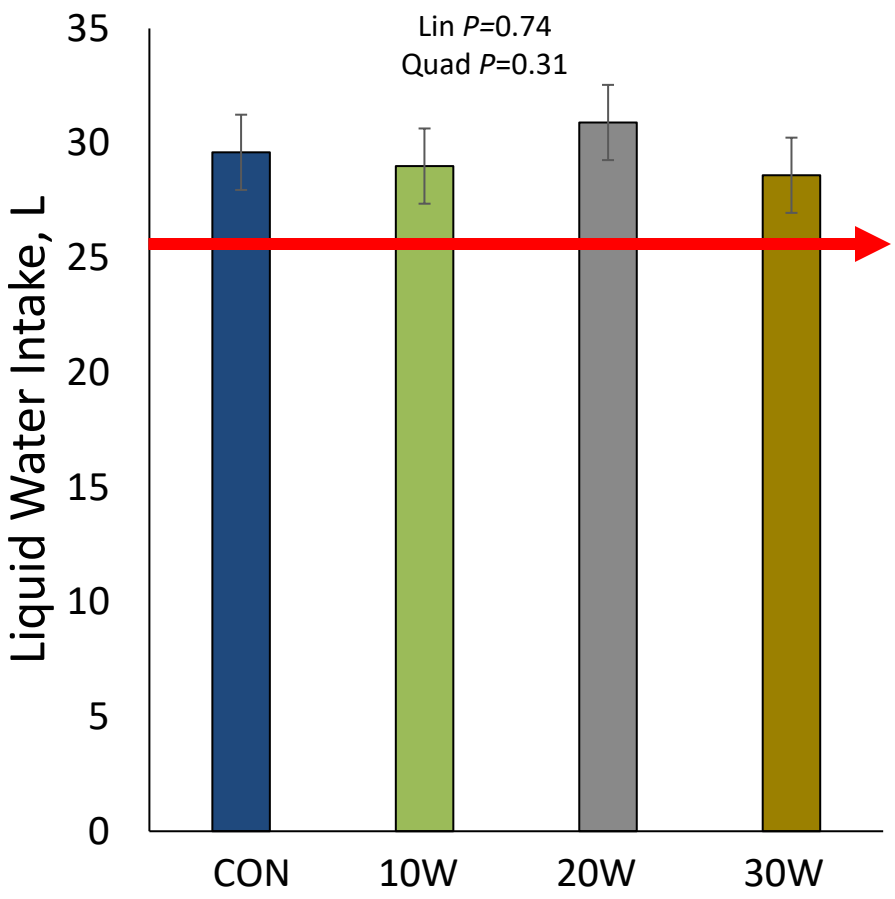
Feed Intake

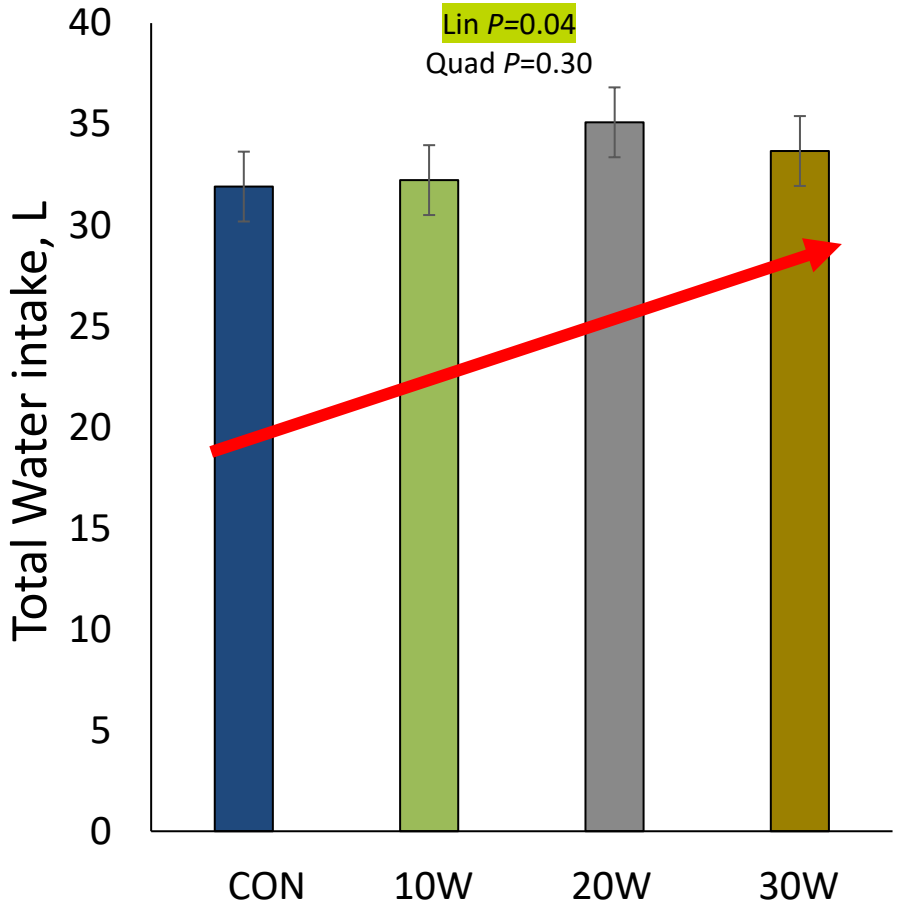

Metabolism Study
Lin P<0.01
Quad P=0.10
DMI, kg
12.0
10.0
8.0
6.0
4.0
2.0
0.0
CON
10W
20W
30W


Feedlot Study
Lin P=0.52
Quad P=0.90
DMI, kg
10.0
8.0
6.0
4.0
2.0
0.0
CON
10W
20W
30W

Water Intake

Metabolism Study



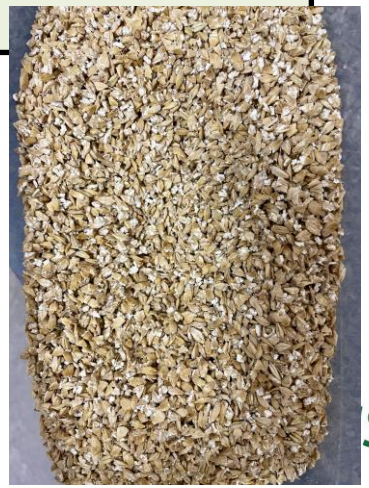


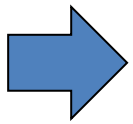
Major Study Difference

Processing Index (PI)	Percent Fines	Processing Index (PI)	Percent Fines
62.2 ± 2.1%	3.2 ± 1.0%	84.2 ± 3.4%	2.1 ± 1.0%

Industry Standard
70-75% PI for dry-rolled barley

Industry Standard
<5% fines





Major Study Difference

	CON	10W	20W	30W
Fecal starch, %	6.9	6.4	7.3	5.5

	CON	10W	20W	30W
Fecal starch, %	16.5	16.8	17.2	15.9

Feed 20 lbs barley
@ 60% starch = 12 lbs starch fed
4.9 lbs DM of feces excreted

Lose 6.5% in manure
=0.32 lbs lost starch in manure
= 0.53 lbs barley in fecal waste

@ $0.11/lb barley ($5.50/bu)
= $0.06/day lost

Lose 16.6% in manure
=0.81 lbs lost starch in manure
= 1.36 lbs barley in fecal waste

@ $0.11/lb barley ($5.50/bu)
= $0.15/day lost
Losing $0.12/hd/day

Best Case Scenario
Lose 3% in manure
= $0.03/day lost

Major Study Difference

	CON	10W	20W	30W
Fecal starch, %	6.9	6.4	7.3	5.5

	CON	10W	20W	30W
Fecal starch, %	16.5	16.8	17.2	15.9

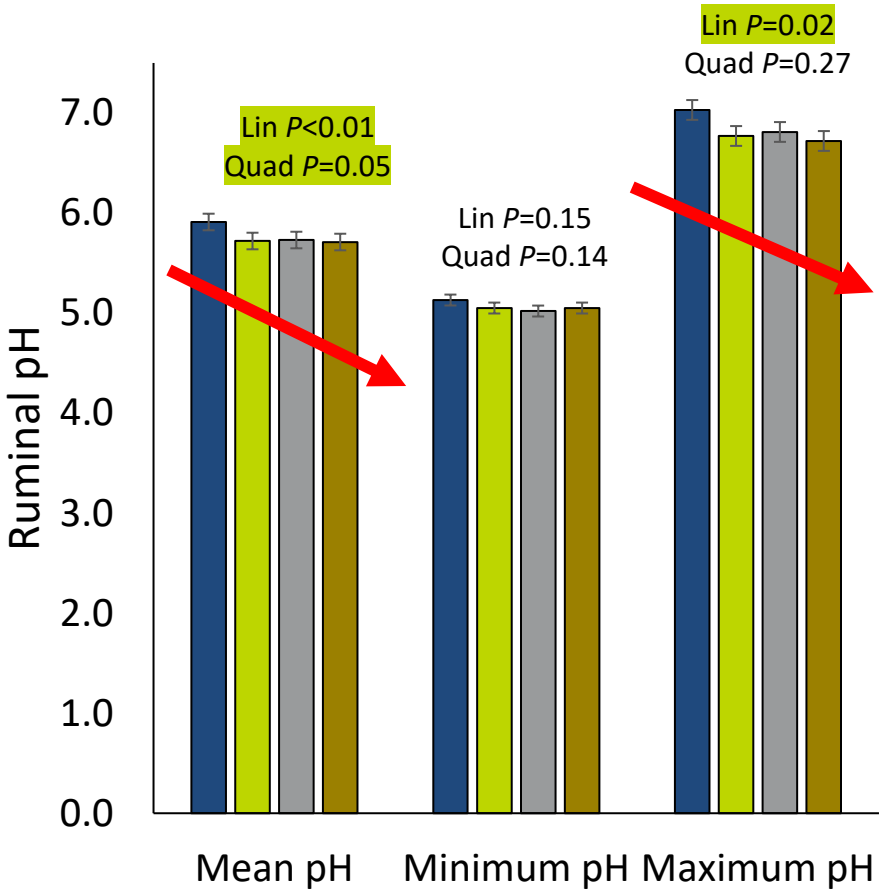
$0.12/hd/day x 150 day feeding period
= $18/hd

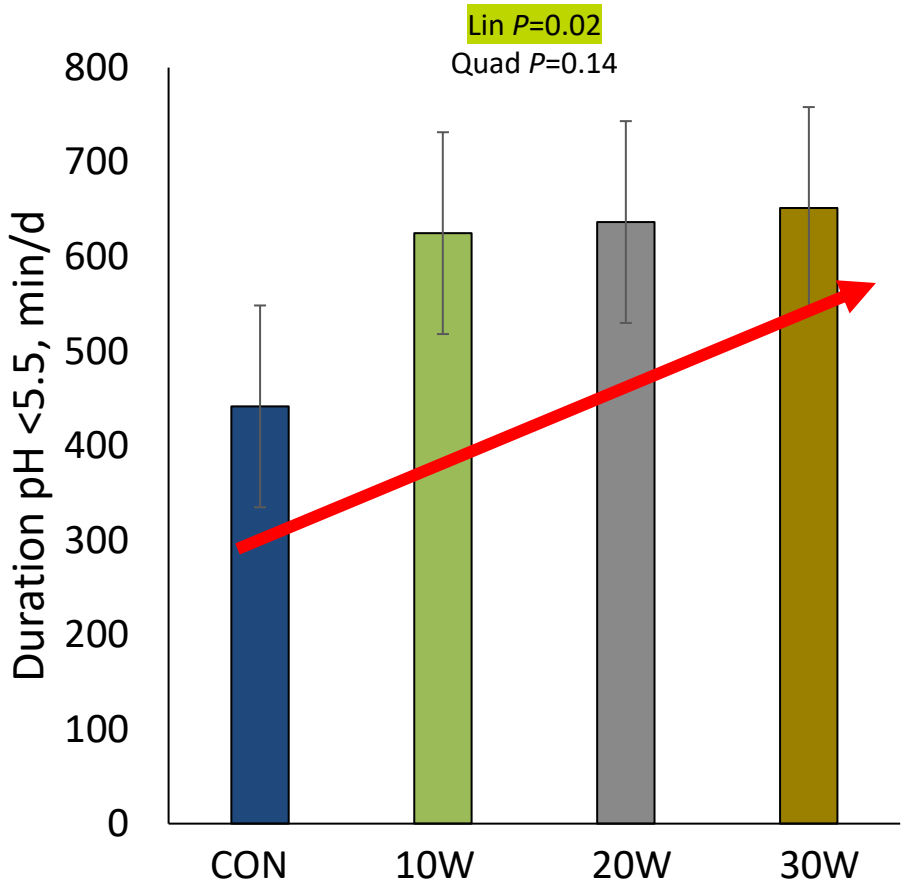
$0.12/hd/day x 20,000 hd feedlot
= $2,400 in barley equivalents lost in feces/day

$2,400 lost/day x 150 day feeding period
= $360,000 in wasted barley equivalents

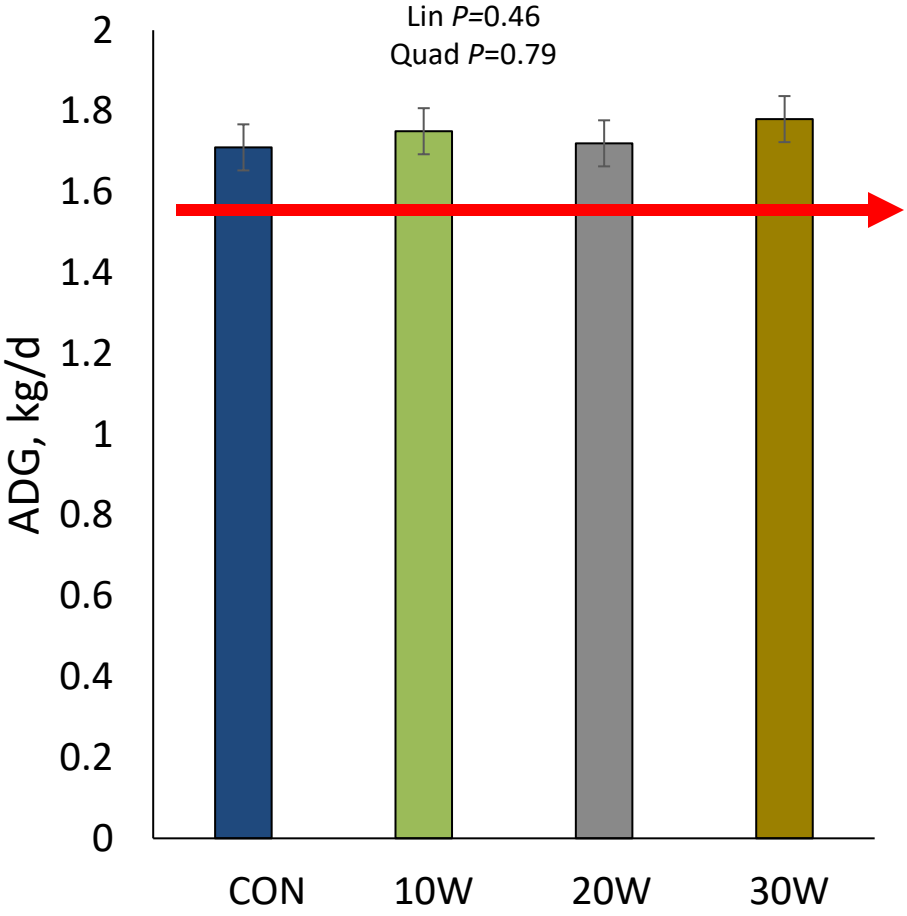
Lose 3% in manure
= $0.03/day lost

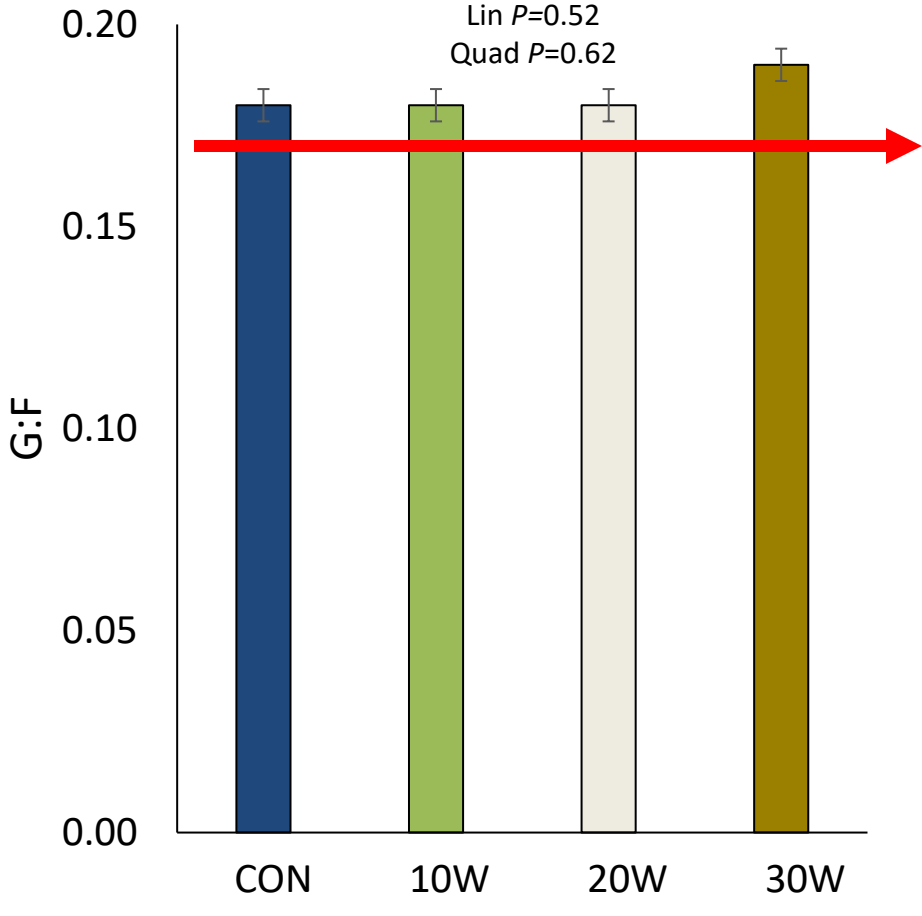
Ruminal Acidosis in Metabolism Study



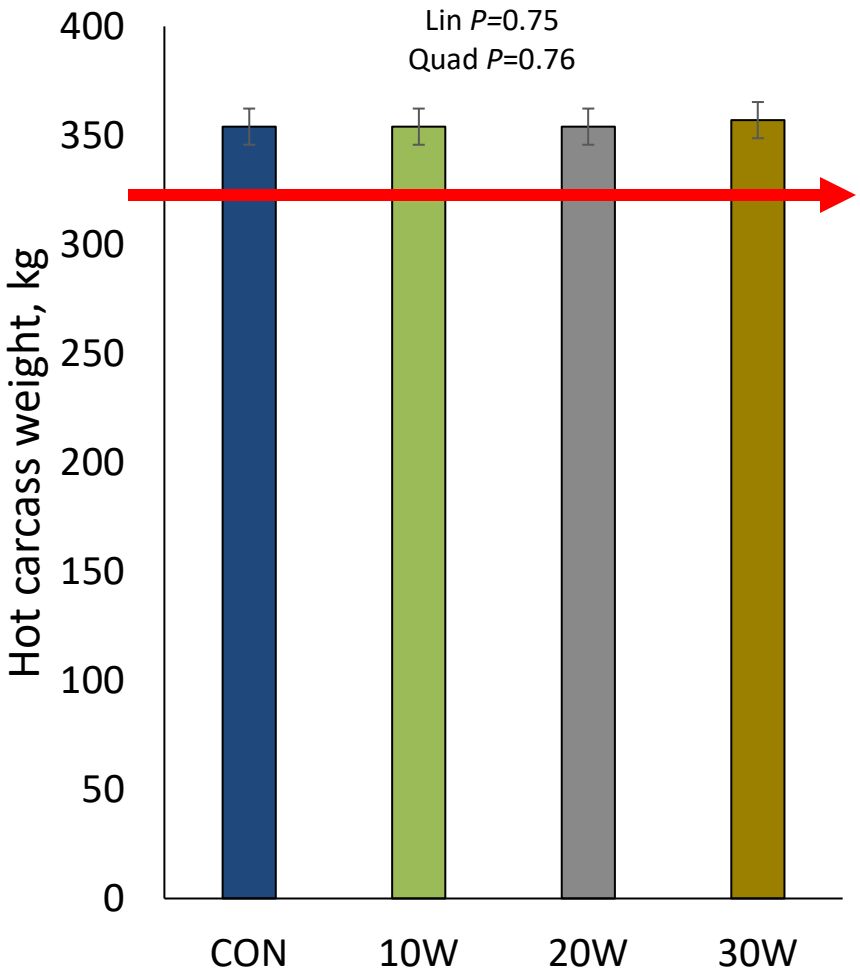


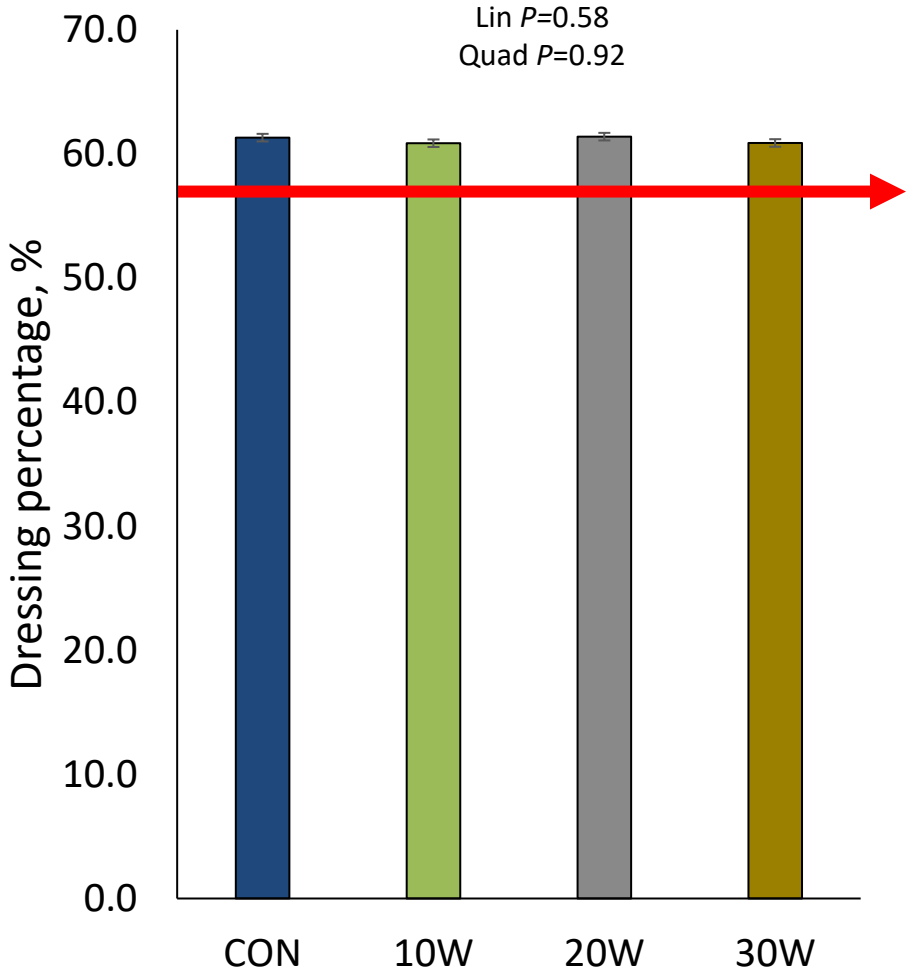
No change in feedlot steer performance





No change on carcass characteristics





Quality and Yield Grade not affected

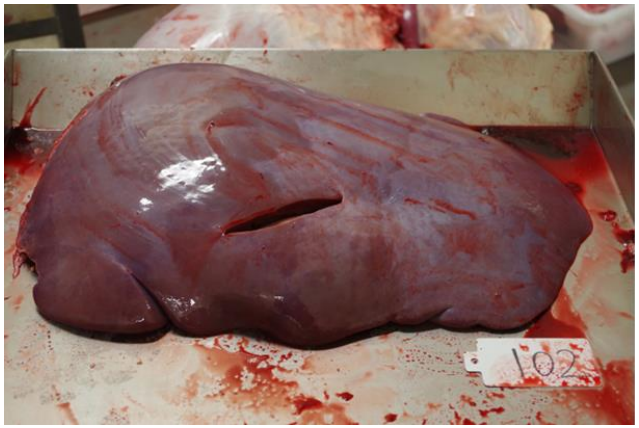
					P-value	
	CON	10W	20W	30W	Linear	Quadratic
Quality Grade						
AA, % of steers	40.00	40.00	36.67	30.00		
AAA, % of steers	60.00	60.00	63.33	70.00		
Odds ratio	1.000	1.000	0.868	0.643	0.49	0.74
Yield grade						
YG1, % of steers	3.33	6.67	10.00	6.67		
YG2, % of steers	73.33	60.00	66.67	66.67		
YG3, % of steers	20.00	33.33	23.33	26.67		
YG4, % of steers	3.33	0.00	0.00	0.00		
Odds ratio	1.000	0.763	1.311	1.009	0.73	0.47

Effects on CBGA grading

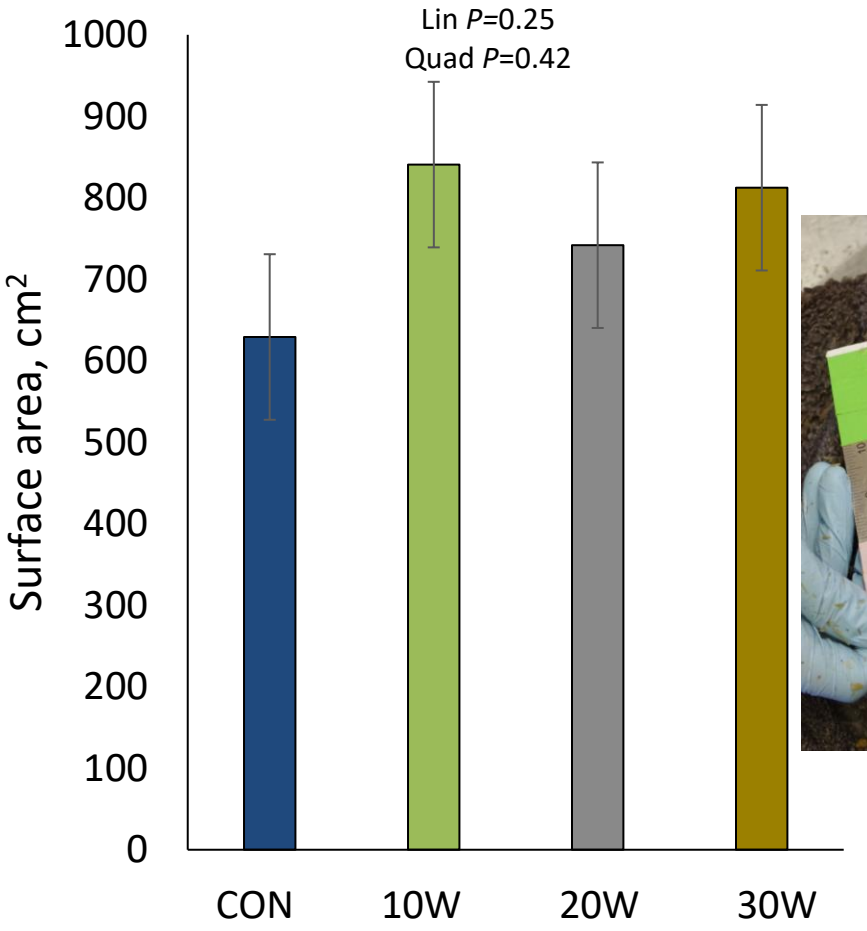
						P-value	
	CON	10W	20W	30W	SEM	Linear	Quadratic
Backfat thickness, mm	10.9	10.4	10.6	10.6	0.45	0.63	0.47
Backfat thickness SD, mm	3.48	2.56	3.00	2.72	0.453	0.30	0.42
Ribeye area, cm^2	91.8	92.5	92.0	95.3	2.15	0.15	0.38
Ribeye area SD, cm^2	5.46	7.72	7.56	7.47	1.002	0.20	0.25
CBGA marbling	414.67	416.17	410.33	407.50	10.487	0.56	0.83
CBGA marbling SD	63.125	58.476	39.698	46.190	7.3168	**0.05**	0.45

Liver Scores

					P-value	
	CON	10W	20W	30W	Linear	Quadratic
Clear, % of steers	46.67	43.33	63.33	50.00		
Minor, % of steers	13.33	13.33	6.67	13.33		
Severe, % of steers	40.00	43.33	30.00	36.67		
Odds ratio	1.000	0.869	1.829	1.139	0.38	0.65

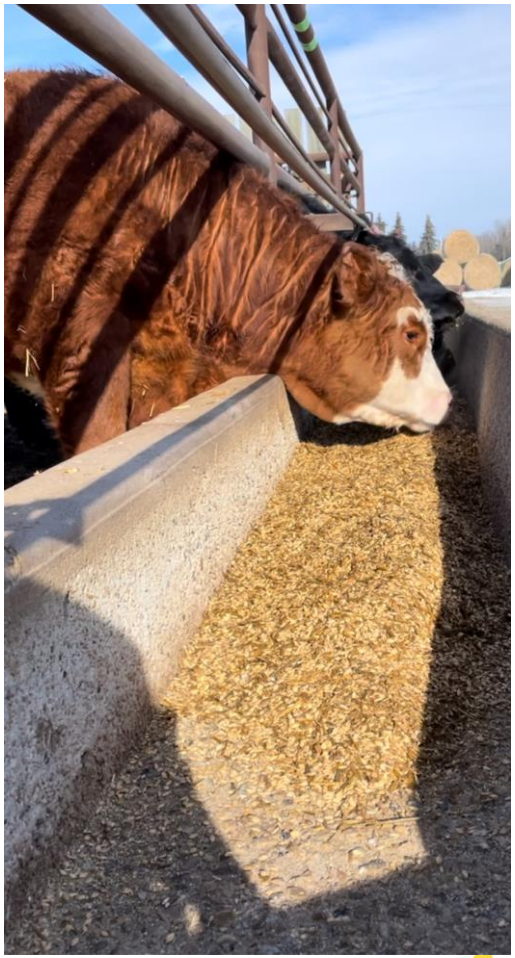


Rumen Damage



Study Conclusions

- Water effectively bound the small particles to larger particles
  - Inhibited sorting behaviour in the steers
  - Sorting index showed more consistent intake
- Minimal changes in growth performance and carcass characteristics
  - Did not adversely affect the cattle!



Practical Applications of this Research

- Optimal point calculations in Study 2 indicated water addition of **22%** relative to the weight of the barley grain
  - Approximately **69% dietary** DM

$$Water\ needed = (weight\ of\ total\ TMR * barley\ \%\ inlcusion) * water\ \%\ inclusion$$

- For example:

- $Water\ needed = (11{,}000\ kg * 88\%) * 22\%$

$$Water\ needed = (9{,}680\ kg) * 22\%$$

$$Water\ needed = 2{,}120\ kg\ or\ 2{,}120\ L\ or\ 466.3\ gal\ PER\ LOAD$$

Adding water to change DM from 80% to 69% in minutes

	Water dispensing rate, kg/s			
Load size, kg	1	5	10	15
8,000	25.7	5.1	2.6	1.7
9,000	28.9	5.8	2.9	1.9
10,000	32.1	6.4	3.2	2.1
11,000	35.3	7.1	3.5	2.4
12,000	38.5	7.7	3.9	2.6
13,000	41.8	8.4	4.2	2.8
14,000	45.0	9.0	4.5	3.0
15,000	48.2	9.6	4.8	3.2

Practically adding water

- Dependent on the mixer you have
- NEED TO READ MANUAL
- Vertical
  - Typically last ingredient
- Horizontal
  - Typically first ingredient

Practical Applications of this Research

- Cow-calf/backgrounding operation
  - Aiming for 70% DM by adding water into TMR wagon
  - Helps cuts dust – pneumonia
  - Helps with mineral and barley to stick to forages

Water Quality

- Remember to consider water quality!!
- If using poor quality water, adding those antagonistic minerals into the TMR
  - Sulfates
  - Nitrates
  - Iron
- Free water testing for livestock use at Ministry of Agriculture offices

Livestock and Feed Extension Specialists

Jenifer Heyden
306-446-7961

Tessa Thomas
306-852-7406

Chelsey Siemens
306-460-5799

Rikki Wilson
306-682-6711

Dwayne Summach
306-867-3966

Alexis DeCorby
306-620-5040

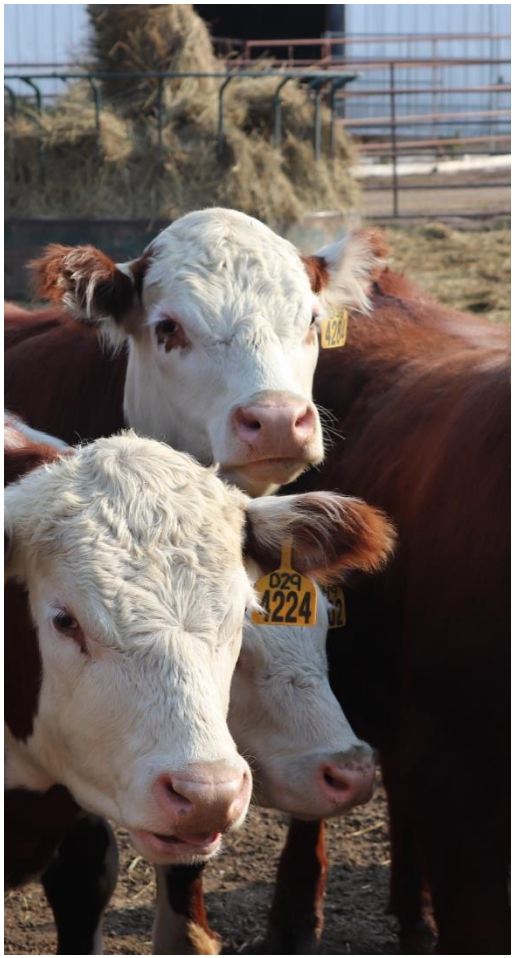
Corissa Wilcox
306-741-6800

Catherine Seidle
306-694-3492

Adriane Good
306-694-3813

Natasha Wilkie
306-848-2380

Conclusion



- Water can be an effective binder for finishing diets
- Promoting a consistent intake among pen-mates is important
  - Minimize digestive upset from competition
  - Consistent growth and end-products
- Larger scale research is needed to determine if these results are repeatable and practical

Acknowledgments

- Dr. Greg Penner (supervisor)
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Team Rumen

AAFC Staff

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  - Moose Jaw Regional Office – 306-694-3492
  - Agriculture Knowledge Center – 1-866-457-2377
  - Email – catherine.seidle@gov.sk.ca