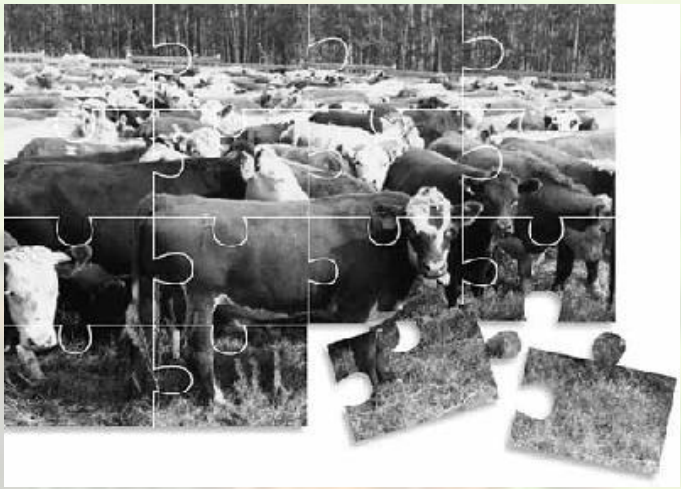
Trace Mineral Supplementation

Dr. Steve Hendrick
Dr. Alvaro Garcia Guerra and Dr. Cheryl Waldner

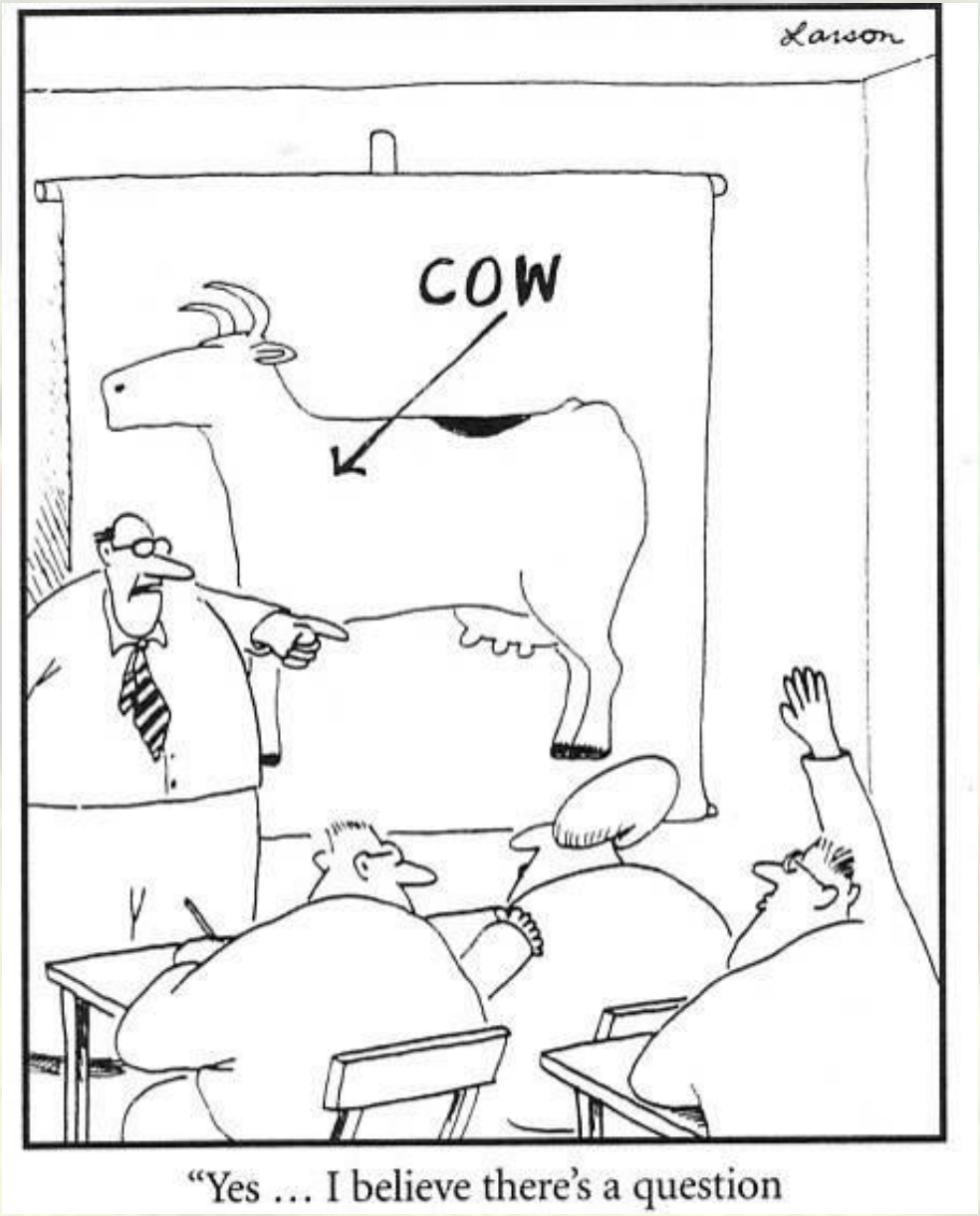
Large Animal Clinical Sciences
Western College of Veterinary Medicine

Outline:

- Why feed mineral to your cows?
- How should I feed mineral?
  - Free-choice vs. force-fed
  - Boluses
- Summary
- Questions & Discussion



University of Saskatchewan



"Yes … I believe there's a question

UNIVERSITY OF SASKATCHEWAN

Why feed minerals?

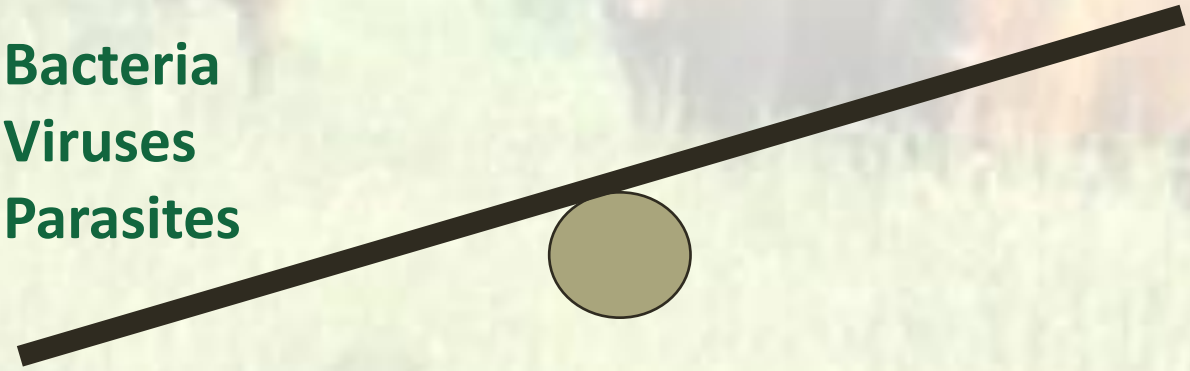
- Insurance – increased productivity and requirements
- Long term recovery from deficiency
- What are the production losses?
  - Reproduction - impact on culling and calf performance
  - Calf health and vigor
  - Lameness
- There needs to be a cost-benefit to the producer
  - Some costs are easier to measure than others!

The Disease Balance - Scours

What's the "tipping point"?

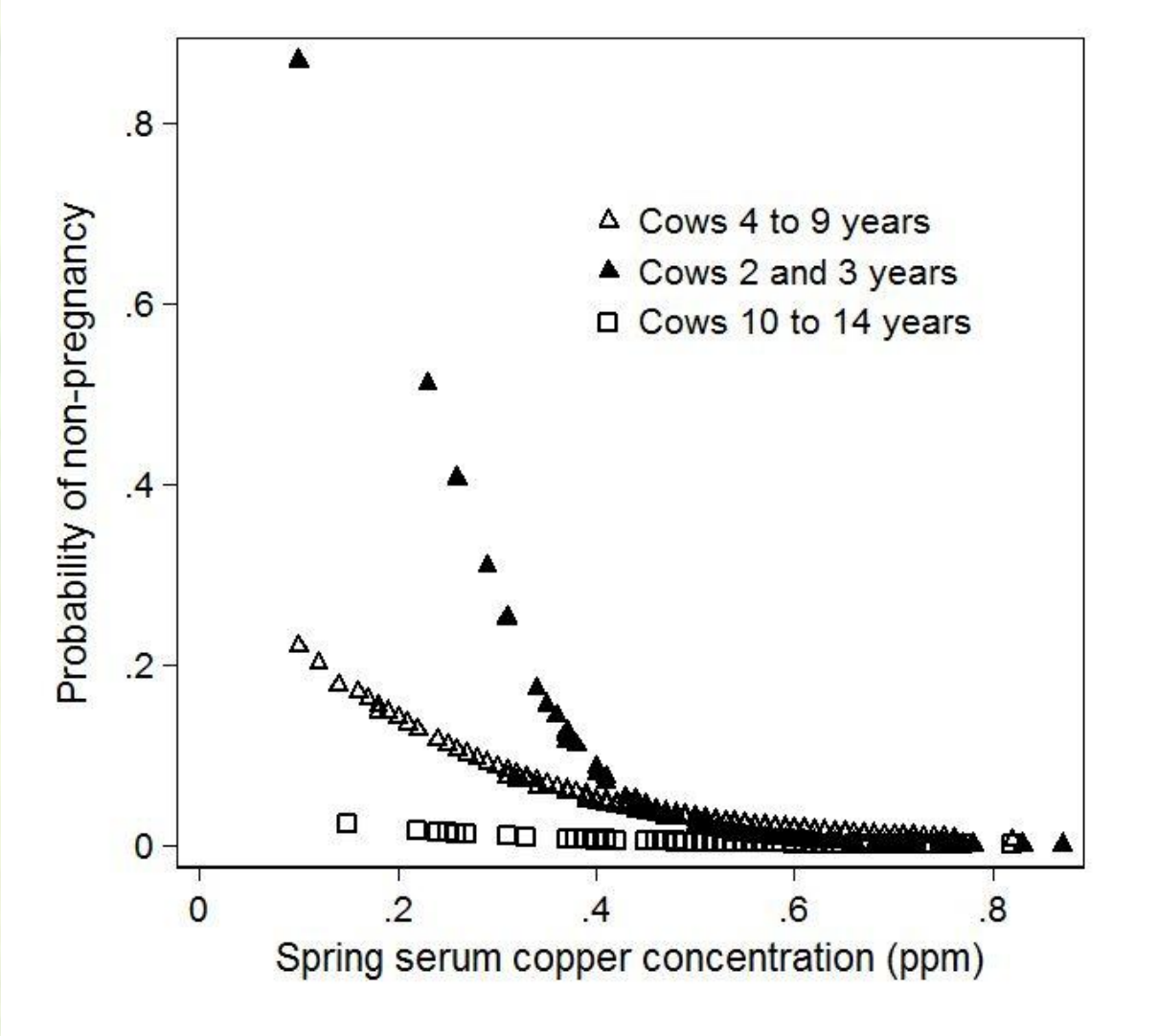
Nutrition
Hygiene
Vaccination
Colostrum
Weather
Stress

Bacteria
Viruses
Parasites



University of Saskatchewan

Reproduction



UNIVERSITY OF SASKATCHEWAN

Calf Health

- Western Canadian Cow-Calf Productivity Study
  - Selenium deficiency – “white muscle disease”
    - Increased calf death loss
    - Weak calves at and after birth
  - Vitamin A deficiency
    - Increased calf treatments

University of Saskatchewan

How should I feed minerals?

1. Free choice:
   - Blocks
   - Loose mineral
   - Lick tubs

   - Consumption limited by palatability and availability
   - Salt is often added to control intakes

2. Force feeding:
   - Fortified pellet
   - Added to grain or silage
   - Boluses

Trace Mineral Supplementation

- Goal:
  - To compare free-choice loose mineral supplementation to force fed mineral supplementation
    - During the pre and post-calving period
    - Blood trace mineral levels
    - Calf health and performance
    - Pregnancy rates
  - Test whether cows self regulate their mineral consumption

- Treatment groups:
  1. Free choice pre-calving and free choice post-calving (FC-FC)
  2. Free choice pre-calving and force fed post-calving (FC-FF)
  3. Force fed pre-calving and force fed post-calving (FF-FF)
  4. Force fed pre-calving and free choice post-calving (FF-FC)

Trace Mineral Supplementation

- Methods:
  - 169 cows from the Goodale Research Farm
    - 121 cows and 48 bred replacement heifers
  - Managed as four groups of cows
    - Heifers were mixed with cows
  - Started mineral supplementation ~75 days before calving
  - Cows bled at:
    - Start of trial (Jan 4, 2011)
    - Within 7-days of calving (Mar 15, 2011)
    - Pasture turnout (May 24, 2011)

Trace Mineral Supplementation

- Feeds Provided

Feed Sample	DM %	CP %	TDN %	ADF %	NDF %	Ca %	P %	K %	Cu (ppm)	Mo (ppm)
Barley Silage	36	11.8	72.4	25.3	43.9	0.29	0.28	1.55	1.4	1.2
Grass Hay Bales	85	9.7	54.0	42.4	62.1	0.71	0.24	2.02	4.8	1.3
Millet North Swaths	23	8.4	58.4	42.6	69.2	0.35	0.33	1.42	6.3	1.0
Millet South Swaths	27	8.6	60.6	43.3	65.1	0.41	0.27	2.76	9.6	1.0
Oats-Barley South Swaths	59	7.7	64.0	38.0	61.5	0.20	0.30	1.25	0.9	1.9
Oats-Barley North Swaths	47	7.5	60.7	43.2	63.1	0.36	0.38	2.89	2.5	2.6
Green Feed Bales	79	6.9	63.6	35.4	56.1	0.26	0.25	1.78	4.8	1.6

Mineral Supplied

- Mineral fed at 100 g per head per day
- Force fed group – mineral added to 5 lbs. of silage

Crude Fat	Min.	1.0	%
Crude Fibre	Max.	8.0	%
Calcium	Act.	28.1	%
Sodium	Act.	4.0	%
Magnesium	Act.	4.0	%
Cobalt	Act.	35	mg/kg
Copper	Act.	3,025	mg/kg
Iodine	Act.	70	mg/kg
Iron	Act.	2,225	mg/kg
Manganese	Act.	4,680	mg/kg
Zinc	Act.	10,000	mg/kg
Fluorine	Max.	3,000	mg/kg
Vitamin A	Act.	500,000	IU/kg
Vitamin D3	Act.	50,000	IU/kg
Vitamin E	Act.	1,500	IU/kg

UNIVERSITY OF SASKATCHEWAN

Project Timeline

Jan 4 – Start of Trial	Free Choice (n=42)	Free Choice (n=43)	Force Fed (n=42)	Force Fed (n=43)
Swath grazing	Millet swaths	Oat swaths	Millet swaths	Oat swaths
Jan 21	1 oat green feed bale	1 oat green feed bale	1 oat green feed bale	1 oat green feed bale
Jan 27	1 grass hay bale	1 grass hay bale	1 grass hay bale	1 grass hay bale
Mar 4 - Brought into pens	Free Choice – Cows (n=60) Free Choice – Heifers (n=25)		Force-Fed – Cows (n=61) Force-Fed – Heifers (n=24)	
Calving	3 hay bales + 1 green feed	1.5 hay bales + 1 green feed	3 hay bales + 1 green feed	1.5 hay bales + 1 green feed
10 days post-calving	Free Choice (n=43)	Force Fed (n=42)	Force Fed (n=43)	Free Choice (n=42)
Swath grazing	Oat swaths	Oat swaths	Oat swaths	Oat swaths

All rations balanced according to NRC requirements

University of Saskatchewan

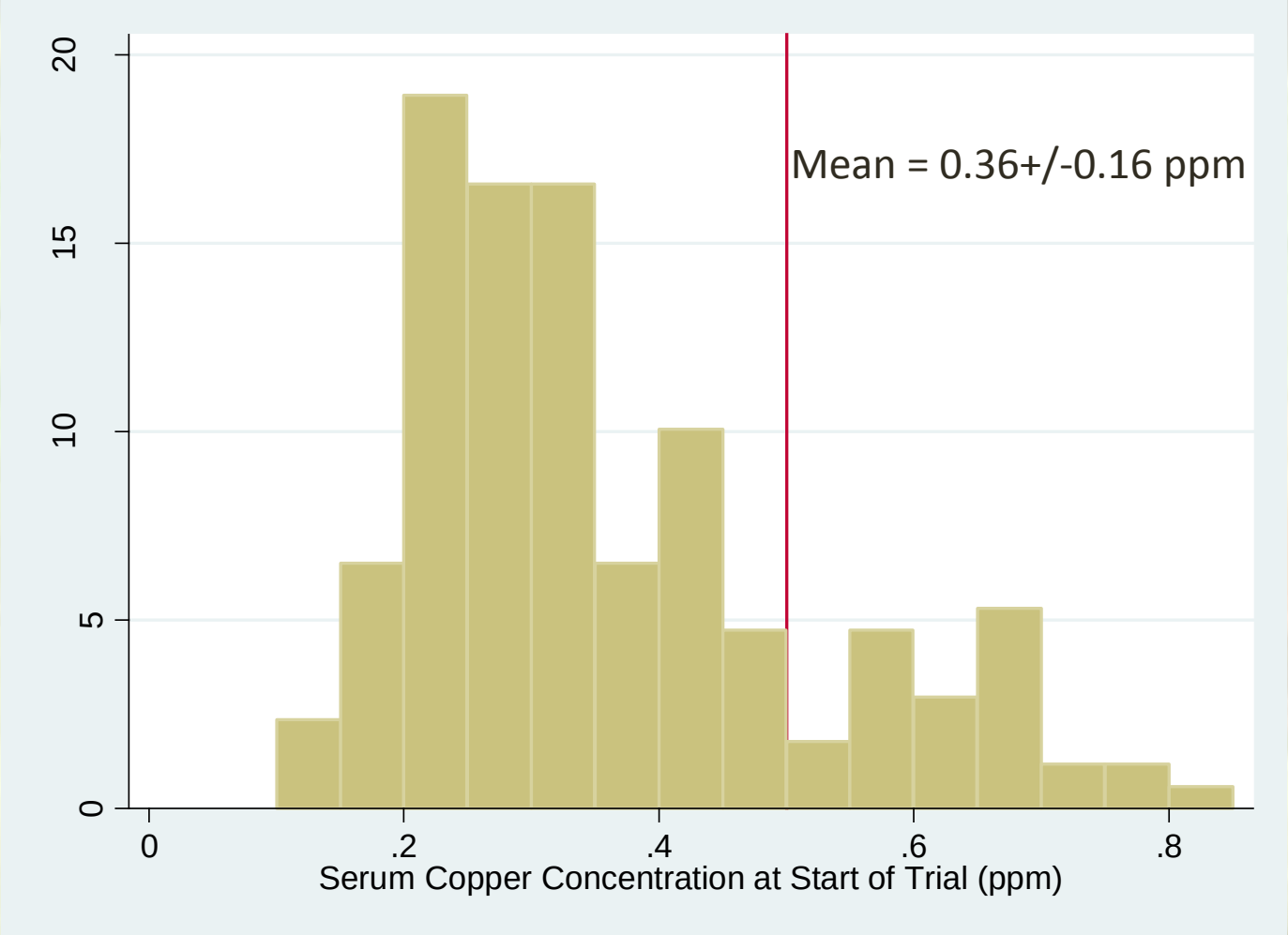
Results – Start of Trial

Treatment Group	Days Fed Mineral Pre-calving	Age (yrs)	BCS (out of 5)	Weight (lbs)	Copper (ppm)
Free Choice	88.6 ± 1.6	4.1 ± 0.3	2.6 ± 0.03	1297 ± 22	0.34 ± 0.01
Force Fed	90.0 ± 1.5	4.2 ± 0.2	2.6 ± 0.04	1281 ± 19	0.37 ± 0.02

No significant differences between the treatment groups

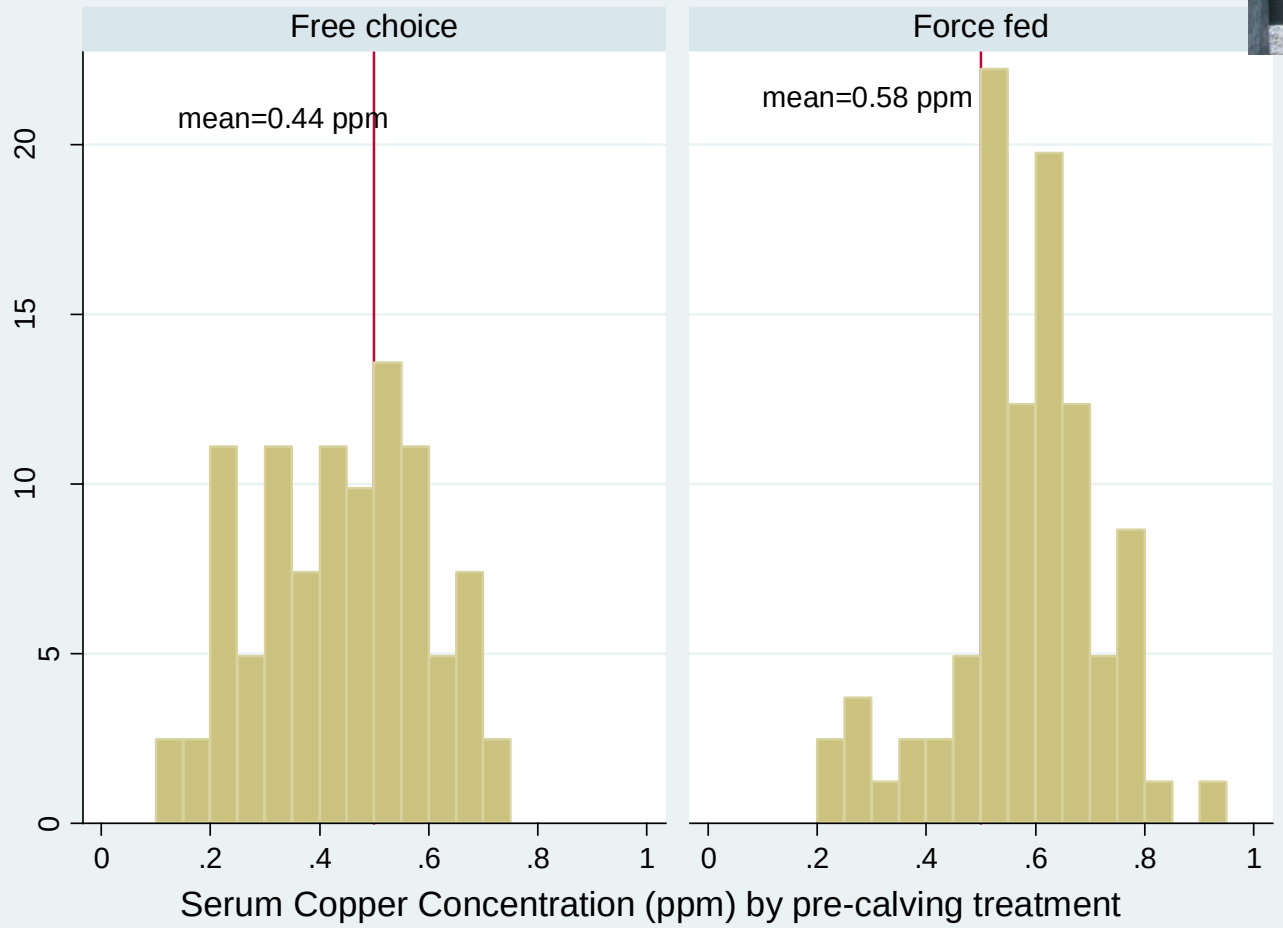
University of Saskatchewan

Results – Start of Trial



UNIVERSITY OF SASKATCHEWAN

Results - Calving



University of Saskatchewan

Results – Calving

Treatment prior to calving (89.3 ± 14.2 days) either free choice or force fed.

Percentage of cows deficient for copper (<0.55 ppm)

Treatment Group	Start of Trial	Calving
Force Fed	83.7%	45.4%
Free Choice	86.9%	77.4%
P-value	0.558	<0.001

University of Saskatchewan

Results - Pre-Calving

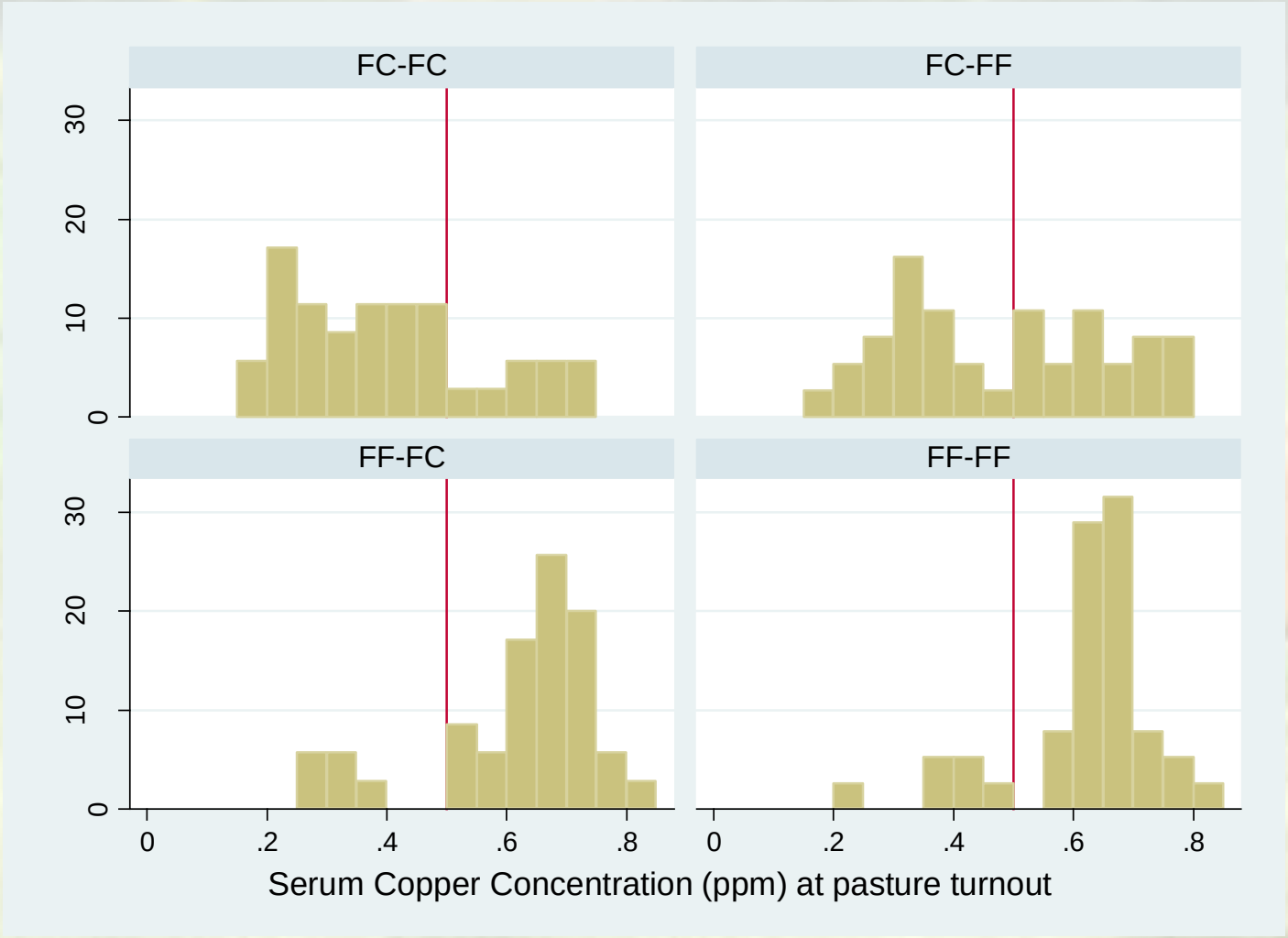
Pre-calving Treatment Group	Cow Disease	Stillborn Calves and Abortions	Calf Treatments	Calving Assistance
Free choice	7.3%	7.4%	7.7%	7.6%
Force fed	5.9%	4.8%	6.2%	4.9%

Pre-calving Treatment Group	Pregnancy Rate
Free choice	94%
Force Fed	94%

No significant differences were found between treatments – too few problems!

University of Saskatchewan

Results – Pasture Turn-out



University of Saskatchewan

Results – Pasture Turn-out

Treatment Group	Mean Cu (ppm)	SEM	Percent Deficient (<0.55 ppm)
Force Fed - Force Fed	0.64 a	0.02	18%
Force Fed - Free Choice	0.64 a	0.02	26%
Free Choice – Free Choice	0.43 b	0.03	78%
Free Choice – Force Fed	0.50 b	0.02	62%

Category	Mean Cu (ppm)	SEM
Heifers	0.61 a	0.02
Cows	0.50 b	0.01

University of Saskatchewan

Results – 1st Standing Heat

Variable:	Hazard Ratio	Robust Std. Error	P-value	95% Confidence Interval
Treatment: Control	Referent	---	---	---
Prostaglandin	1.1	0.19	0.570	0.79-1.55
PRID	2.6	0.81	0.002	1.45-4.83
Blood Copper concentration	2.3	0.82	0.017	1.16-4.66
Calving to breeding interval (days)	1.01	0.01	0.007	1.00-1.02

Cows with higher blood Cu at turnout came into heat quicker
Pre-calving mineral supplementation = blood Cu concentration

UNIVERSITY OF SASKATCHEWAN

Results – Pregnancy

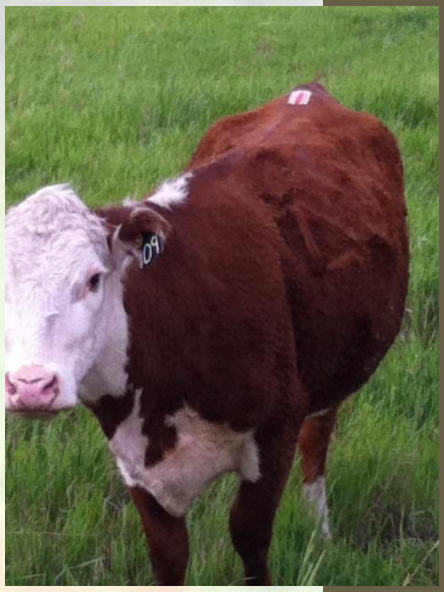
Variable:	Hazard Ratio	Robust Std. Error	P-value	95% Confidence Interval
Body condition score	2.20	0.54	0.001	1.36-3.55
Serum vitamin E concentration	0.88	0.04	0.009	0.80-0.97
Serum copper concentration	6.36	3.13	<0.001	2.42-16.69
Age	1.19	0.02	<0.001	1.14-1.24
Age x serum copper conc.	0.80	0.07	0.010	0.68-0.95

Cows with higher blood Cu at turnout became pregnant quicker, but no difference between 60-day pregnancy rates

Cows force fed mineral were pregnant 5 days earlier (50% of cows were pregnant by 12 vs. 17 days)

UNIVERSITY OF SASKATCHEWAN

Discussion

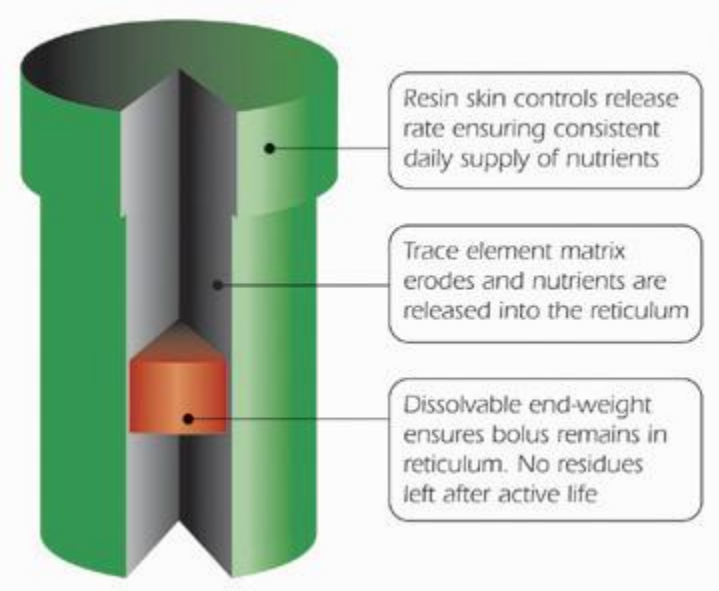


- Force feeding mineral pre-calving resulted in:
  - Numerically lower treatment rates in cows and calves
  - Significantly improved the blood copper concentration
    - Reduced the time to show estrus and become pregnant
      - 5 days difference between median days pregnant
- Free choice mineral intake was very low
  - Palatability or experience
- Cost-benefit
  - If a calf gains 2.25 lbs per day, then 5 extra days is 11.25 lbs
  - If you are paid $1.50 per lb, then the value of the extra weight is $16.88
  - If the mineral costs $470/1000 lbs. and we feed 100 g for 130 days
  - Then we spend $13.47 per cow and profit $3.41 (ROI of 25%)

UNIVERSITY OF SASKATCHEWAN

All-Trace Boluses

- Sustained-release trace mineral boluses
  - Provides trace minerals for 240 days



All-Trace Boluses

- Sustained-release trace mineral boluses
  - Provides trace minerals for 240 days

Active component	Quantity in each bolus	Daily supply over 240 days from 2 boluses
Copper	16,379 mg	136.5 mg
Cobalt	236 mg	2.0 mg
Selenium	251 mg	2.1 mg
Manganese	8,326 mg	69.4 mg
Zinc	13,382 mg	111.5 mg
Iodine	497 mg	4.1 mg
Vitamin A	549,408 IU	4,580.0 IU
Vitamin D3	109,881 IU	916.0 IU
Vitamin E	1,099 IU	9.0 IU

All-Trace Boluses

- Clinical Trial:
  - 450 cows given All-Trace boluses, and
  - 450 untreated cows (herd matched)
    - 8 herds
      - Collected BCS, age, breed and management details
      - Bled 10% of the cows – trace mineral panel
- Goal:
  - To compare the pregnancy rates between bolused and non-bolused cow and perform a cost-benefit analysis

University of Saskatchewan

Herd	Pasture	Breed	Bolused	Non-Bolused	Total	BCS	Cu	Mo
1	A	BA	26/29 (90%)	32/33 (97%)	62	2.9	0.60	0.02
2	A	BA	31/32 (97%)	27/29 (93%)	61	2.9	0.55	0.02
3	B	BA & Char	37/40 (93%)	36/39 (92%)	79	3.0	0.26	0.07
4	B	CharX	28/32 (88%)	26/33 (79%)	65	2.8	0.57	0.03
5	B	Char	7/8 (93%)	7/7 (100%)	15	3.5	0.28	0.01
6	C	Simm/ RA	87/91 (96%)	87/94 (93%)	185	2.5	0.53	0.17
7	D	BA	178/212 (84%)	167/212 (79%)	424	1.9	0.49	0.05
All	---	---	394/444 (89%)	382/447 (85.5%)	891	2.5	0.48	0.07

All-Trace Boluses

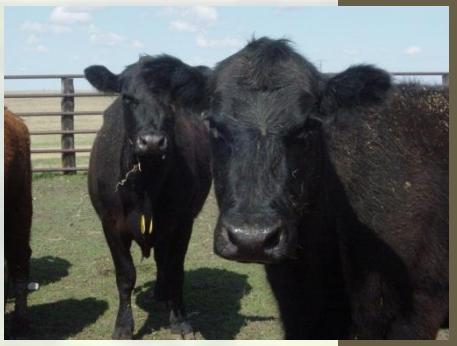
- When herd is controlled for in the analysis
  - There are significant treatment differences ($P<0.001$)
  - Pregnancy rates of 88.75% versus 85.5%
- Considerable herd variation
  - Suggests many other factors influencing the results!
  - Body condition, age, mineral status, breeding season length, bull:female ratio, infectious disease, etc.
- May help herds that need mineral supplementation
  - Provide more than just copper
- Perhaps they should be given in the fall, rather than just before breeding

All-Trace Boluses

- Cost-Benefit:
  - If you have 100 cows:
    - The difference between using boluses and not is 3% more open
      - That means 3 more open cows
    - If it costs $1200 for a replacement heifer and the open cows sell for $0.65/lb ($780 for each 1200 lb cow)
    - Then the net cost to replace the 3 open cows is $420 x 3 ($1260)
  - The retail cost for each bolus is $6 or $12 per cow (2 boluses)
    - Not including labour
  - For this 100 cow herd – need to spend $1200 and only make $60 (ROI of 5%)
- However, this study only looked at pregnancy rates
  - There may be other health benefits?

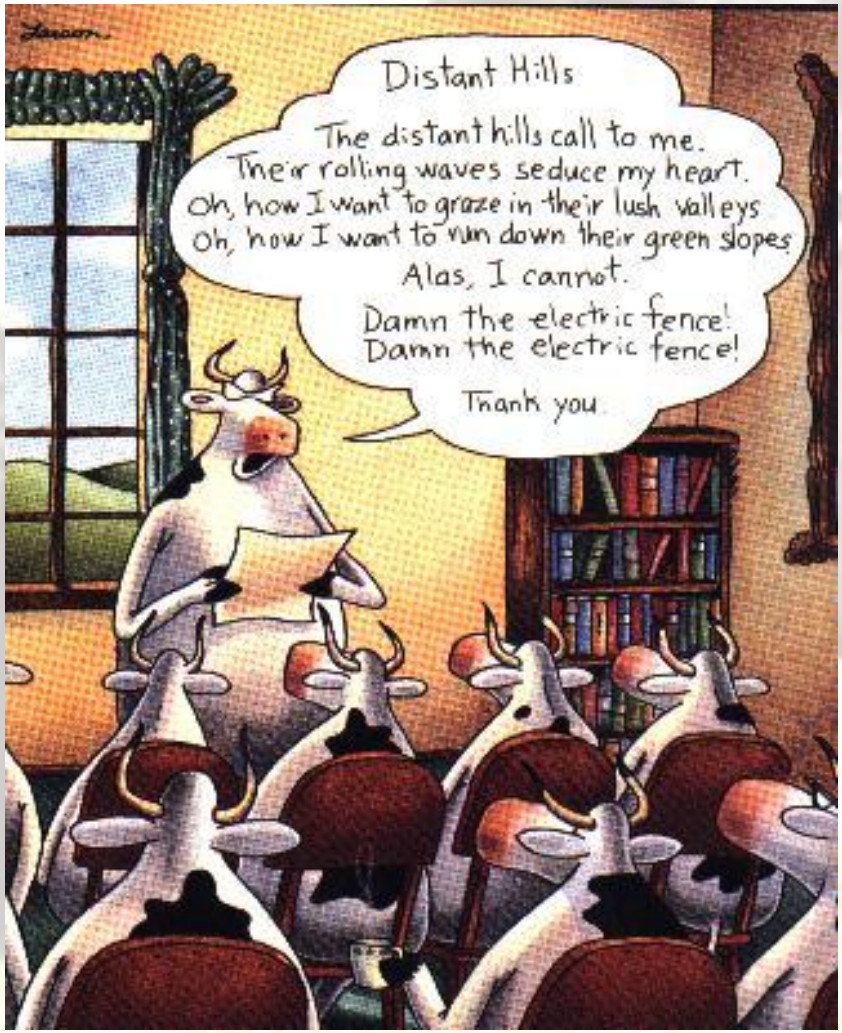
UNIVERSITY OF SASKATCHEWAN

Summary



- Trace minerals do impact reproduction and health
- Provide minerals to cows pre-calving
  - Force feeding appears more effective than free choice
- Trace mineral boluses are another option of force feeding mineral
  - Can improve pregnancy rates
- Mineral programs need to be cost-effective
  - What's the return on investment of your mineral program?

Questions and Discussion



UNIVERSITY OF SASKATCHEWAN

Thanks!

- **Acknowledgements:**
  - Collaborators – Drs. Cheryl Waldner & Alvaro Garcia Guerra
  - Technical Assistants – Brittany Wiese & Patty Tulloch
  - Funding – SK Agriculture Development Fund, Beef Cattle Research Council
  - Bioniche Animal Health – boluses and testing

SASKATCHEWAN beef INDUSTRY Conference

UNIVERSITY OF SASKATCHEWAN