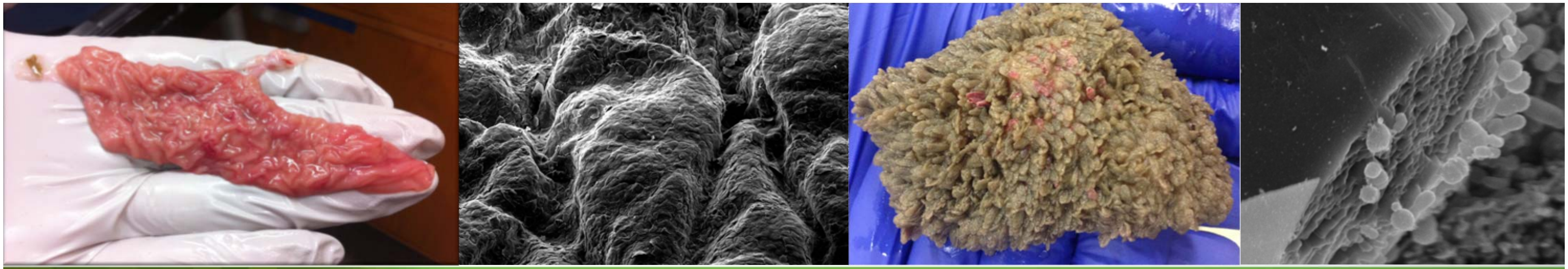

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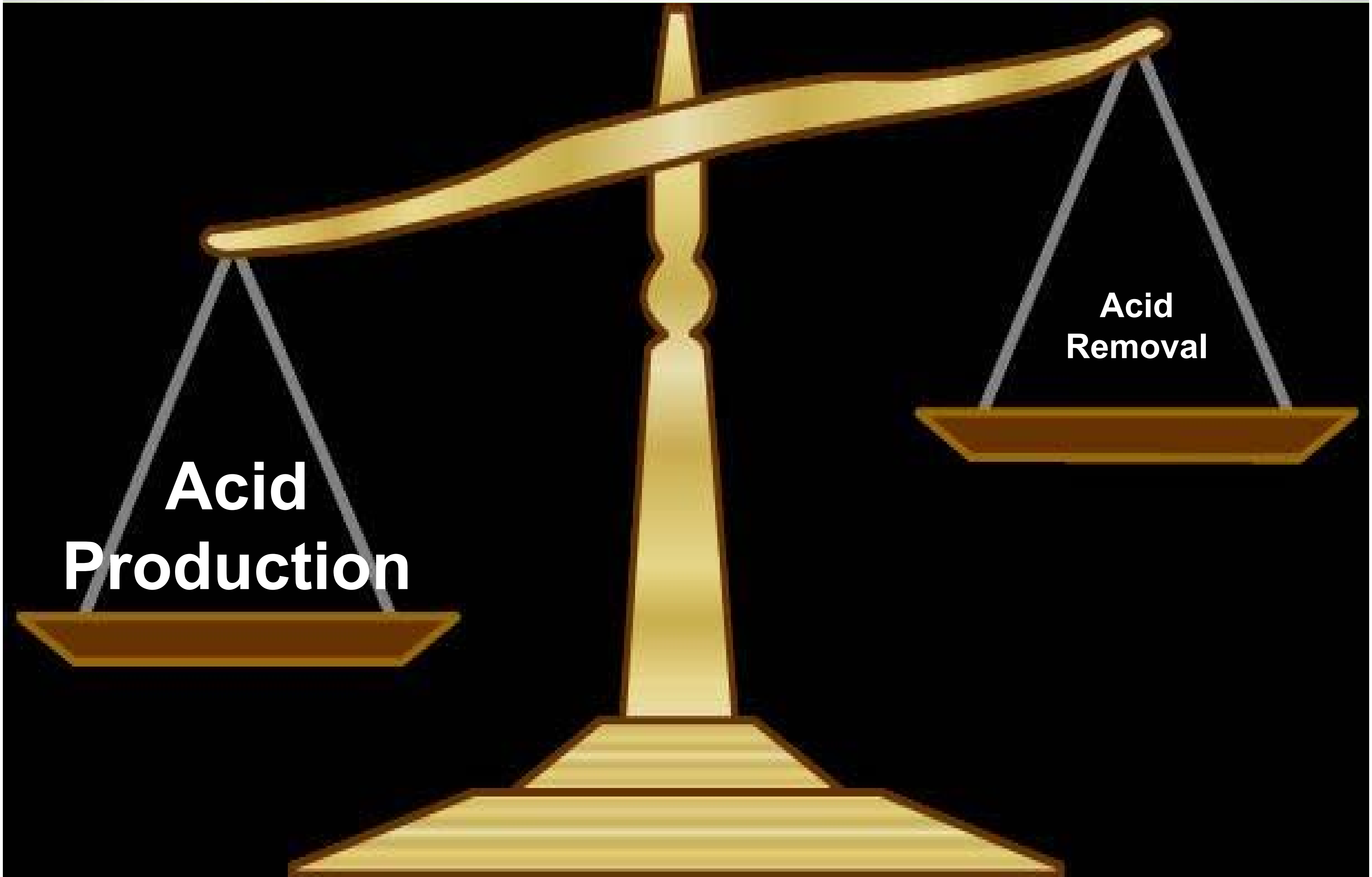
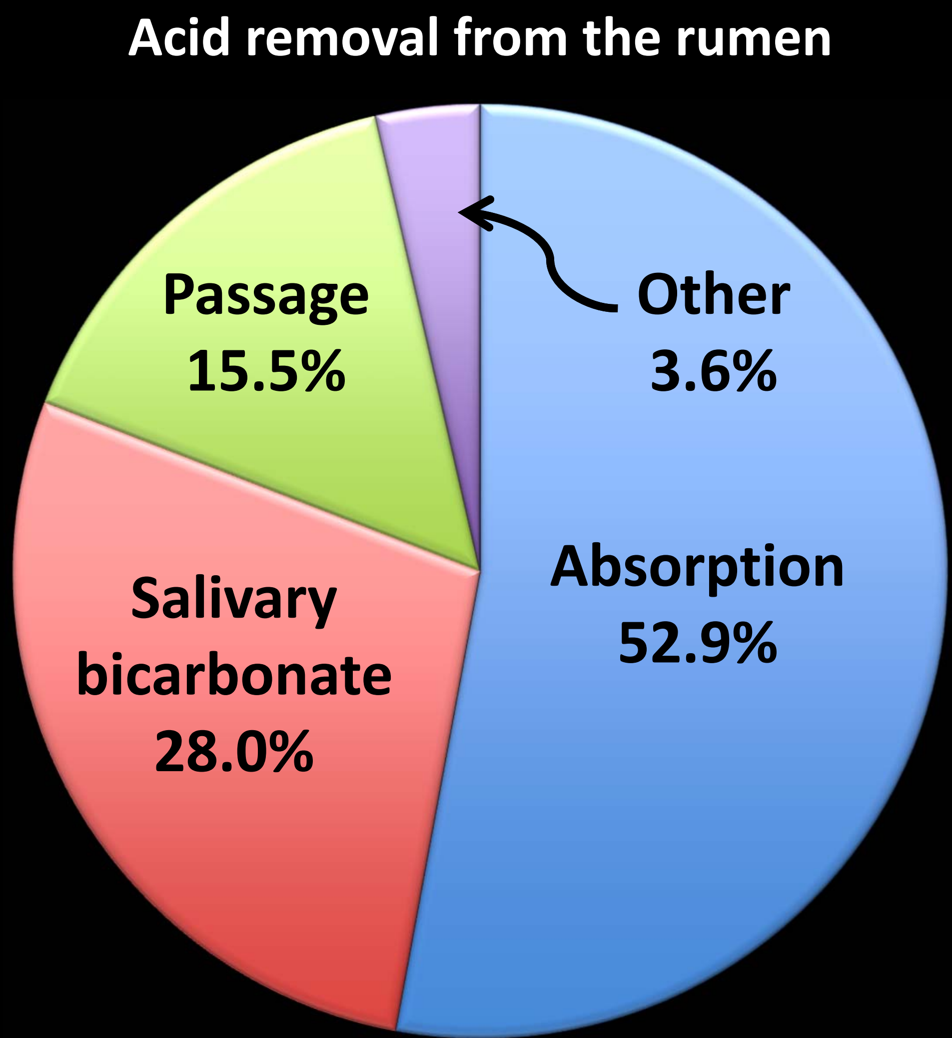
Transient low feed intake: a major risk factor for ruminal acidosis

Greg Penner, PhD
Associate Professor and Centennial Enhancement Chair in Ruminant Nutritional Physiology
University of Saskatchewan


Acid
Removal
Acid
Production

Removal of acid from the rumen



Allen, 1997

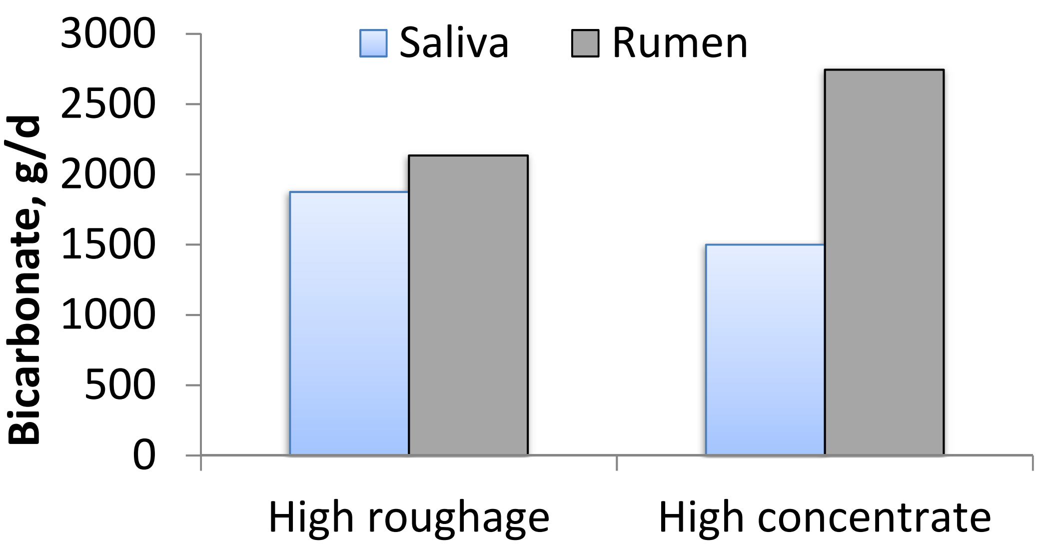
Where does most of the bicarbonate entering the rumen come from?

a) Saliva

b) Rumen tissue

c) Diet

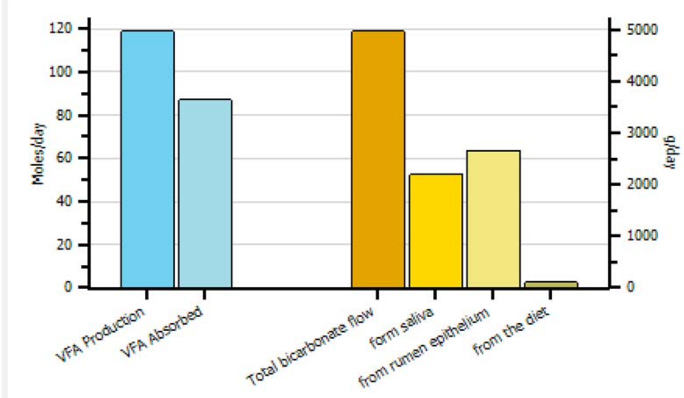
Contributions to ruminal bicarbonate



Dijkstra et al., 2012

Rumen pH NDS | Acidosis risks | Volatile Fatty Acids | Buffering

VFA Production	Moles/day	118.8	
VFA Absorbed	Moles/day	87.0	73.3%
Saliva production	Liters/day	294	
Total bicarbonate flow	g/day	4,968	
form saliva	g/day	2,198	44.2%
from rumen epithelium	g/day	2,654	53.4%
from the diet	g/day	116	2.3%



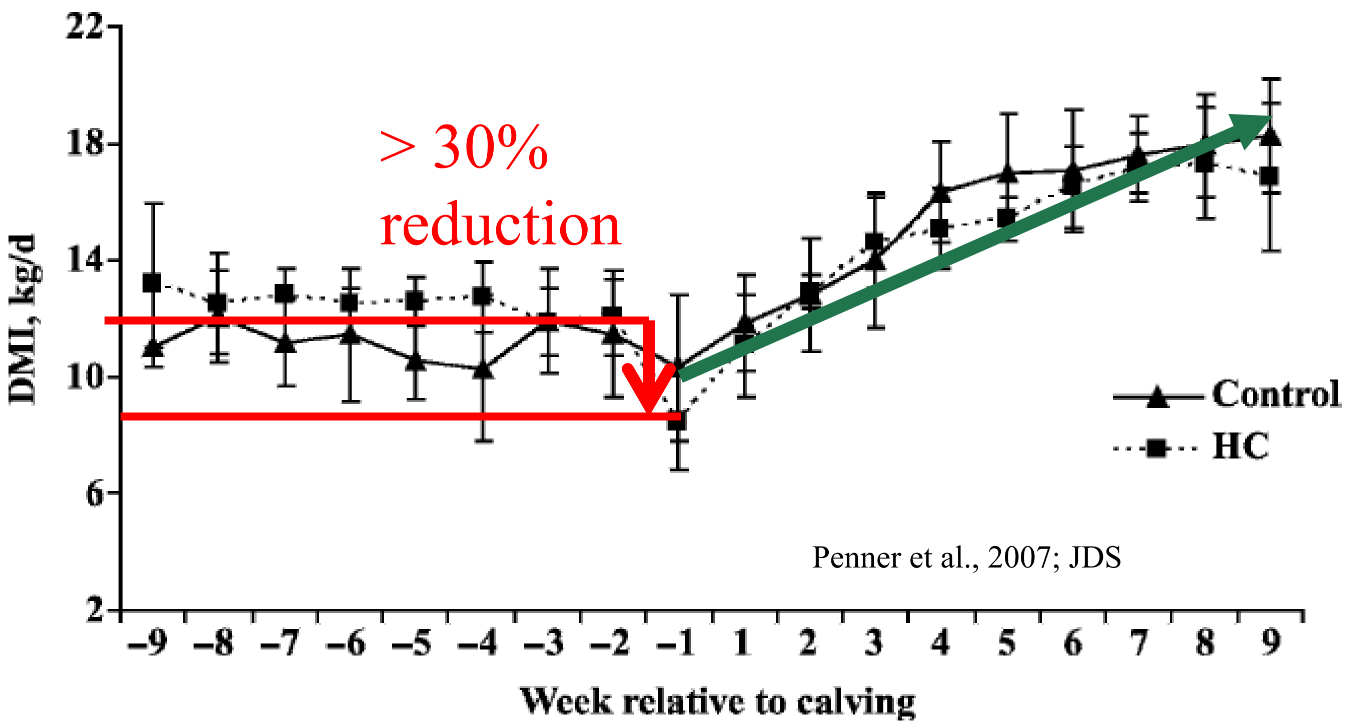
Selected functions of the gut

- **Absorptive and secretory**
  - Feed digestion and passage
  - **Regulates luminal pH**
  - **Nutrient absorption**
  - Urea recycling
- **Barrier**
  - **First arm of the immune response**
  - **Prevents pathogen and antigen translocation**
    - Intrinsic, extrinsic, immunological (Jutfelt, 2011)
- Communicative
  - Facilitates cross-talk between host and microbiota
  - Nutrient sensing and signaling

Voluntary feed withdrawal in transition dairy cattle

- Average depression in DMI = 33%
- 88% of reduction in last week before calving

Hayirli et al., 2002; JDS

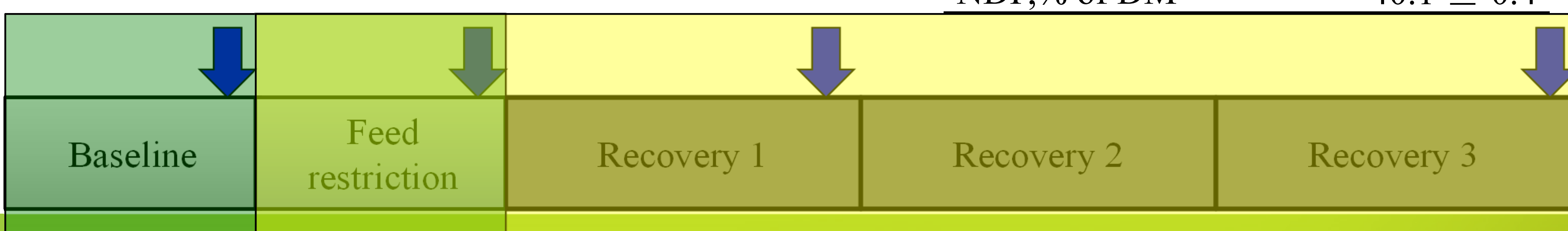


Health disorders and the impact on DMI

Health disorder	Initial effect[b] (kg DM)	Total effect[c] (kg DM)	*P* value[d]
Difficult calving	2.5	37.0	0.001
Very difficult calving	3.5	43.4	0.001
Twin calving	2.3	13.4	0.001
Retained placenta	0.8	10.4	0.001
Milk fever	14.7	38.2	0.001
Udder oedema	0.6	15.5	0.001
Puerperal metritis	5.1	46.8	0.001
Chronic metritis	2.6	18.2	0.001
Ketosis	7.5	71.9	0.001
1st recurrence	*11.3*	*64.9*	*0.001*
Teat injury	0.0	5.1	0.078
Systemic mastitis	6.7	30.2	0.001
1st recurrence	*0.6*	*48.4*	*0.001*
Local mastitis	1.6	1.6	0.024
1st recurrence	*1.2*	*11.4*	*0.001*
Diarrhoea	7.8	36.9	0.001
1st recurrence	*11.1*	*34.4*	*0.001*
Other digestive disorder	7.4	24.8	0.001
1st recurrence	*6.7*	*12.3*	*0.001*
Hock lesions	2.7	48.1	0.001
1st recurrence	*5.6*	*46.1*	*0.001*
Foot lesions	6.4	27.8	0.001

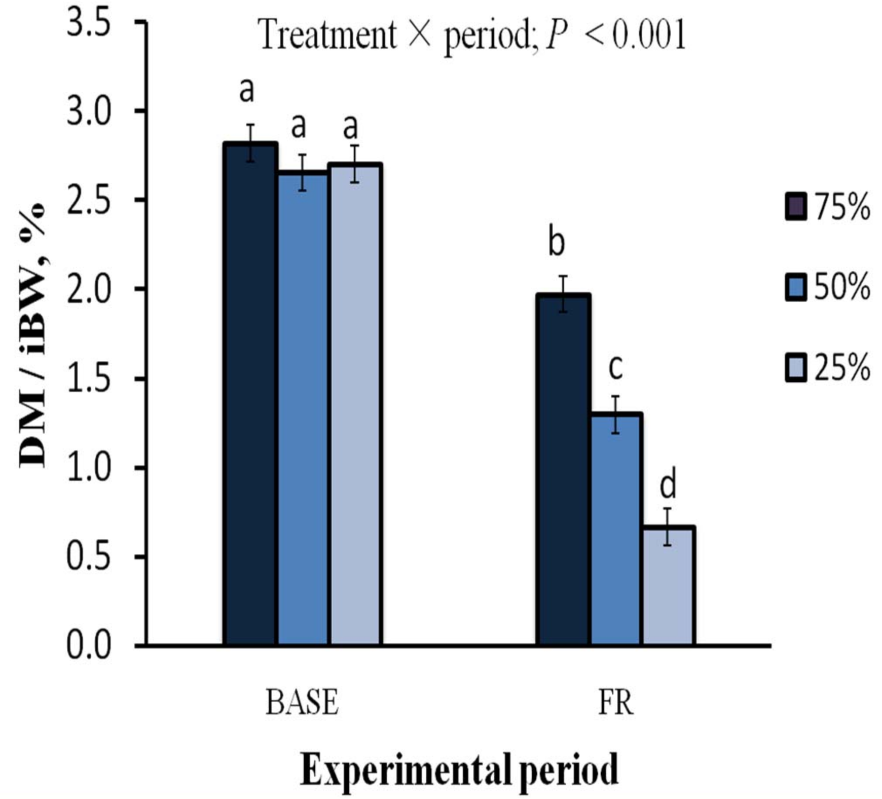
- 18 cannulated Angus heifers
  - 3 treatments
    - 75% of feed ad libitum
    - 50% of feed ad libitum
    - 25% of feed ad libitum
- 5 periods

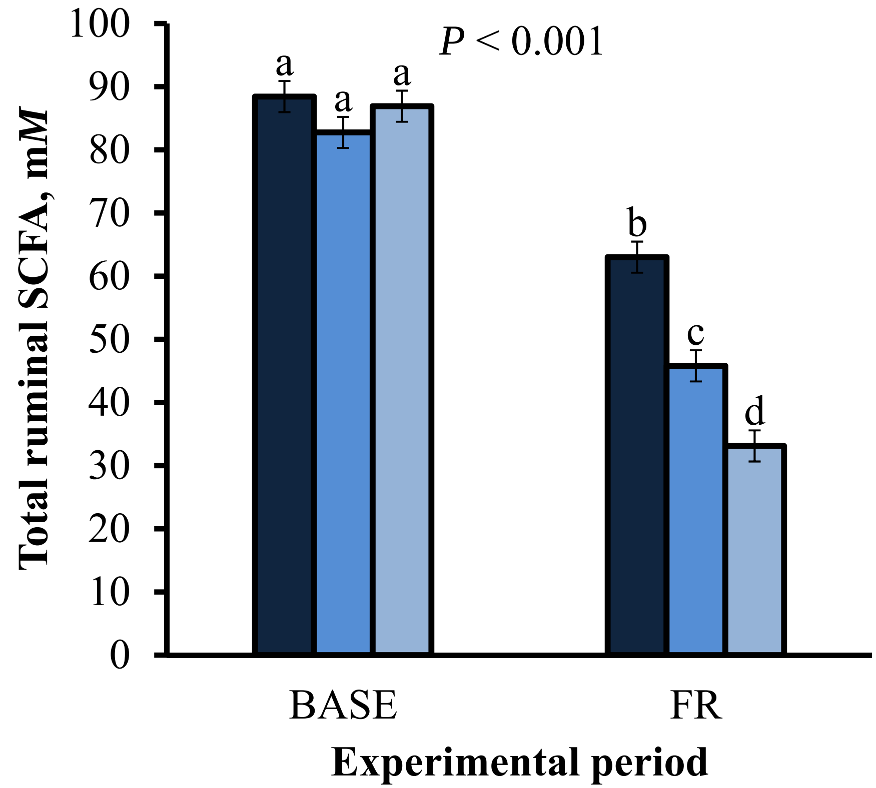
Ingredient , % of DM	
Barley silage	30
Grass-Alfalfa hay	30
Barley grain (rolled)	32
Pellet	8
Nutrient composition	
DM,%	65.8 ± 1.9
OM,% of DM	92.3 ± 1.2
CP,% of DM	11.2 ± 0.4
Fat, % of DM	1.8 ± 0.0
NDF,% of DM	40.1 ± 0.4



Zhang et al., 2013; JAS

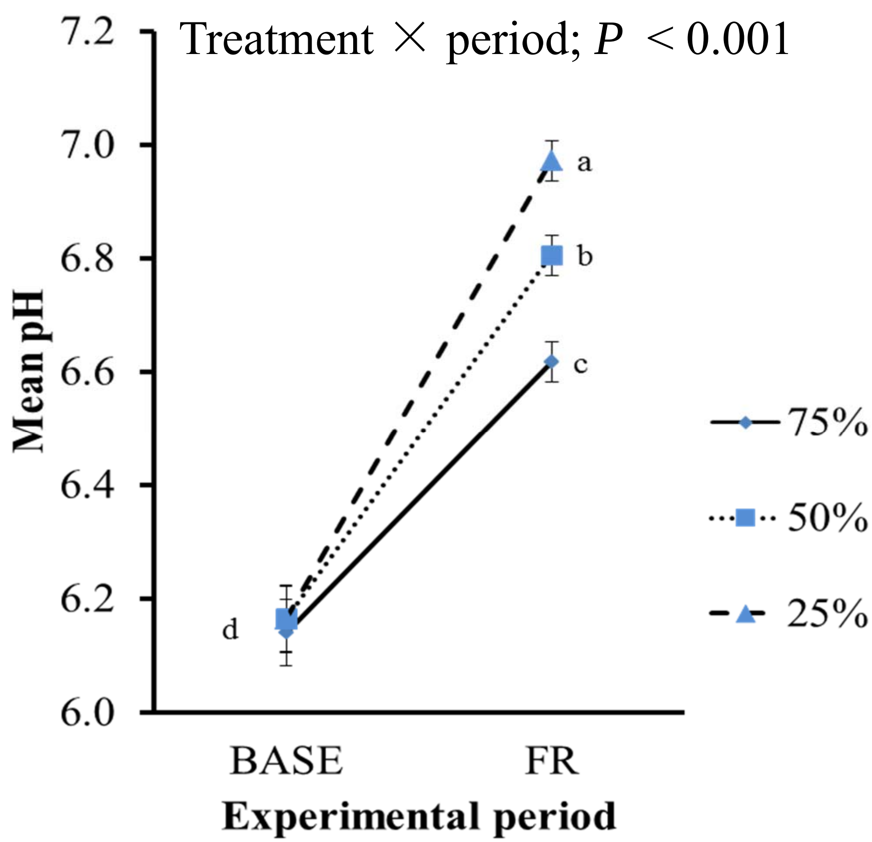
Low feed intake decreases ruminal SCFA concentration

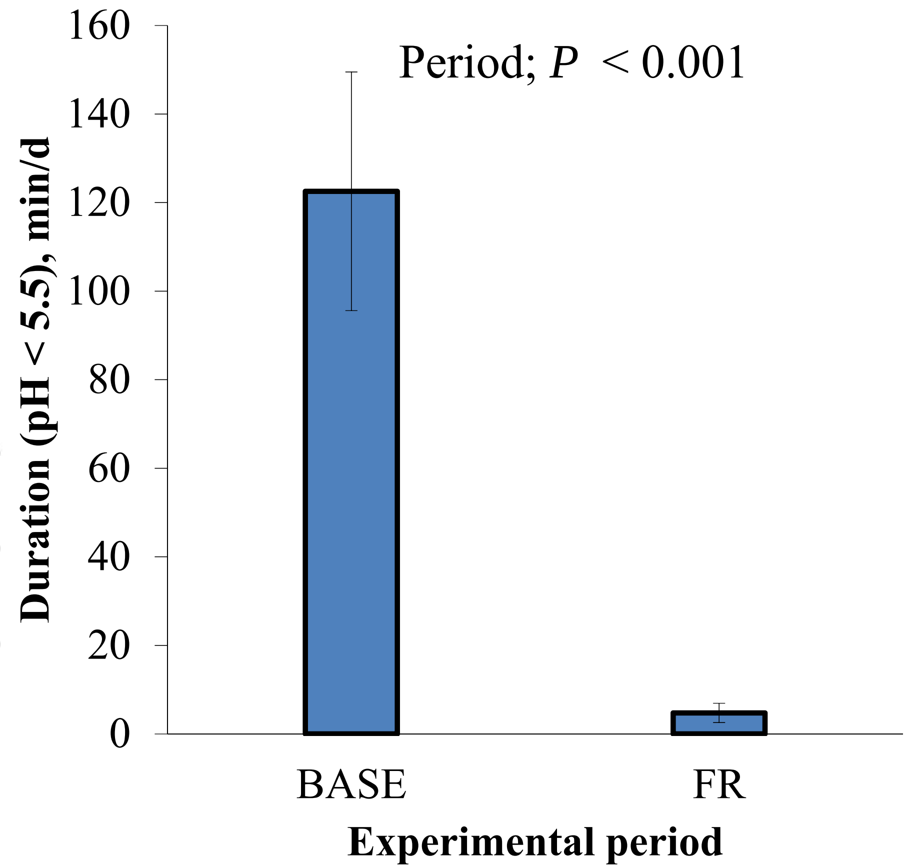




Zhang et al., 2013

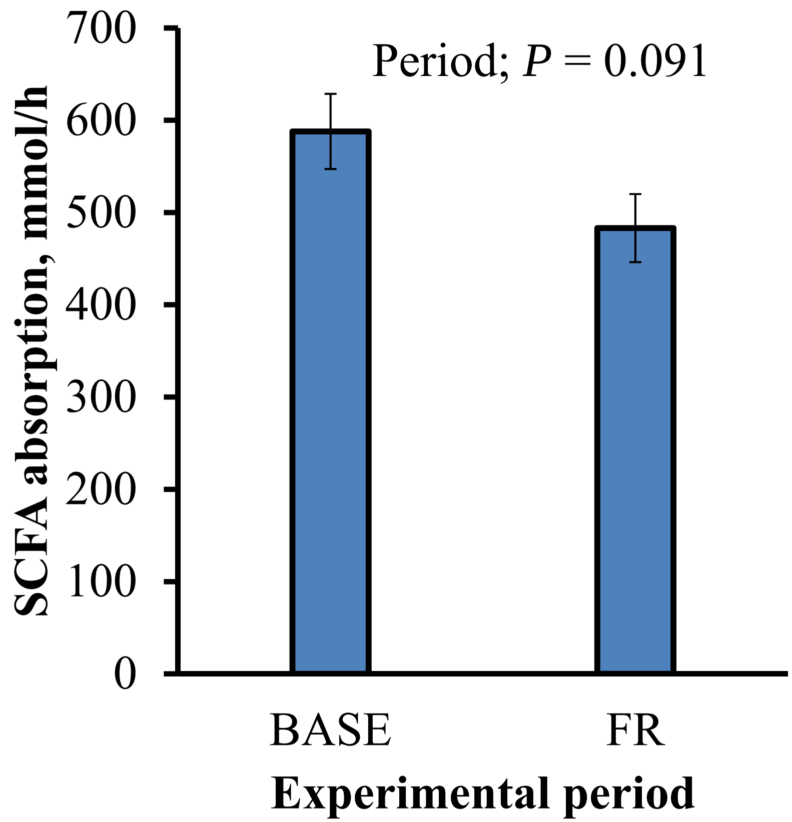
Ruminal pH increases with low feed intake

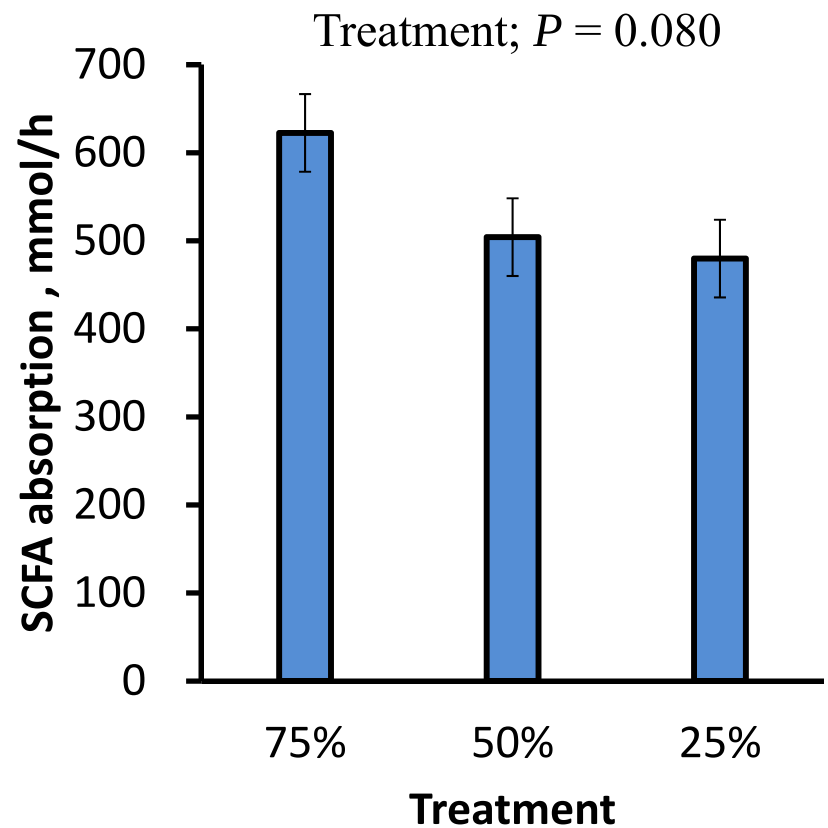




Zhang et al., 2013

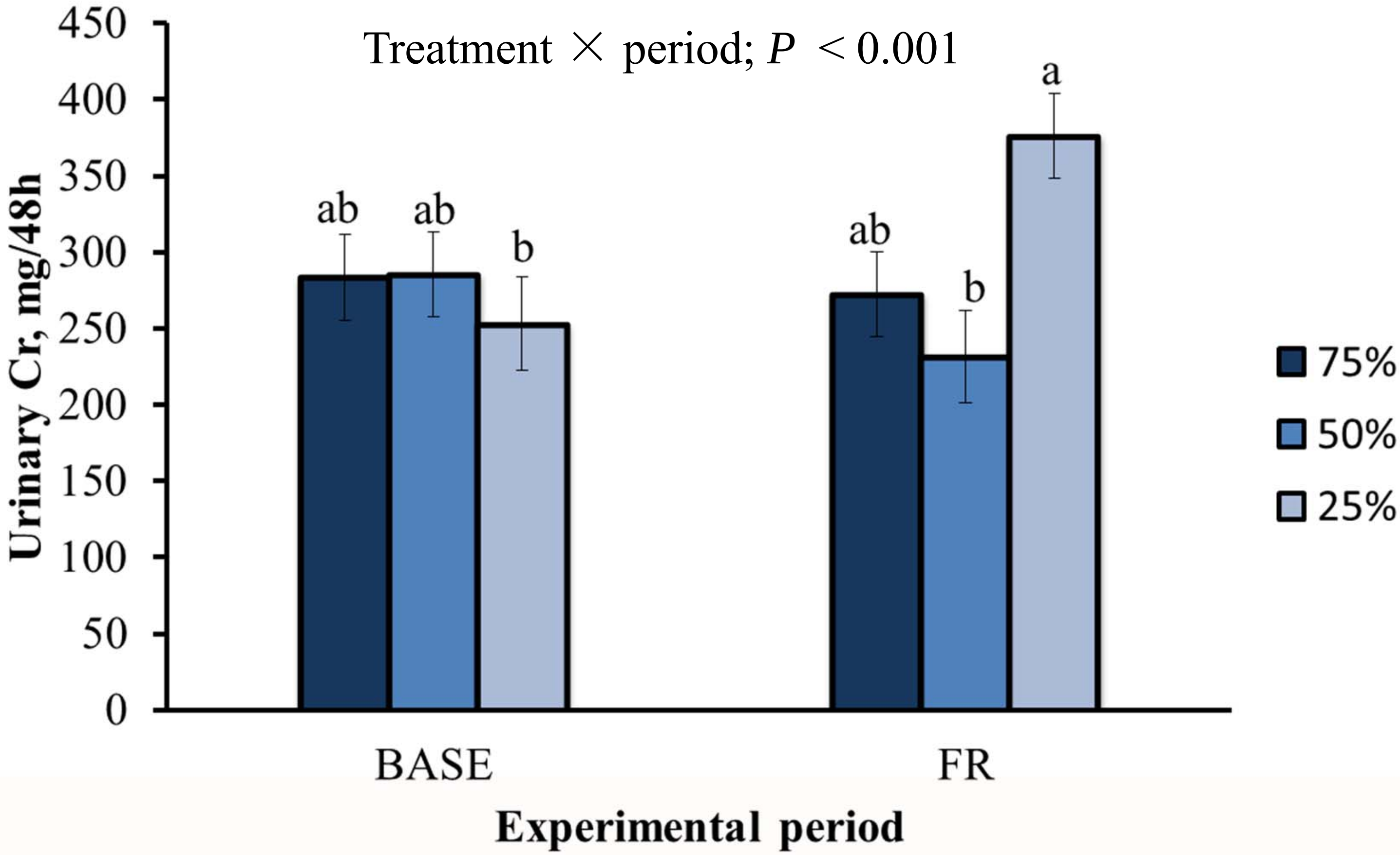
SCFA absorption is reduced with low feed intake





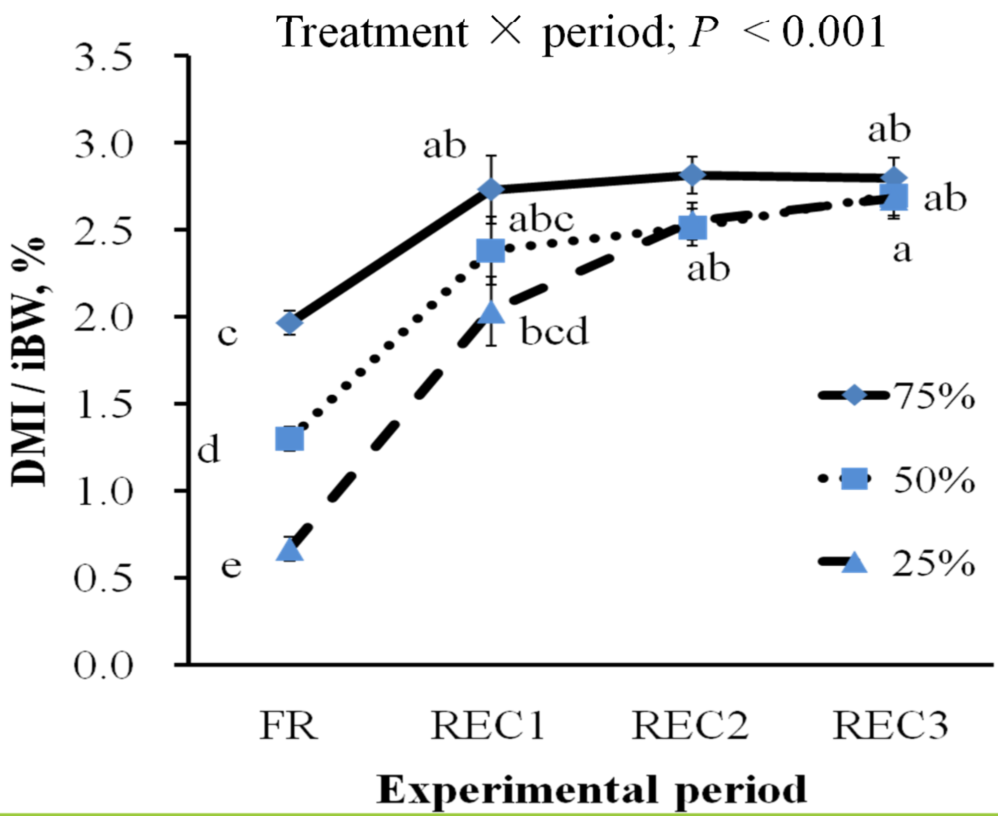
Zhang et al., 2013

Barrier function of the gut is reduced with severe low feed intake (d 3 and 4)



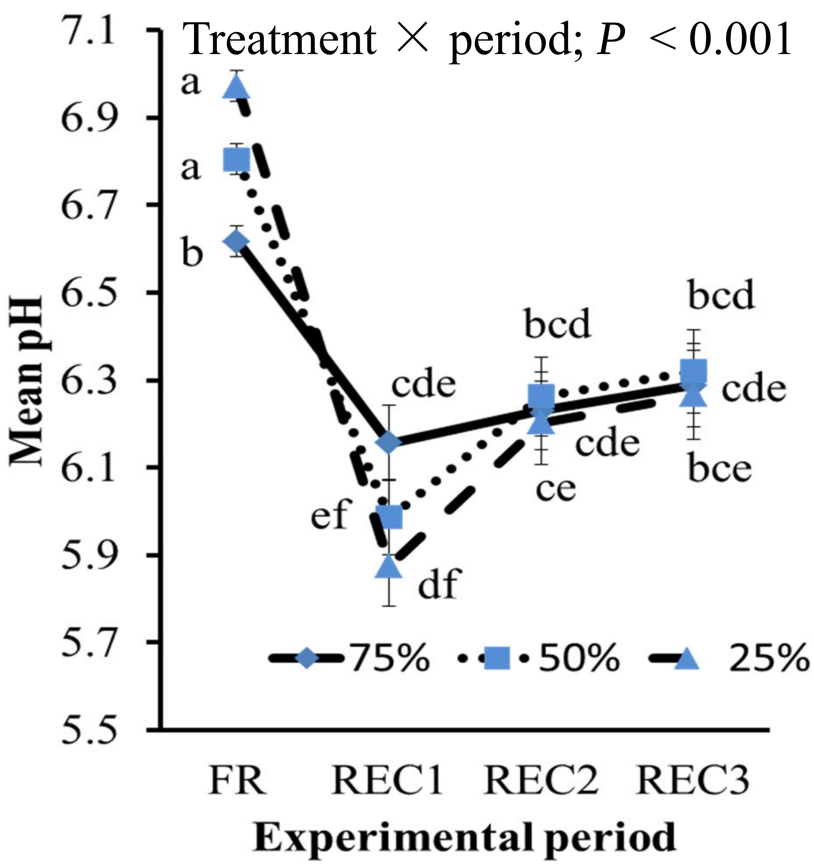
Zhang et al., 2013

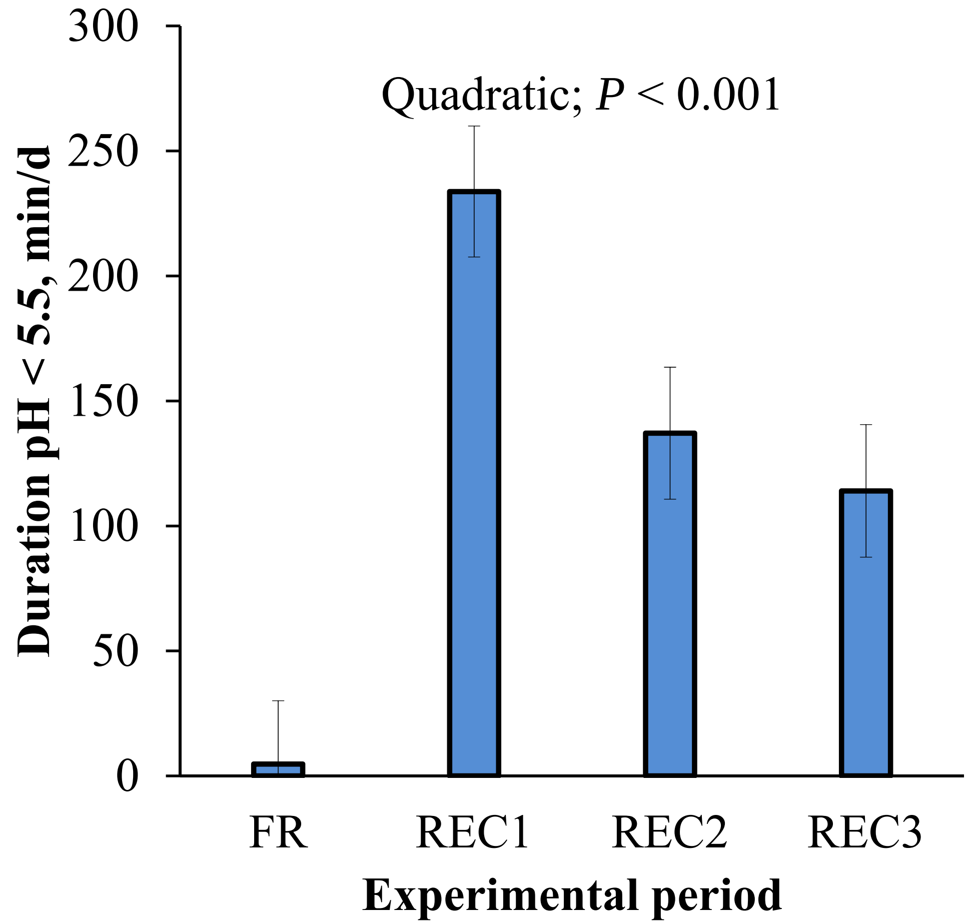
Severity of low feed intake impacts the recovery response



Zhang et al., 2013

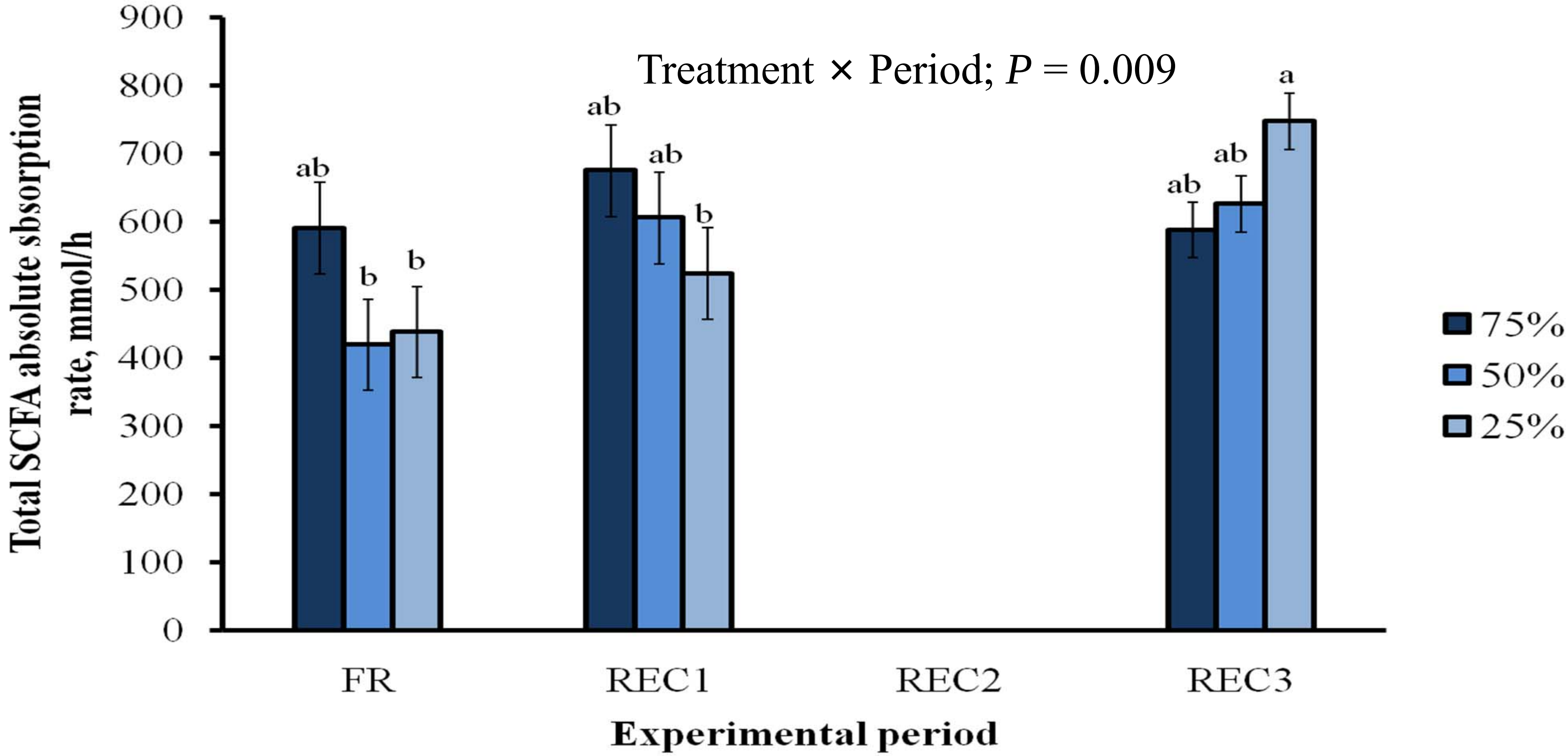
Gradual increases in DMI after low feed intake induces ruminal acidosis – even with a 'safe' diet





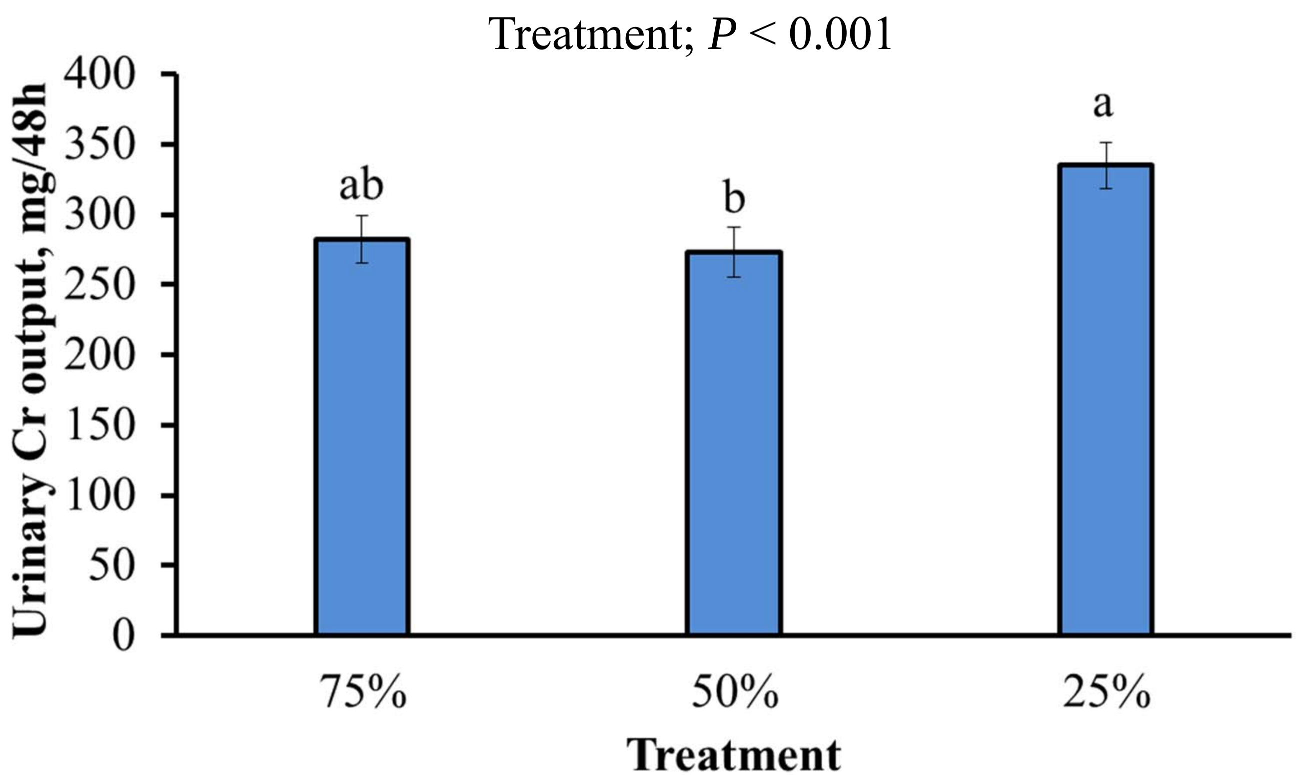
Zhang et al., 2013; JAS

Delayed response for recovery of SCFA absorption with low feed intake



Zhang et al., 2013; JAS

Total tract barrier function was still compromised 3 wk after severe low feed intake



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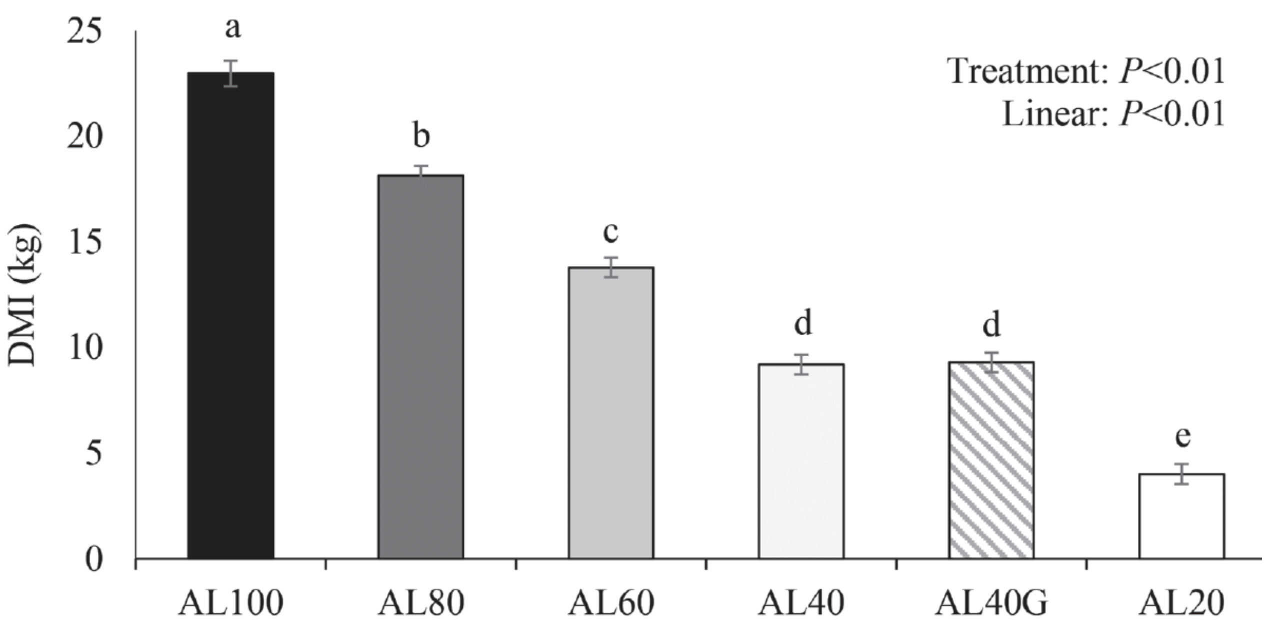
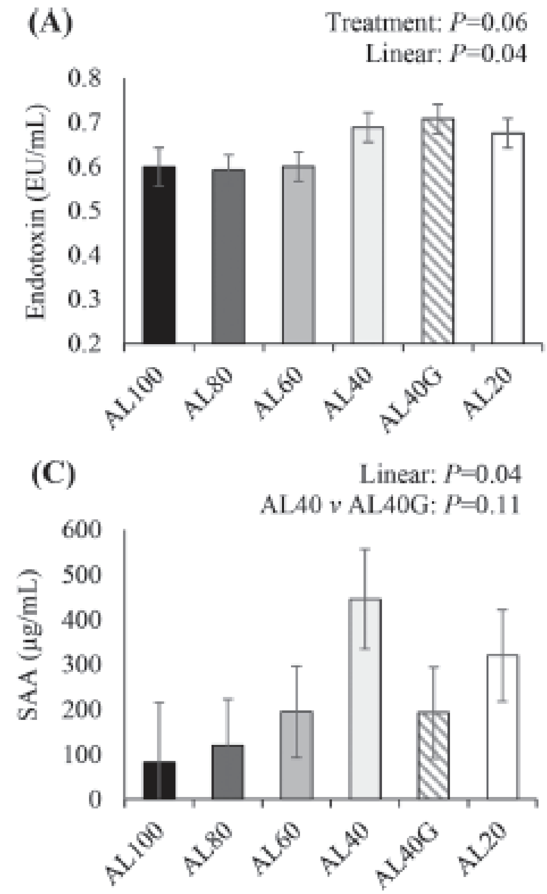
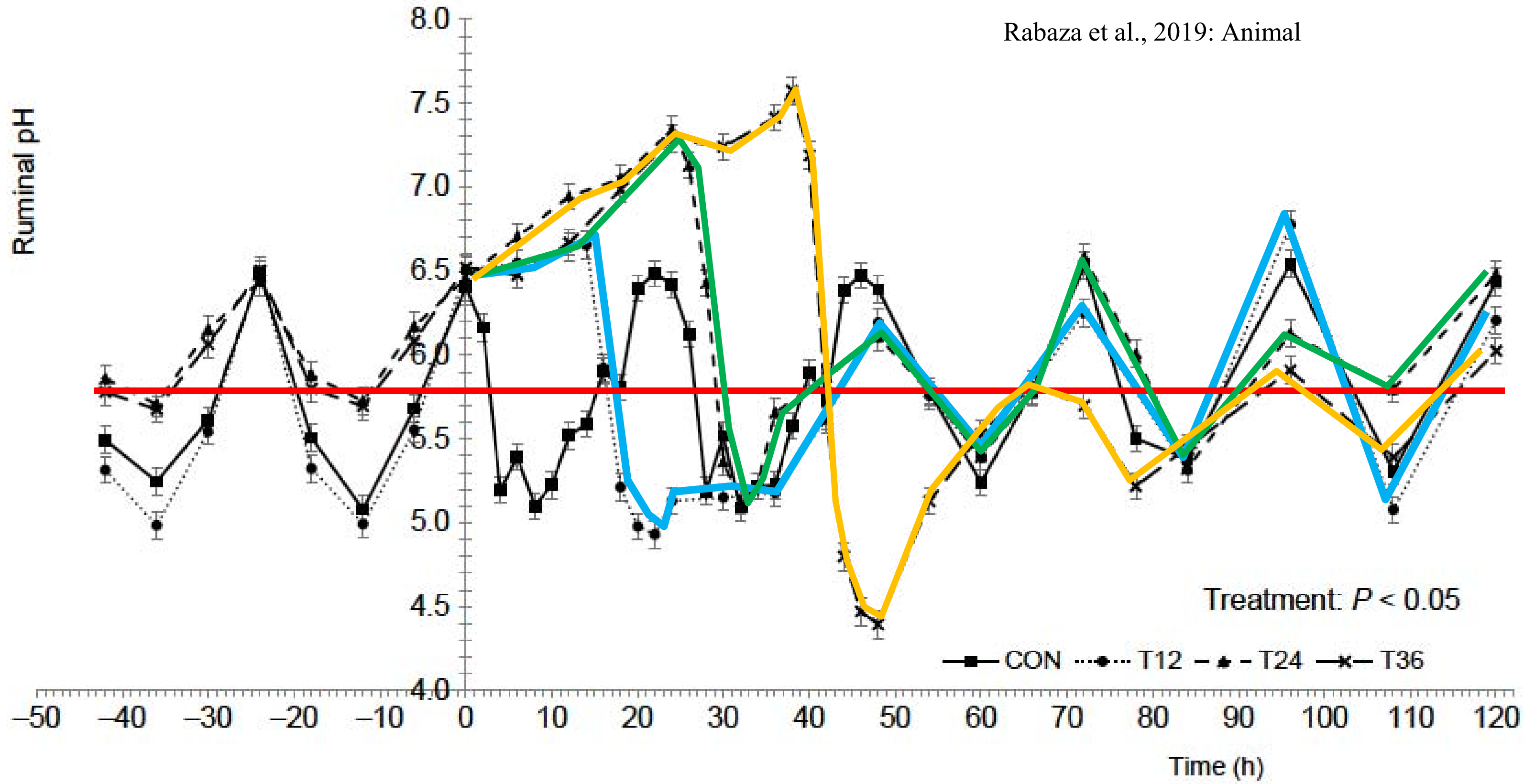
Intestinal effects with low feed intake





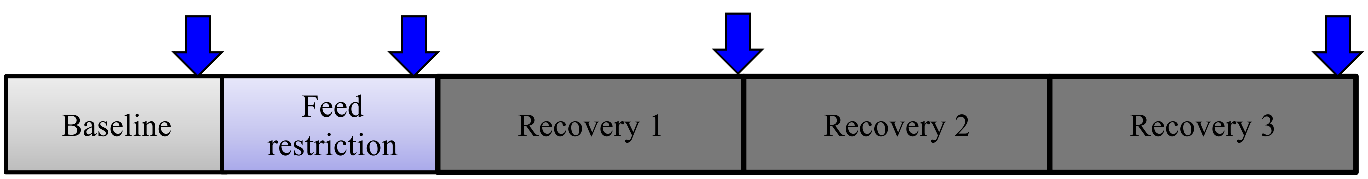
Kvidera et al., 2017; JDS

Short-term feed inaccessibility



Can we mitigate the response by changing the forage-to-concentrate ratio?

- Animals and Experimental Design
- 20 cannulated Angus heifers
  - 4 treatments
    - High forage/High forage
    - High forage/Moderate forage
    - Moderate forage/High forage
    - Moderate forage/Moderate forage



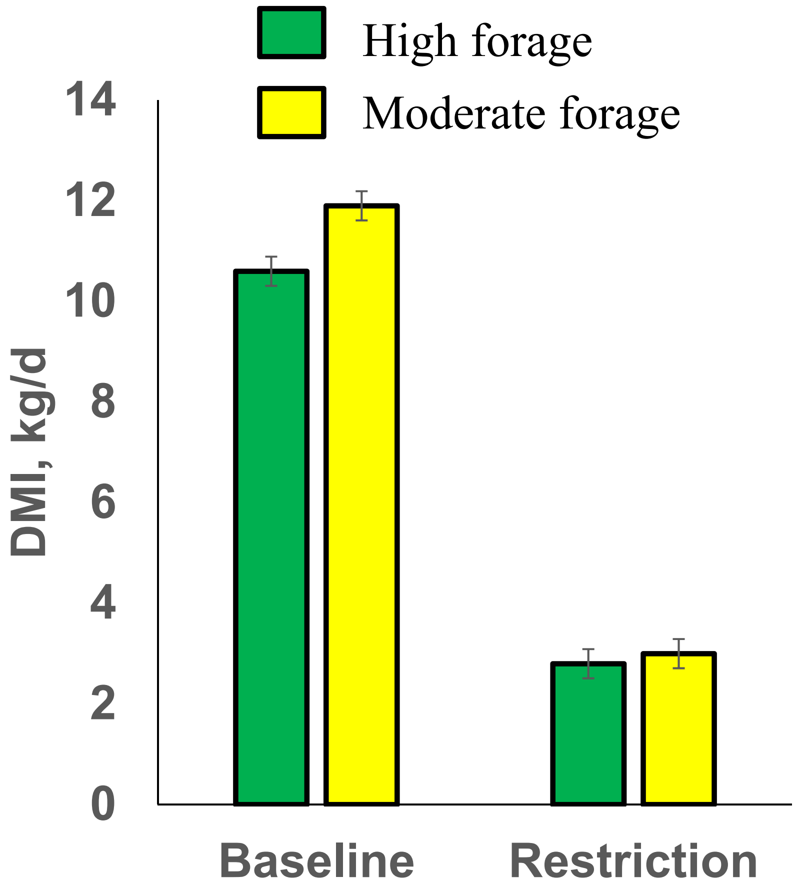
Albornoz et al., 2013

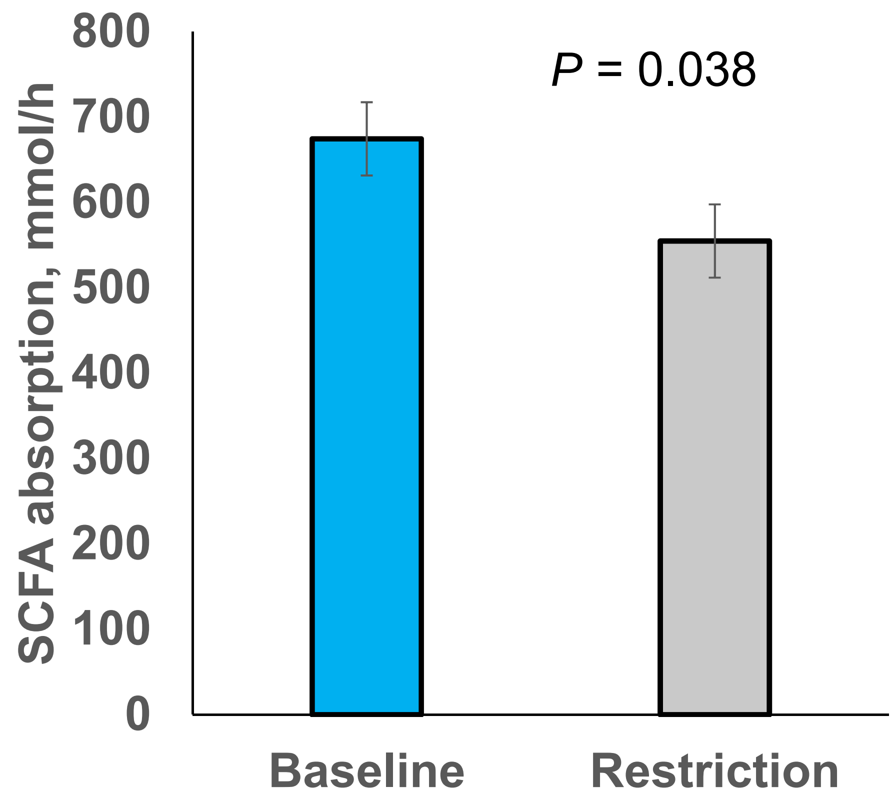
Role of forage in recovery after low feed intake

	Treatment[1]	
	HF	MF
Ingredient, % of DM		
Grass hay	46	30
Barley silage	46	30
Barley grain	0	32
Pellet[2]	8	8
Chemical composition,[3] g/kg ± SD		
DM	584 ± 69.7	557 ± 47.3
OM	907 ± 2.3	925 ± 1.9
CP	107 ± 5.7	111 ± 5.4
Crude fat	21 ± 0.4	19 ± 0.7
NDF	527 ± 4.6	405 ± 1.4
ADF	291 ± 5.4	209 ± 4.5
NEm,[4] MJ/kg	4.61	6.09
NEg,[4] MJ/kg	2.03	2.21

Albornoz et al., 2013; JAS

Low feed intake decreases SCFA absorption

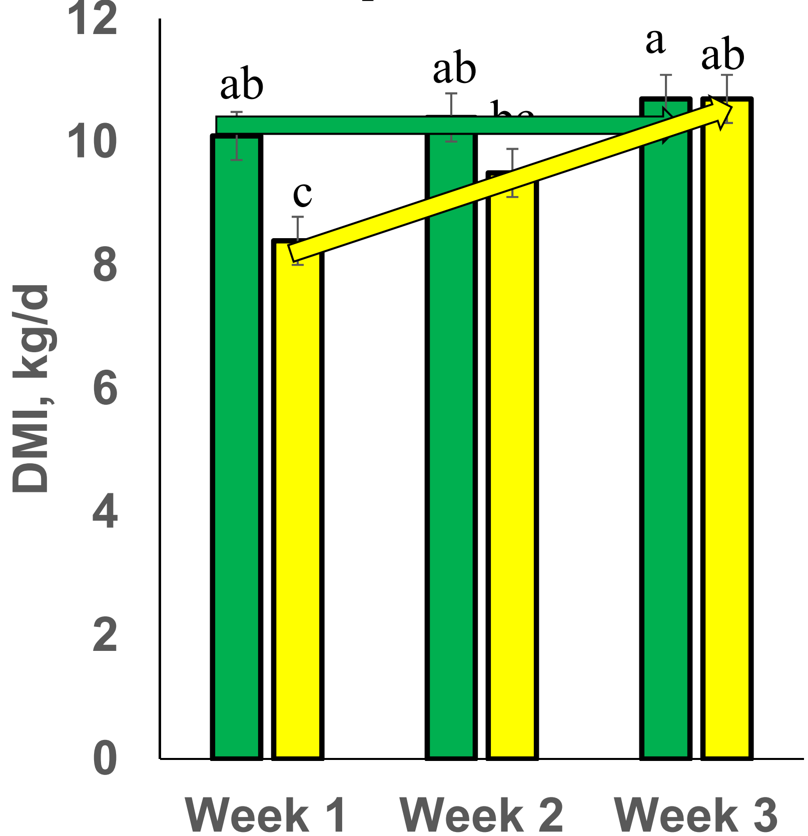




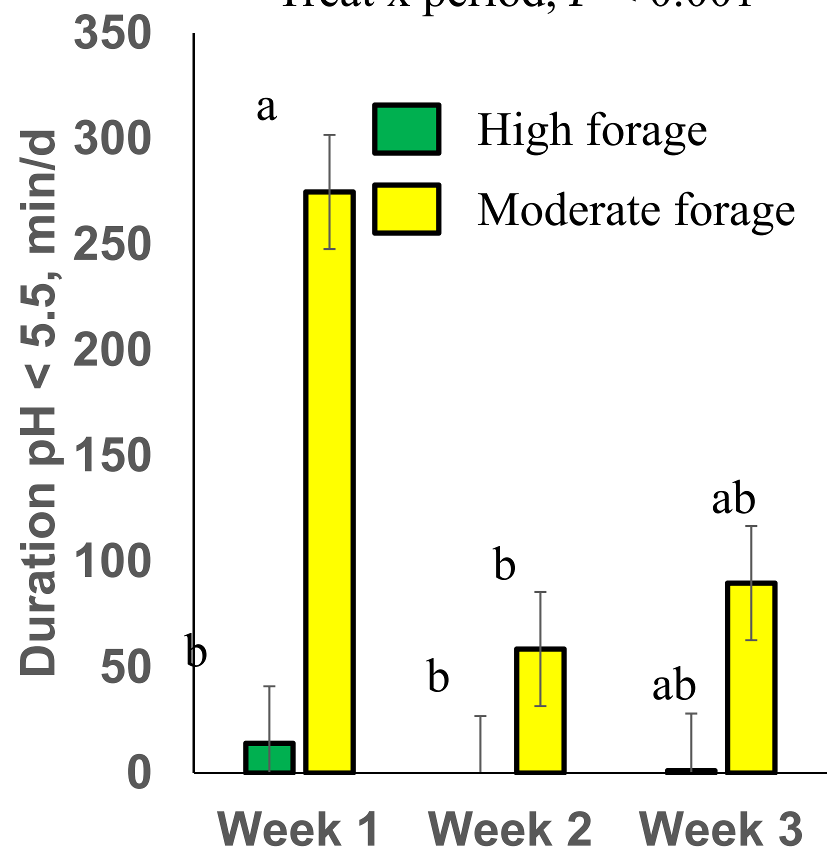
Albornoz et al., 2013; JAS

Feeding a high forage diet improves recovery

Treat x period, $P = 0.033$



Treat x period, $P < 0.001$



Albornoz et al., 2013; JAS

Conclusions

- Low feed intake is an under-appreciated challenge
- GIT responds to low feed intake
  - Nutrient absorption – reduced
  - Risk for ruminal acidosis – increases!
  - Barrier function of the gut – reduced
  - Increased risk for inflammation
- Little is known regarding factors that promote recovery

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Questions

ALMA
Alberta Livestock and Meat Agency Ltd.

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