Relationship between eating patterns and performance of feedlot cattle

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Current perceptions

- Feed Intake Variation
  - Increases incidence of acidosis
  - can decrease performance
  - increase time on feed

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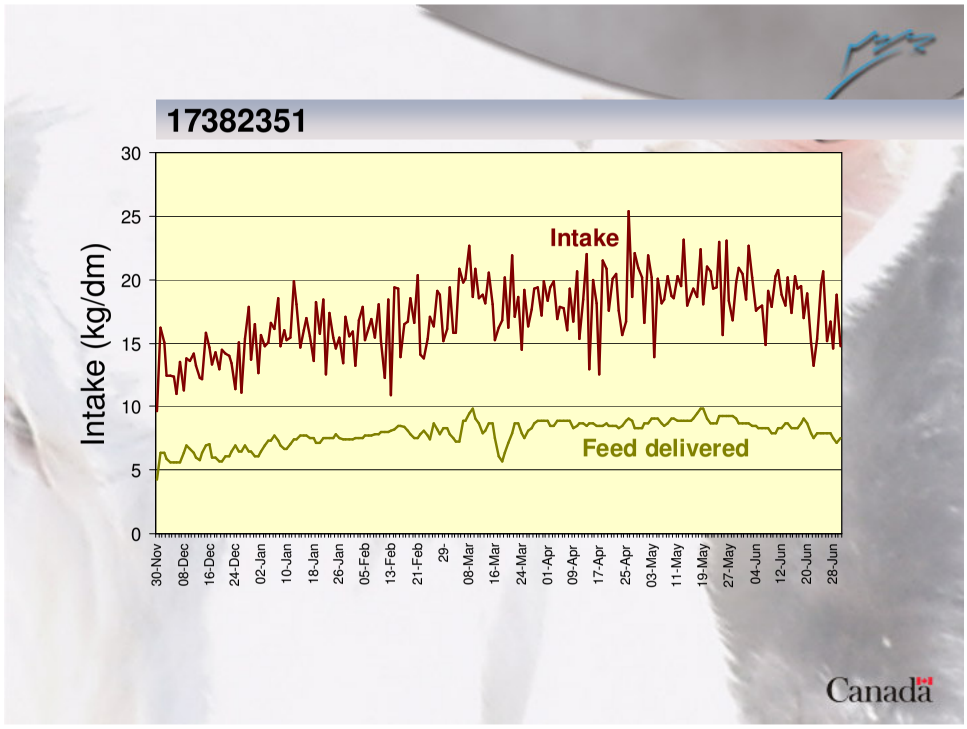
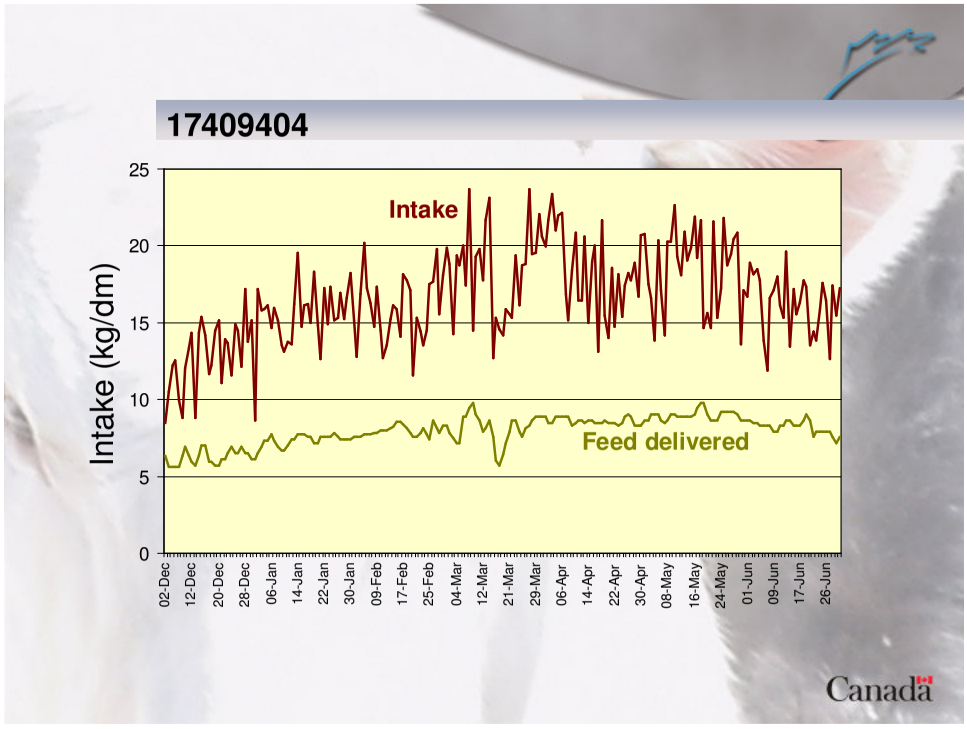

17382351
Intake (kg/dm)
30
25
20
15
10
5
0
Intake
Feed delivered
30-Nov
08-Dec
16-Dec
24-Dec
02-Jan
10-Jan
18-Jan
26-Jan
05-Feb
13-Feb
21-Feb
29-
08-Mar
16-Mar
24-Mar
01-Apr
09-Apr
17-Apr
25-Apr
03-May
11-May
19-May
27-May
04-Jun
12-Jun
20-Jun
28-Jun
Canada


17409404
Intake (kg/dm)
25
20
15
10
5
0
Intake
Feed delivered
02-Dec
12-Dec
20-Dec
28-Dec
06-Jan
14-Jan
22-Jan
30-Jan
09-Feb
17-Feb
25-Feb
04-Mar
12-Mar
21-Mar
29-Mar
06-Apr
14-Apr
22-Apr
30-Apr
08-May
16-May
24-May
01-Jun
09-Jun
17-Jun
26-Jun
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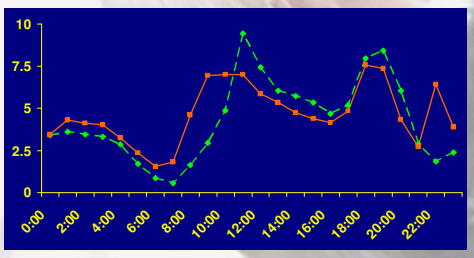
Feeding behaviour

- Diurnal pattern
- Very little known
- Influenced by many factors
  - (Stricklin, 1987; Hicks et al., 1989)



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Factors affecting feeding behavior

- Social dominance
- Temperament
- Bunk space
- Amount/feed delivery times
- Weather
- Bunk management

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Variables in relationship

Performance
- ADG
- Feed:Gain

Behavior
- bunk duration
- bunk frequency

Intake
- Daily variation
- Consumption

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Cattle

- Charolais sired X-bred calves
- N = 81 (277±111 kg)
- Blocked by BW
- Diet- typical barley silage/barley grain
- 213 D trial

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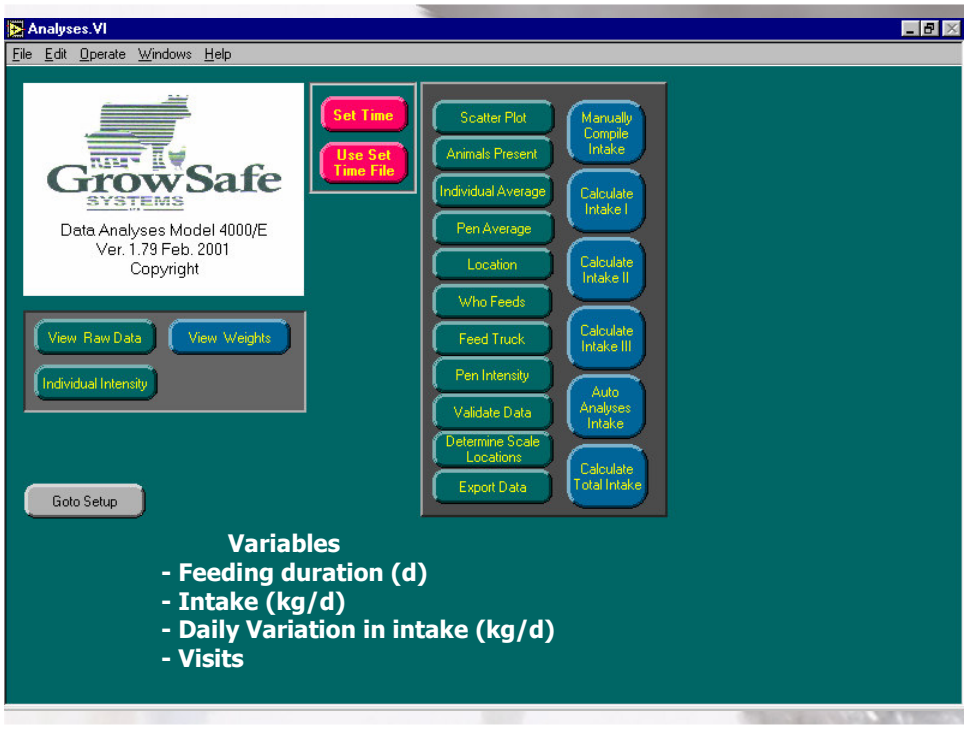

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Backgrounding

	ADG	Intake	D/var. (kg)	Freq.	Duration	Feed: gain
ADG category						
High (1.34-1.60)	1.41	7.45	2.88	5.21	135.55	6.03
Avg (0.95-1.31)	1.12	7.04	2.69	4.54	129.43	6.93
Low (0.60-0.94)	0.87	6.72	2.63	4.52	124.16	8.12
Feed:Gain category						
High (5.55-6.11)	1.33	6.24	2.93	4.36	125.64	5.88
Avg (6.12-7.79)	1.14	7.13	2.67	4.59	129.81	6.87
Low (7.83-9.10)	0.91	7.60	2.70	4.82	129.49	8.31

P value = 0.001

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Finishing

	ADG	Intake	D/var. (kg)	Freq.	Duration	Feed: gain
ADG category						
High (1.61-1.72)	1.65	8.95	3.15	4.88	73.99	5.98
Avg (1.27-1.58)	1.43	8.55	3.25	4.63	81.79	6.90
Low (0.90-1.26)	1.18	8.13	3.17	4.70	86.69	8.15
Feed:Gain category						
High (4.35-6.10)	1.63	8.04	3.21	4.42	74.28	5.62
Avg (6.12-7.78)	1.44	8.57	3.23	4.67	81.18	6.85
Low (7.82-11.30)	1.19	8.80	3.20	4.74	92.27	8.52

P value = 0.001

Canada

Overall

	N =	ADG means	Intake	D/var. (kg)	Freq.	Duration	Feed: gain
ADG category							
High (1.47-1.60)	9	1.54	8.69	3.08	4.88	99.99	5.76
Avg (1.21-1.45)	52	1.34	8.04	2.94	4.63	102.04	6.13
Low (0.98-1.20)	13	1.12	7.66	2.72	4.70	102.79	6.91
Feed:Gain category							
High (4.85-5.22)	11	1.43	7.55	3.28	4.44	106.52	5.04
Avg (5.25-6.28)	50	1.33	8.05	2.85	4.90	106.63	5.69
Low (6.37-7.07)	13	1.22	8.50	2.90	4.93	110.21	6.62

P value = 0.001

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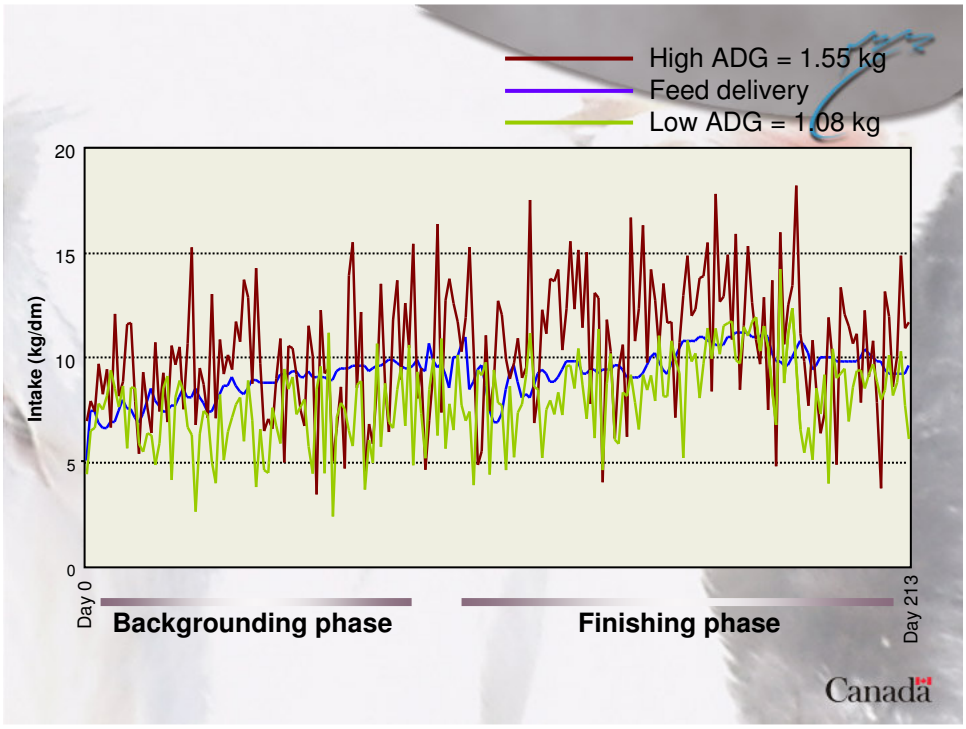
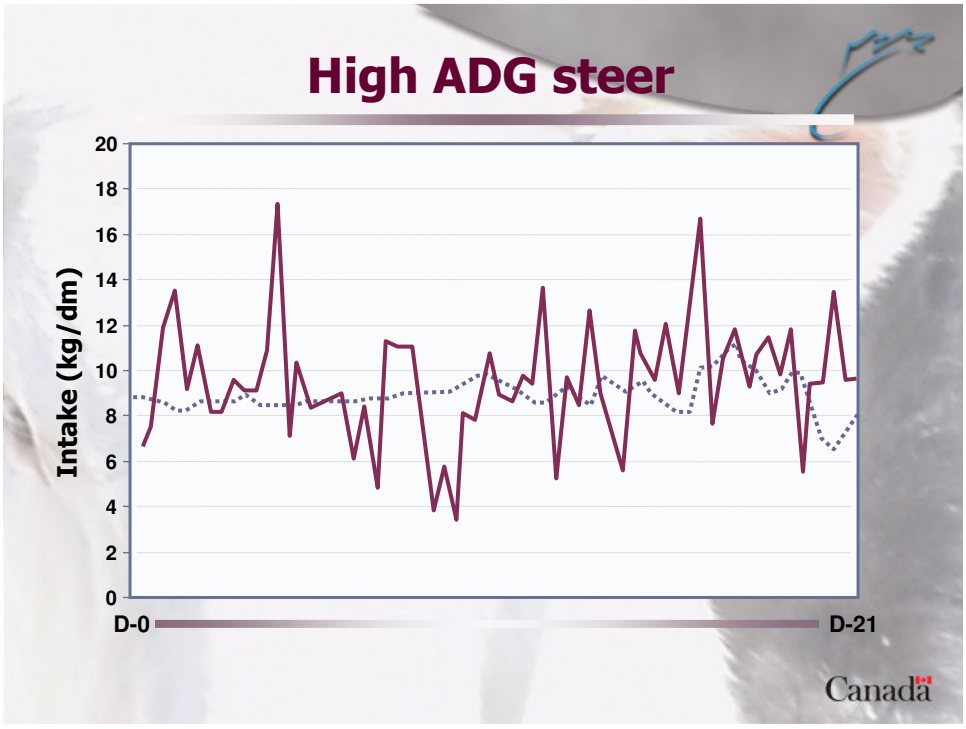
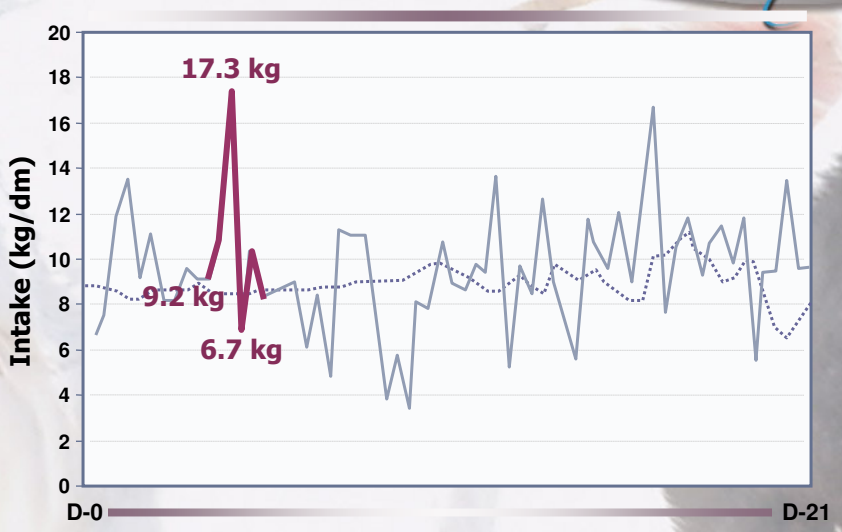

High ADG = 1.55 kg
Feed delivery
Low ADG = 1.08 kg
Intake (kg/dm)
20
15
10
5
0
Day 0
Backgrounding phase
Finishing phase
Day 213
Canada


High ADG steer
Intake (kg/dm)
20
18
16
14
12
10
8
6
4
2
0
D-0
D-21
Canada

High ADG steer



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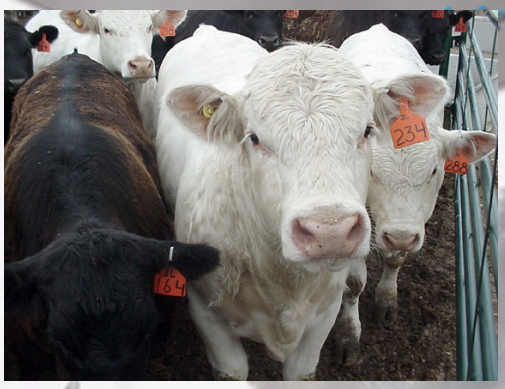
Implications



- Acidosis
- Consumption patterns
- Current beliefs based upon average animals?

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Effect of uniformity of feed delivery on feeding behavior, ruminal pH and growth performance of feedlot cattle

K. Schwartzkopf-Genswein[1], T.A. McAllister[2], D. J. Gibb[2], K. A. Beauchemin[2] and M. Streeter[3]

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BUNK MANAGEMENT

- Controlling intake
- Improving FE
- Transition

Variation in Intake

- Large variations in intake may cause digestive disturbance and reduce performance
  - Fulton et al., 1979
  - Britton and Stock, 1987
  - Stock, 1995
  - Galyean et al., 1992

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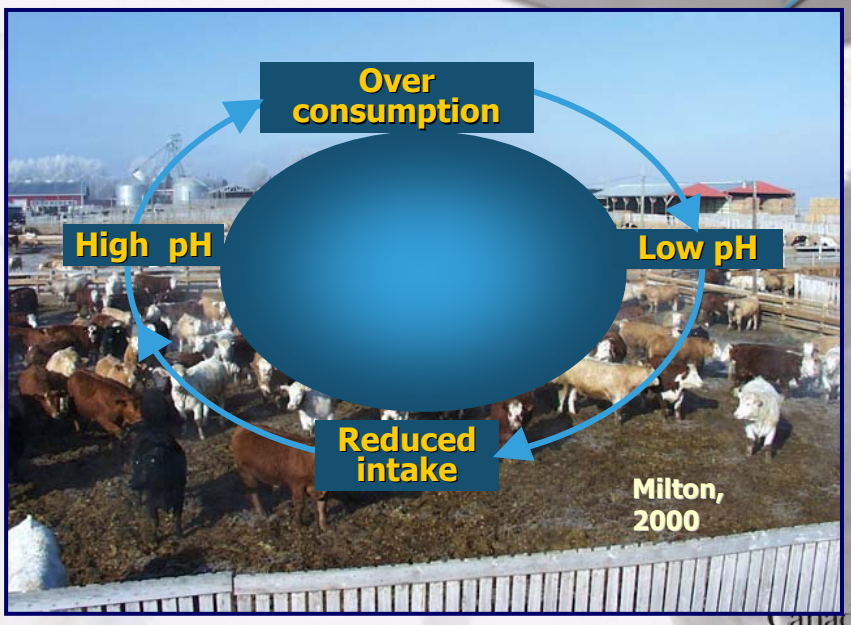
Intake and rumen pH



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Intake variation and performance (Galyean *et al.,* 1992)

- 380 kg calves, program fed
- 10% daily, or weekly fluctuations (DMI = between groups)
- Constant feeding resulted in:
  - 6% higher average daily gain
  - 7% improvement in feed efficiency
- Acidosis ??

Canada

Intake variation and acidosis

- **Summary of trials that found no difference**
  - Zinn, R.A., 1994
  - Stock *et al.,* 1995
  - Soto-Navarro *et al.,* 1997
  - Cooper *et al.,* 1998

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Objectives

- Experiment 1- Determine effects of fluctuation in quantity of feed delivered
  - Intake, Rumen pH
- Experiment 2 - Determine effects of fluctuation and time of feed delivery
  - Intake, ADG, FE, Feeding behavior

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Methods - Experiment 1

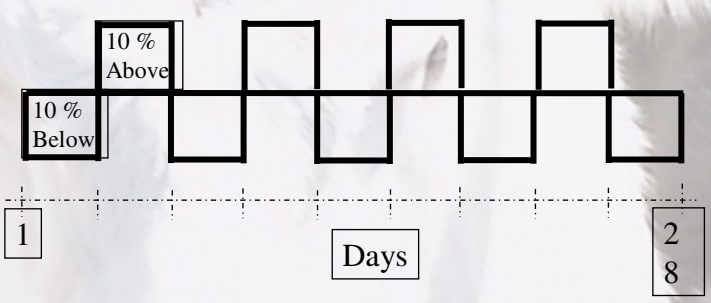
- 6 cannulated steers (797 kg)
- Barley grain/silage finishing diet
- *ad libitum* DMI determined (10.3 kg/d)
- Record feed offered and refused

Canada

Methods - Experiment 1

Treatment

- C = Constant feed delivery (ad libitum intake)
- F = 10% above and below A (3d)



Crossover experiment (Two -28d periods)

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Continuous measurement of pH

- Electrodes calibrated daily
- Data collected every 5 s
- Average over 15 min

pH Data

- Daily each steer, each period
  - mean pH
  - Max
  - Min
  - Amount and % time pH below 5.8 -5.5

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pH Results

	Fluctuating	Constant
Mean pH	5.63[b]	5.73[a]
Min pH	5.04	5.17
Max pH	6.53	6.45
Time pH < 6.2 (h)	18.1[a]	17.2[b]
Time pH < 5.8 (h)	14.7[c]	12.5[d]
Time pH < 5.5 (h)	11.2[a]	9.0[b]

[a,b] P <.15

[c,d] P <.05

Proc Mixed SAS

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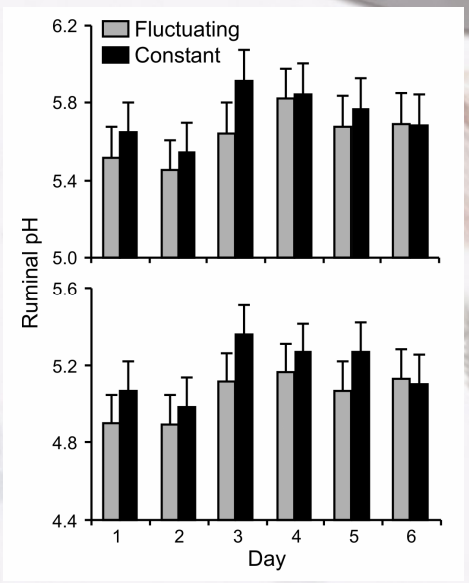
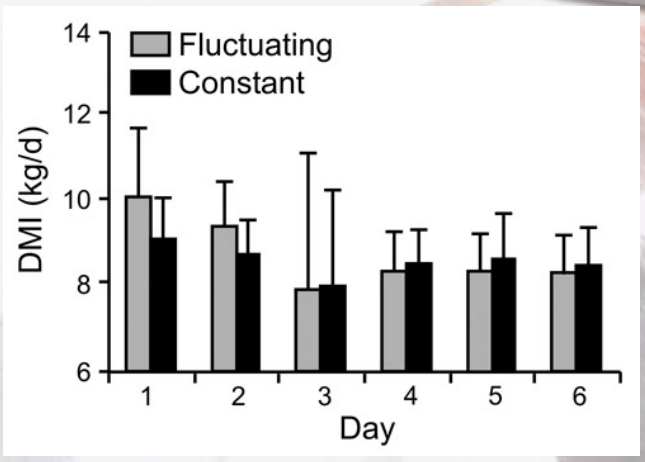

Fluctuating
Constant
Ruminal pH
6.2
5.8
5.4
5.0
5.6
5.2
4.8
4.4
1
2
3
4
5
6
Day


Fluctuating
Constant
DMI (kg/d)
14
12
10
8
6
1
2
3
4
5
6
Day

DMI Results

F - 8.81 +/- 1.01
C - 8.66 +/- .84 P =.15

- C feeding did not eliminate day-day var.
- 99% of variation = 2.5 kg or 29% of DMI
- Risk of acidosis not related to intake

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Methods - Experiment 2

- 240 cross bred steers (310 +/- 23 kg)
  - Treatments
    C - Constant feed delivery
    F - Fluctuating feed delivery (10% above and below)
- 209 d trial

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Methods - Experiment 2

- 16 pens -15hd/pen - 8 pens/treatment
- 209 d trial - backgrounding and finishing
- Barley grain / barley silage diet
- Weighed and vaccinated on arrival

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Performance Data

- Weights - 21d intervals
- ADG
- Feed Efficiency - F:G ratio
- Intake - Feed delivered daily - feed refusals for pen

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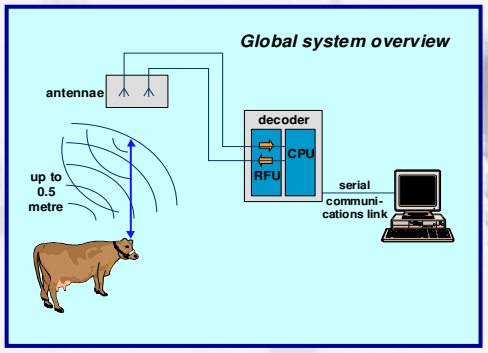
Feeding Behavior

60 steers - 4 pens

Bunk attendance (frequency and duration)



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Constant vs Fluctuating Feeding

	Treatment	
	C	F
Steers, no. (pens)	120 (8)	120 (8)
Daily gain, kg	1.23	1.20
Daily DMI, kg/steer	7.35	7.39
Feed Efficiency	6.22	6.41
Bunk attendance, min/d	23.40	23.25
Frequency, visits/d	10.22[b]	10.82[a]

[a,b] P <.01

Proc Mixed

Canada

Conclusions

- Risk of ruminal acidosis was increased with fluctuation feed delivery but increased risk did not impair performance
- Feedlot cattle on finishing diets appear to adapt to fluctuations in intake with little effect on performance

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Effect of rapid vs. gradual adaptation to a high concentrate diet on rumen pH and fermentation of feedlot cattle

D.W. Bevans, K.S. Schwartzkopf-Genswein, T.A. McAllister, K.A. Beauchemin and J.J. McKinnon

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n adaptation

- Abrupt dietary change from forage to concentrate can result in acidosis (Goad et al., 1998; Coe et al., 1999)
- Acidosis results in reduced feed intake and performance (Owens et al., 1998)

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Step-up programs

- Dietary concentrate is typically increased in a step-up manner
  - Series of sequential diets with increasing grain concentration
  - Many variations exist
- Common Goal
  - To achieve a high level of concentrate intake as rapidly as possible without causing significant acidosis

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Step-up programs - Acidosis

- Even with step-up programs some acidosis is prevalent during grain adaptation (Burrin and Britton, 1986)
- All cattle experience some level of acidosis during grain adaptation (Klopfenstein et al., 2003)

Canada

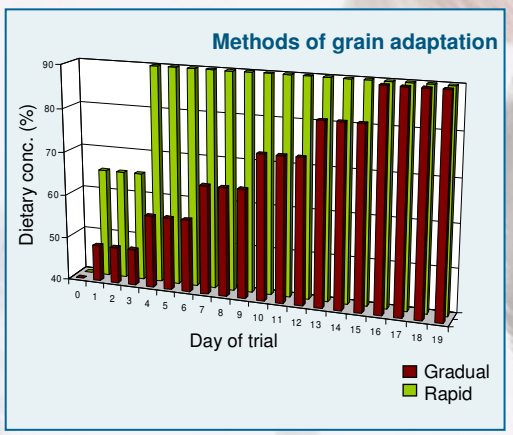
Objectives

- To determine effects of rapid vs. gradual adaptation to a high grain diet on rumen pH and fermentation

Canada

Methods

- 12 cannulated heifers (384 ± 25 kg)
- Adapted from 40 to 90% concentrate
  - Rapid or gradual adaptation



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Ruminal pH – Continuous data

- 20 d of rumen pH
  - Summarized for each day as
    - Mean
    - Minimum
    - Maximum
    - Area < pH 6.2, 5.6, 5.2
    - Time pH < 6.2, 5.6, 5.2

Canada

pH results – 65% concentrate

- d 1, d 2, d 3
  - pH variable means did not differ ($P > 0.14$)
- 3 d combined
  - Area pH < 5.6 tended to be greater for rapid adaptation ($P = 0.08$)

Canada

pH results - 65% concentrate (d 1)

	Rapid	Gradual	Equality of variance (*P*)
Mean pH	5.86 ± 0.42	5.97 ± 0.12	0.02
Min pH	5.29 ± 0.37	5.36 ± 0.17	0.12
Area pH < 5.6 (pH x h)	2.43 ± 2.64	0.62 ± 0.70	0.01
Time pH < 5.6 (h)	7.96 ± 7.56	3.88 ± 2.91	0.06
Area pH < 5.2 (pH x h)	0.28 ± 0.45	0.01 ± 0.03	<0.01
Time pH < 5.2 (h)	2.47 ± 3.45	0.18 ± 0.44	<0.01

(diff. between means $P > 0.14$)

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pH results - 90% concentrate

- d 1, d 2, d 3, d 4 and combined 3 d
- pH variable means did not differ ($P > 0.15$)

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pH results - 90% concentrate (d 1)

	Rapid	Gradual	Equality of variance (*P*)
Mean pH	5.62 ± 0.30	5.70 ± 0.23	0.54
Min pH	5.01 ± 0.29	5.10 ± 0.16	0.22
Area pH < 5.6 (pH x h)	4.27 ± 4.08	2.72 ± 1.92	0.12
Time pH < 5.6 (h)	11.99 ± 6.55	10.19 ± 5.20	0.62
Area pH < 5.2 (pH x h)	1.11 ± 1.69	0.24 ± 0.33	<0.01
Time pH < 5.2 (h)	4.58 ± 5.28	2.18 ± 1.19	0.04

(diff. between means $P > 0.15$)

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Rumen fermentation

- Ruminal sampling on days of grain increase
  - 0, 8, 18 h post-feeding
- Measured
  - VFA
  - Lactate
  - Osmolality
- Means did not differ between treatments ($P < 0.05$)
  - 65 and 90% concentrate

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Feed intake

- DMI and DMI variation was not affected by treatment on any day of feeding 65 or 90% concentrate
- Overall DMI was less on d 2 of each diet than on d 1 ($P < 0.05$)

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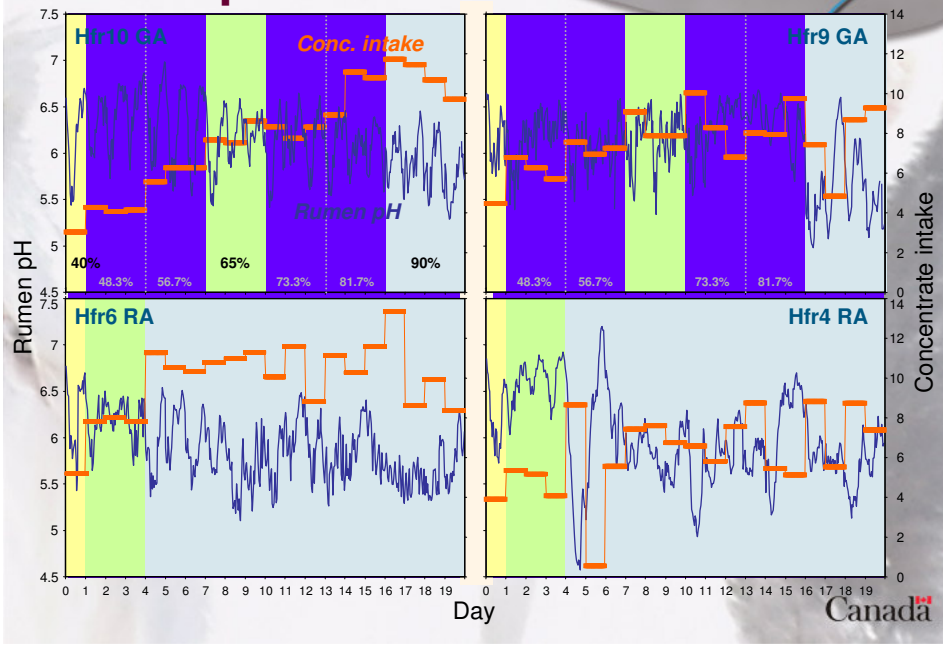
Rumen pH – Individual animal variation



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Implications

- Extreme variation exists in ability of cattle to deal with grain adaptation
- Rapid adaptation to high concentrate diets results in increased risk of acidosis for some individuals
- Management of grain adaptation must be tailored to the most susceptible animals if acidosis is to be prevented

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Role of feed choice in reducing acidosis

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Feeding techniques to improve welfare of cattle fed high grain diets

- Determine optimal forage: concentrate ratio in finishing diets based on animal choice, health and performance.

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Total Mixed Ration (TMR)

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Hypothesis

- If calves have access to grain and forage separately they will select a diet that best maintains rumen health and prevents acidosis and liver abscesses

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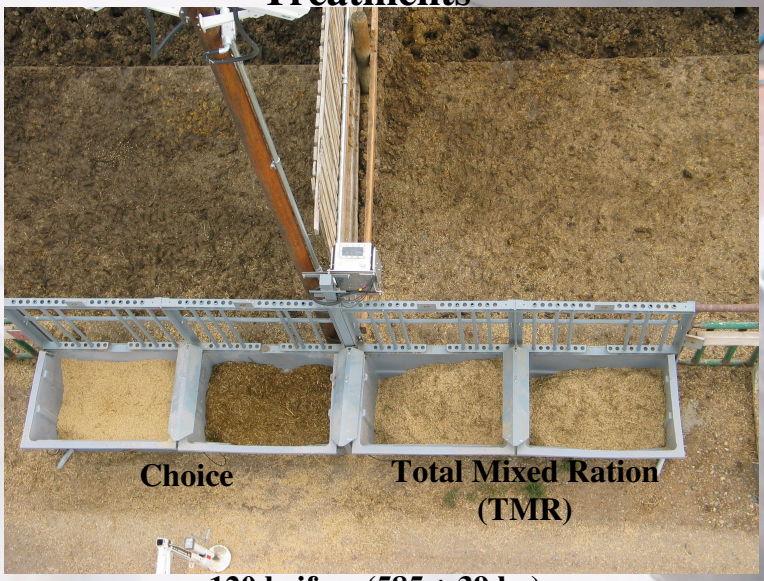
Treatments



120 heifers (585 ± 39 kg)
8 pens - 15 animals/pen

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Methods

- 0900, 1300 and 1500 to accommodate *ad libitum* appetite
- 68 d trial
- Weighed every 2 wks
- Weigh backs collected daily

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Methods

Individual animal information

- Intake
- ADG
- Feed efficiency
- Feeding behaviour
- Carcass - warm carcass weight, fat cover, ribeye area marbling quality
- Liver Abscess scores
  0 –no abscess
  3 –severe abscess 1 abscess > 2.5 cm in diameter

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Results

	Choice	*TMR*	*SEM*	*P value*
Heifers	60	59		
Pens	4	4		
Initial wt	593.2	593.3		
DMI (kg)	7.6	10.3	0.21	<.0001
Barley % DMI	80.4	87.7	0.83	.0008
ADG (kg)	1.34	1.39	.07	.636
FE gain:feed kg	.17	.13	.005	<.0001

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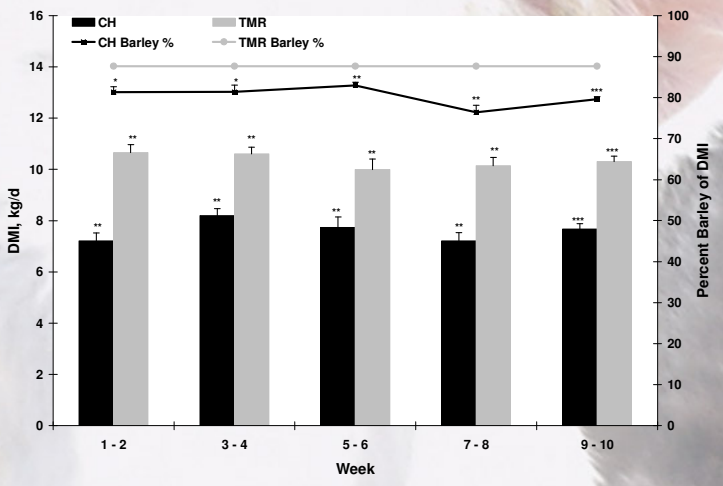
Results



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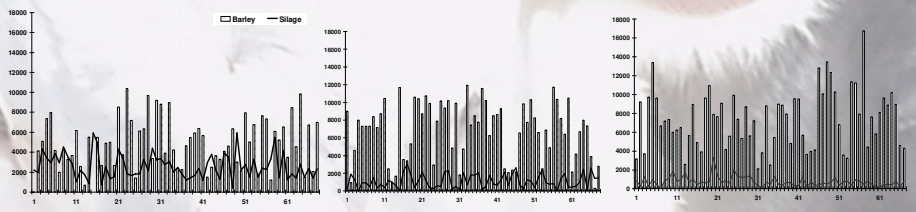
Variation in daily DMI for 3 calves



Canada

Results

	Choice	*TMR*	*SEM*	*P value*
Warm carcass wt (kg)	396.0	397.7	1.48	.450
Fat Cover (mm) 1	15.9	16.8	.36	.186
2	13.4	13.9	.64	.583
Grade fat	12.9	13.0	.56	.861
Average fat	14.1	14.6	.46	.489
REA cm^2	94.4	94.7	.59	.790
Marbling Quality	2.8	2.7	.08	.209
Marbling level	38.2	45.2	3.49	.229
Salable meat %	56.8	56.1	.57	.461
Liver score	.59	.50	.16	.697

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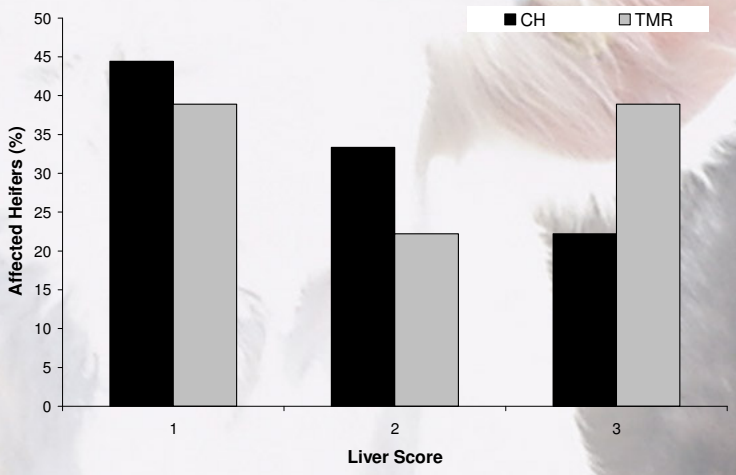

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Conclusions

- Choice do not over consume grain
- Select diet with less grain then current industry practice
- Overall performance id the same or better (FE)
- Trend towards reduced liver abscess
- Atwood et al. (2001) found that producing animals on a free-choice diet could reduce costs by almost 25 %

Canada