How does dairy cow behavior affect rumen health?

Konferencja 2024
Jak ograniczać ryzyko kwasicy żwacza u krów mlecznych?
March 20, 2024

UNIVERSITY of GUELPH
DAIRY at GUELPH
CANADA'S DAIRY UNIVERSITY

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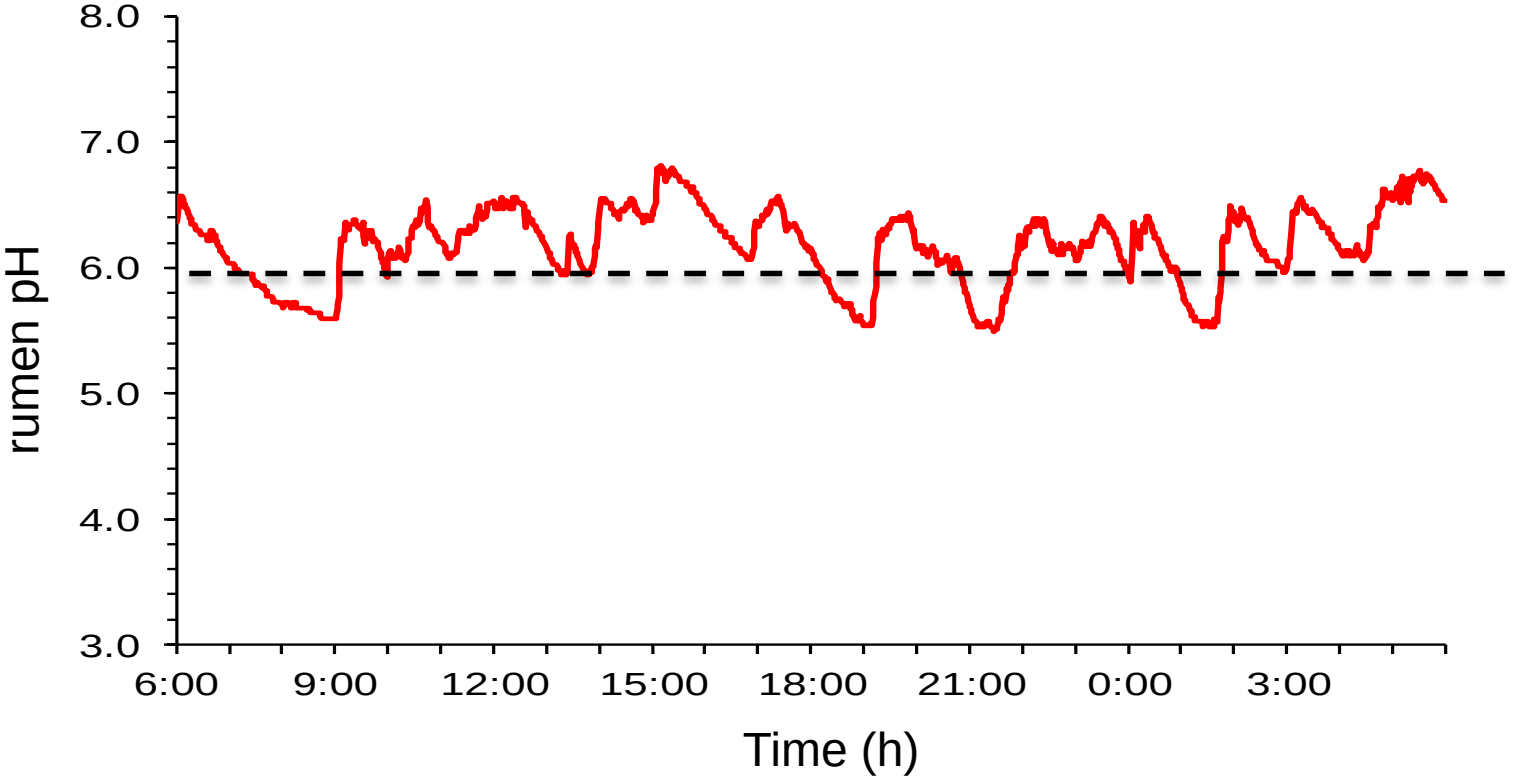
Linking eating behavior to rumen health…

- How does eating behavior influence rumen function and health?
- How does rumen health affect eating behavior?
- How can we modify eating behavior and rumen health through nutrition and management?

How does eating behavior influence rumen function and health?

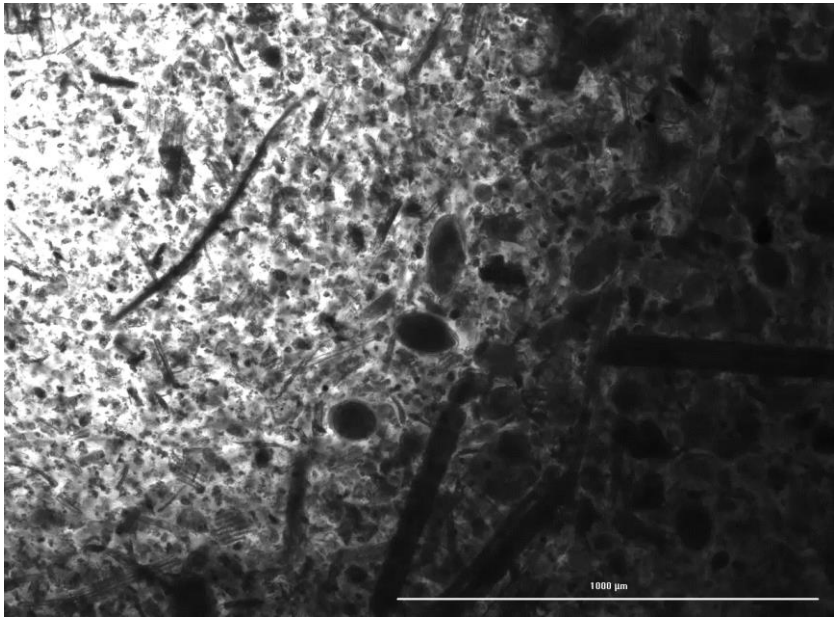
Feed consumption patterns relate to rumen fermentation…



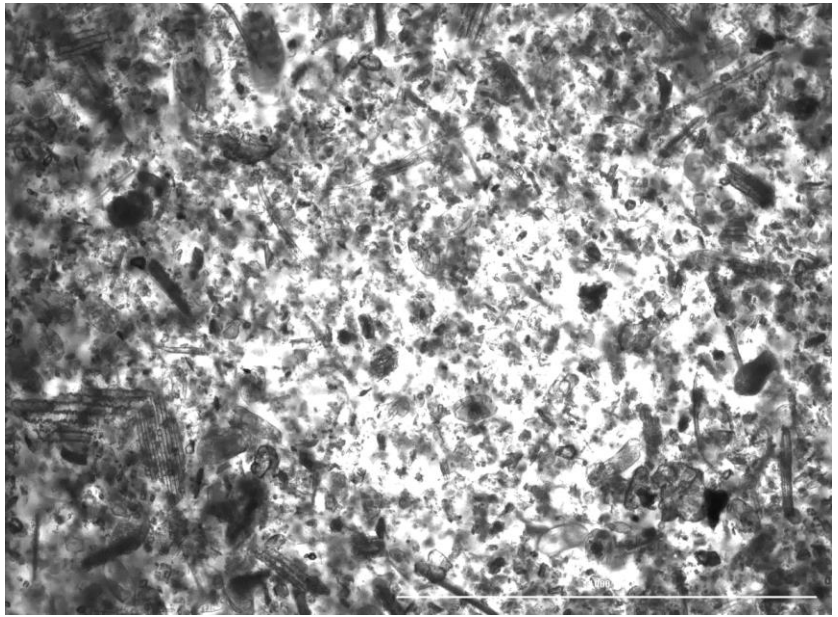
Data from Dohme et al. 2008 J. Dairy Sci. 91:3554-3567

What happens in the rumen when pH drops?

Rumen bacteria are negatively affected

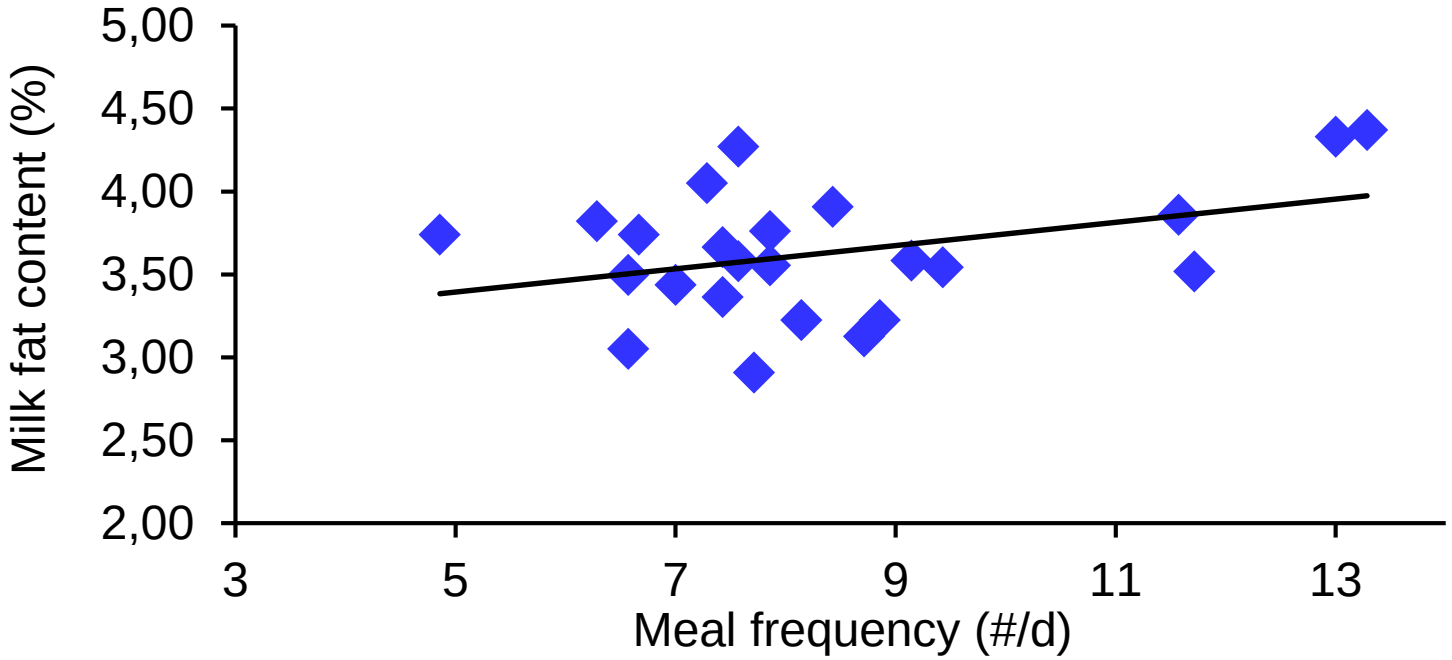


Low rumen fluid pH (5.5)



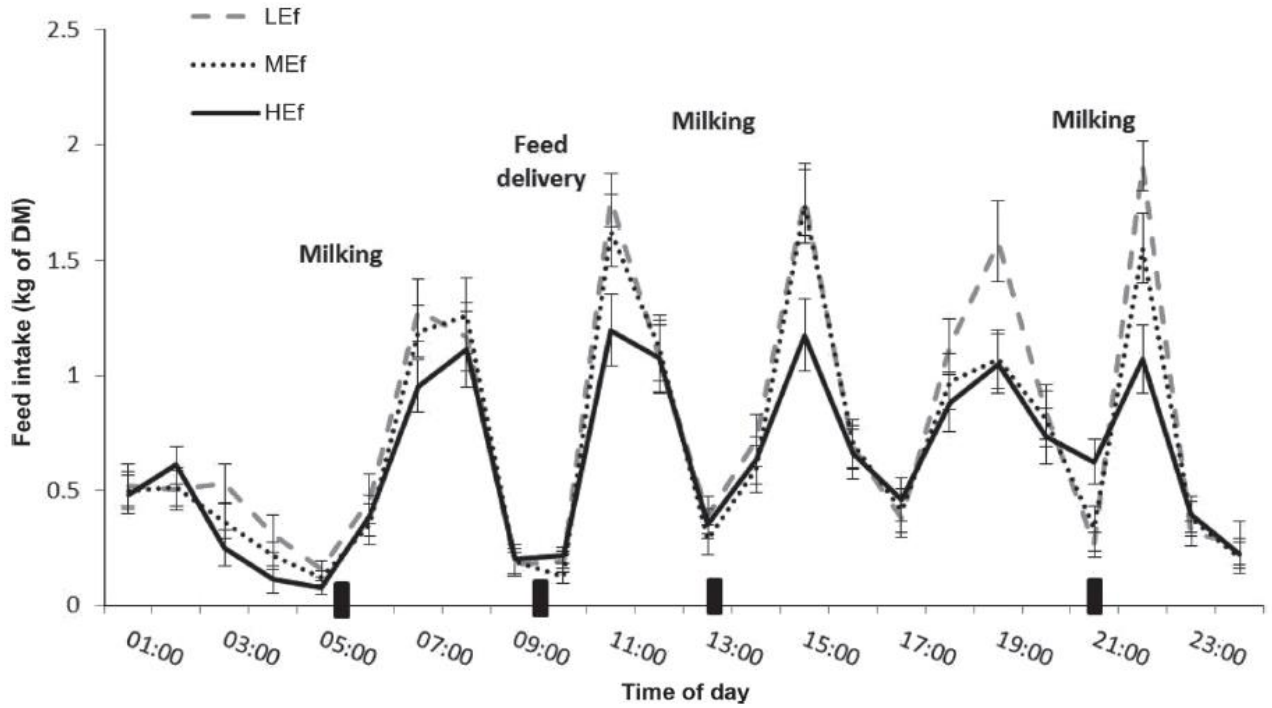
High rumen fluid pH (7.5)

Greater meal frequency = greater milk fat %



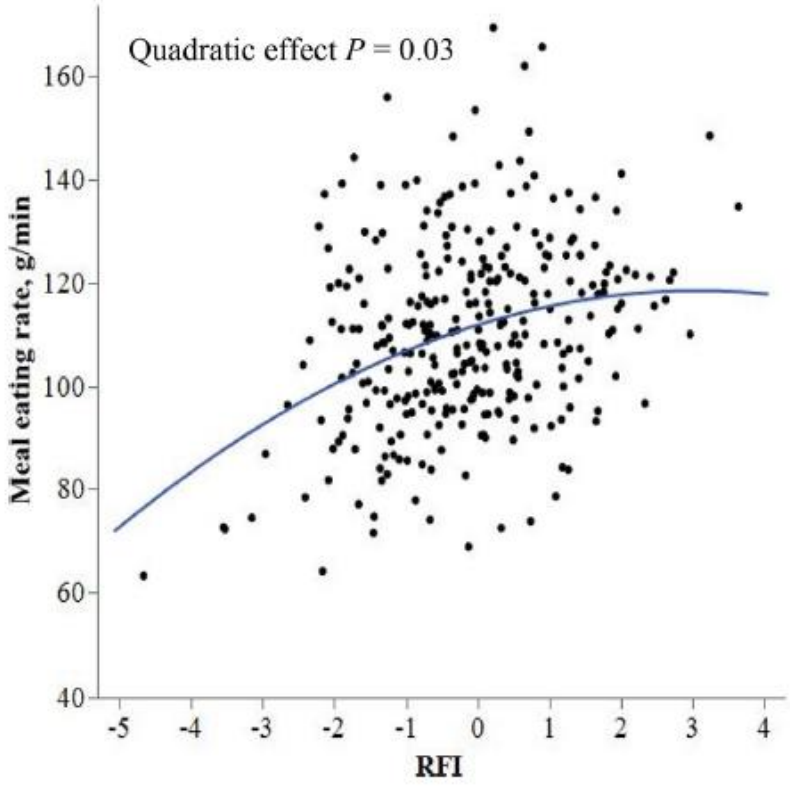
Data from DeVries and Chevaux. 2014. J. Dairy Sci. 97:6499-6510

Highly efficient cows consume smaller meals and eat slower!



Data from Ben Meir et al. 2018. J. Dairy Sci. 101:10973–10984

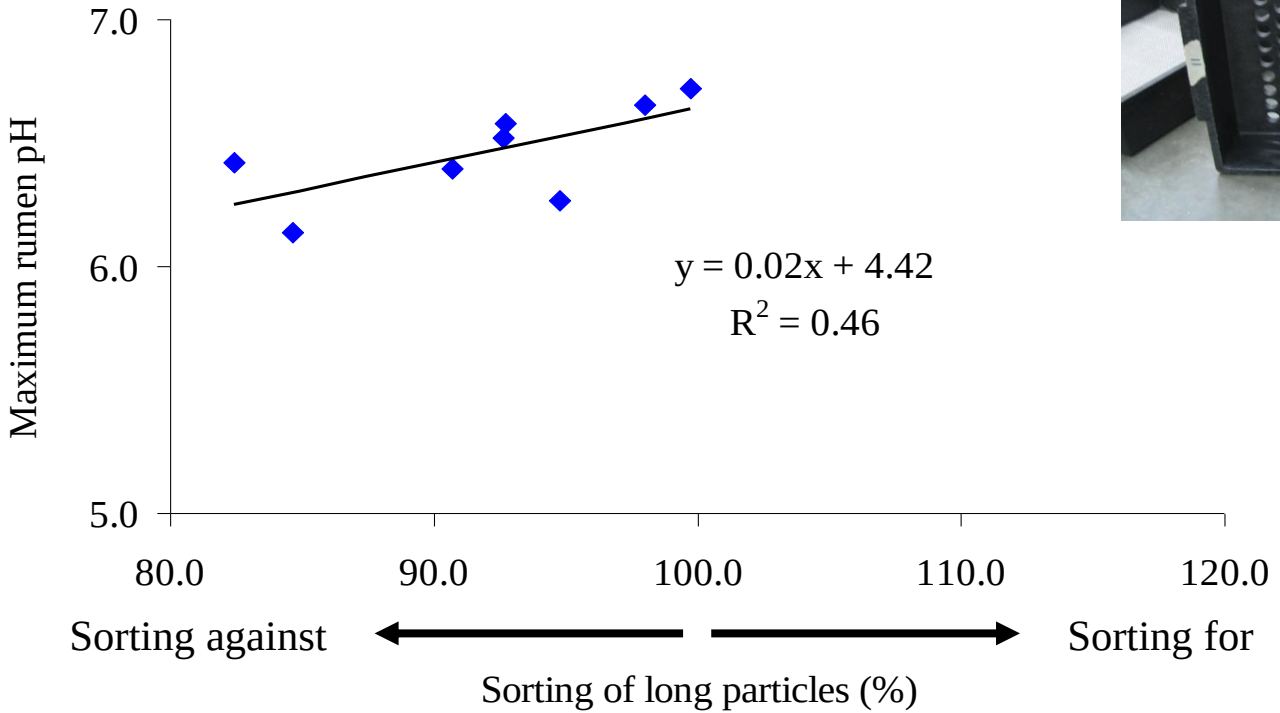
Highly efficient cows have a slower eating rate!



Data from Brown et al. 2022. J. Dairy Sci. 105:8130-8142

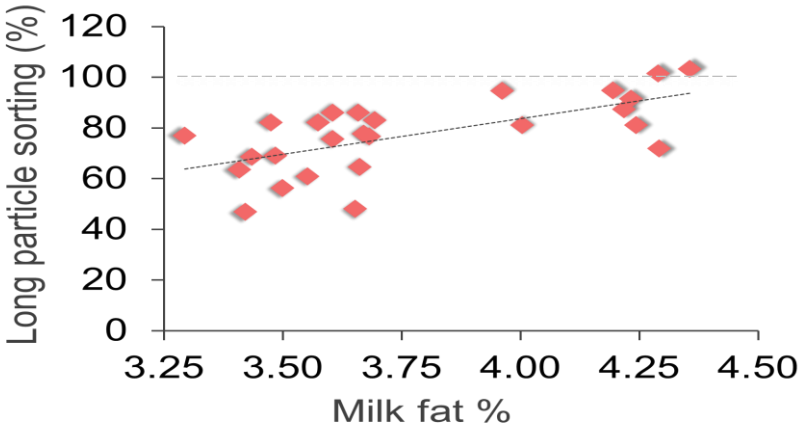
What the cow actually consumes from her diet also may impact what happens in the rumen…

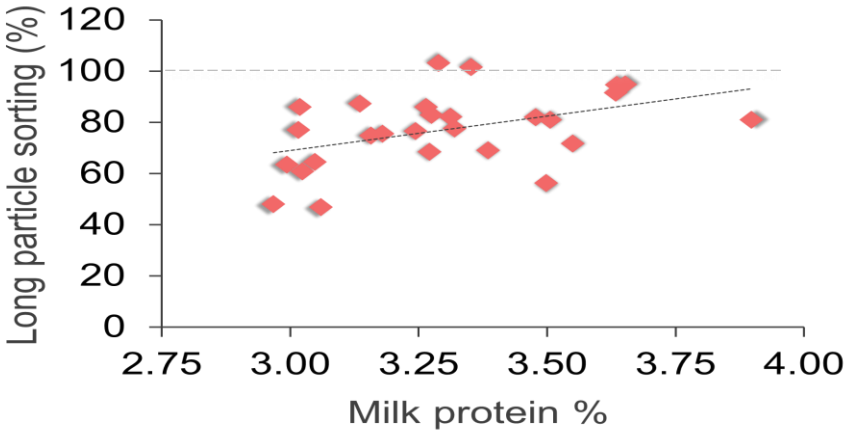
More sorting against long particles = lower rumen pH



DeVries et al. 2008 J. Dairy Sci. 91:3958-3967

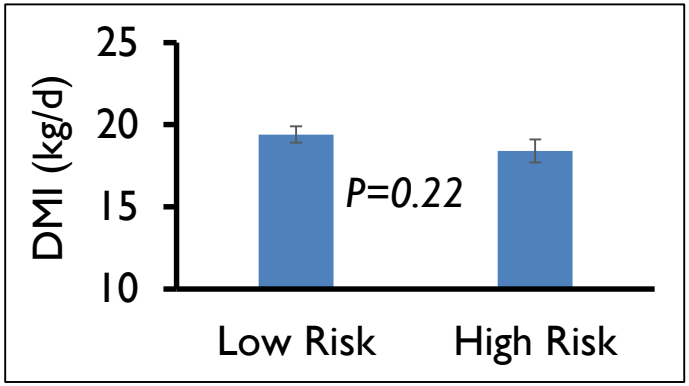
More sorting = lower milk component content

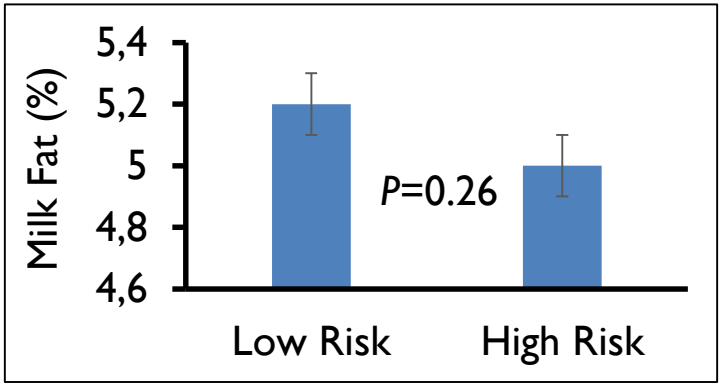


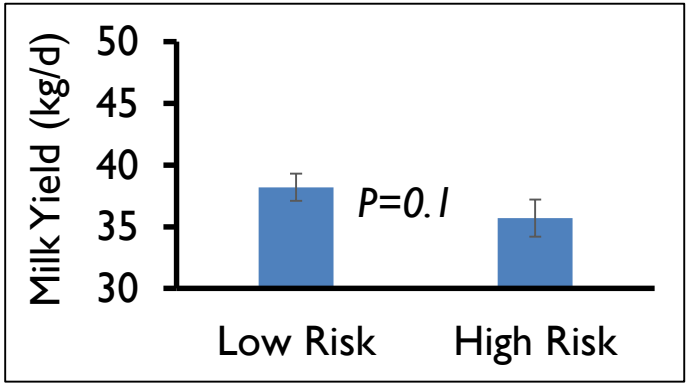


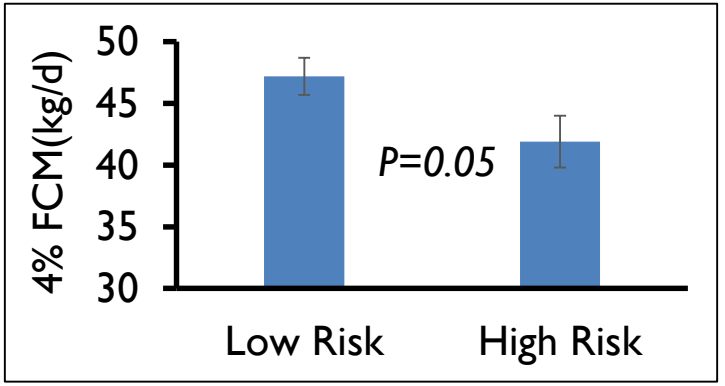
Miller-Cushon and DeVries. 2017. J. Dairy Sci. 100:2213-2218.

Production differences in early lactation cows based on acidosis risk…as influenced by feed sorting!



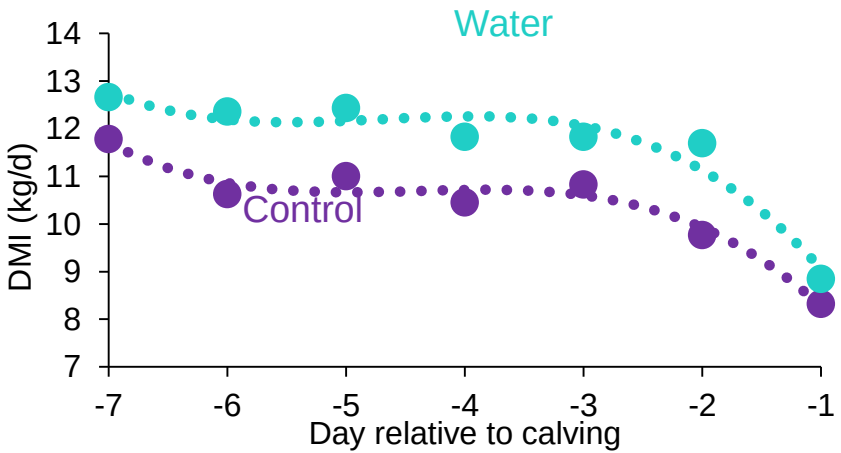


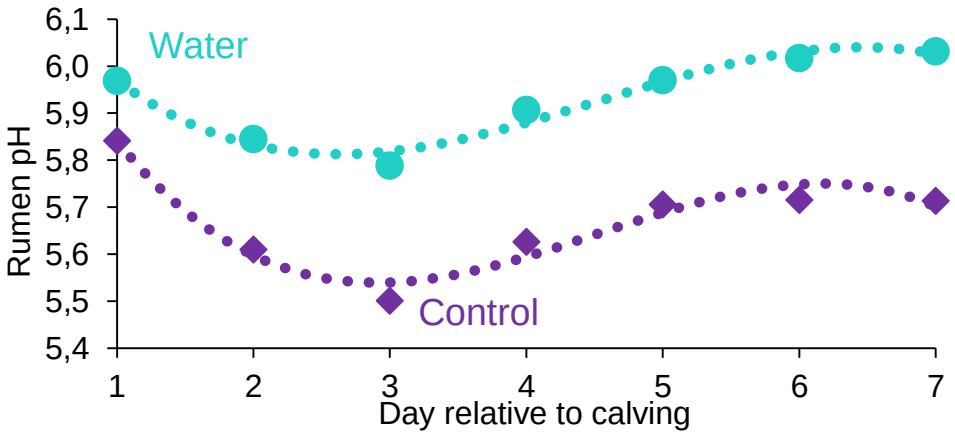




Coon et al. 2019. J. Dairy Sci. 102:652-659

More stable intake (amount and composition) prior to calving = more stable rumen environment post-calving





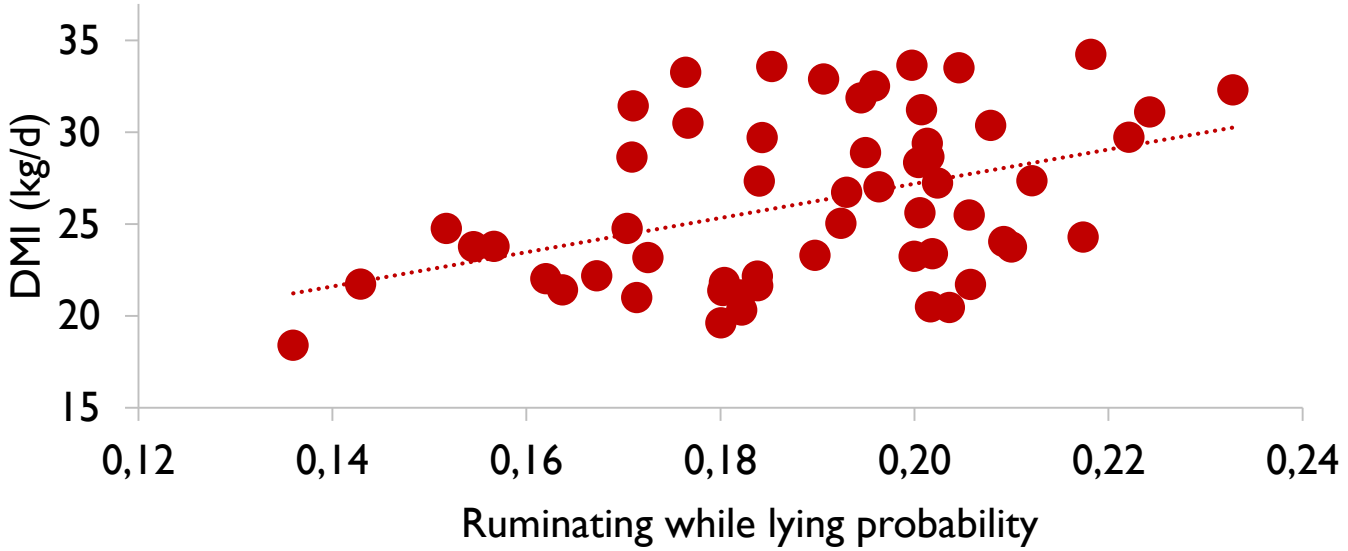
Havekes et al. 2020. J. Dairy Sci.103:1500-1515

What the cow does with her feed after she has eaten has an impact on the rumen environment…

- Rumination keeps the rumen working and healthy!
  - Reduce size of feed particles, increase surface area
  - Buffer the rumen

Where cows ruminate may have an effect on rumen performance…influencing intake and production

- Cows need time (and space) to ruminate!



McWilliams et al. 2022. JDS Communications. 3:66-71

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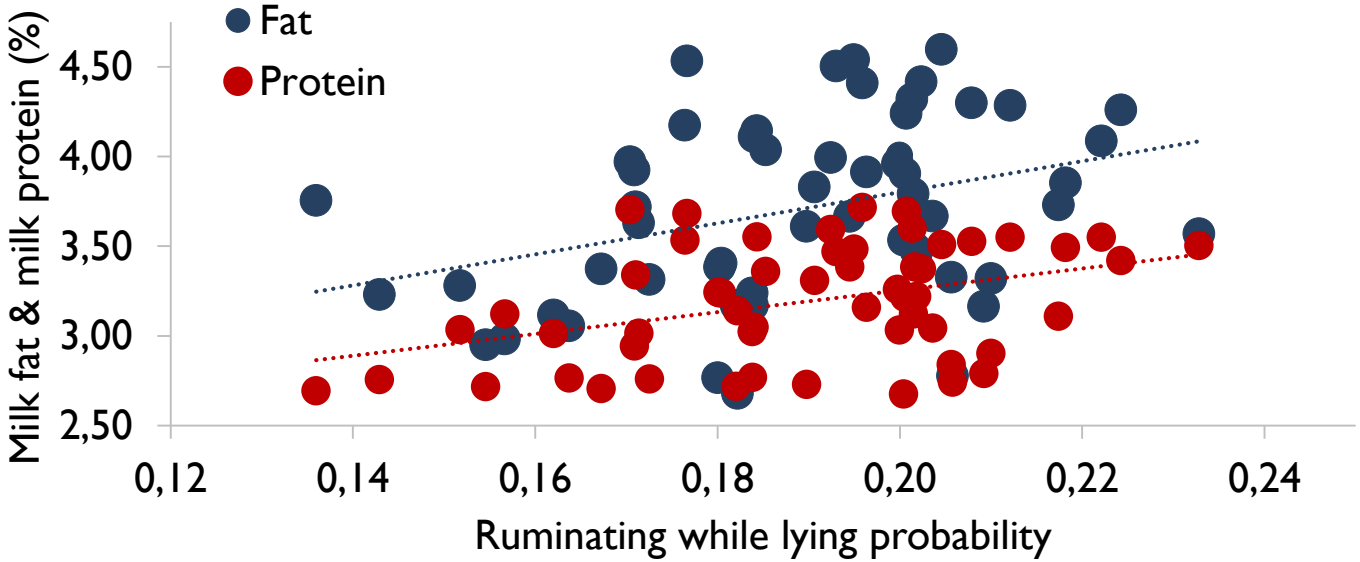
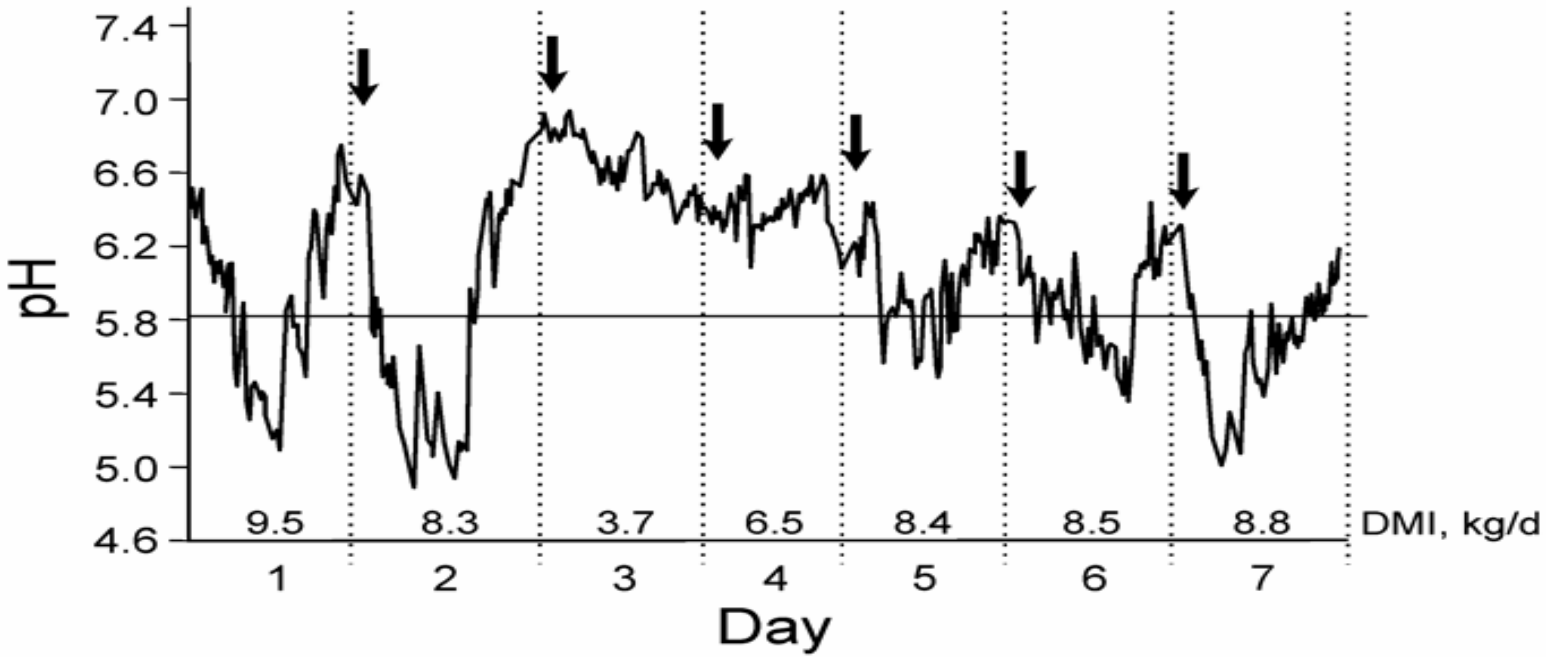


McWilliams et al. 2022. JDS Communications. 3:66-71

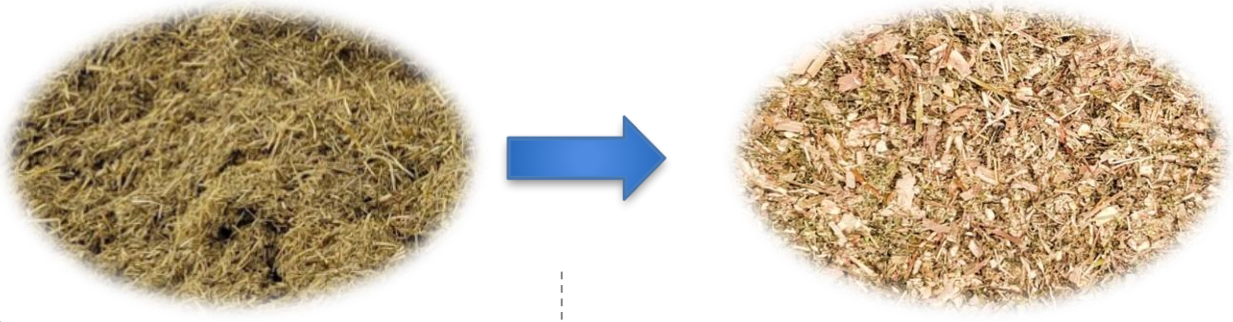
How does rumen health affect eating behavior?

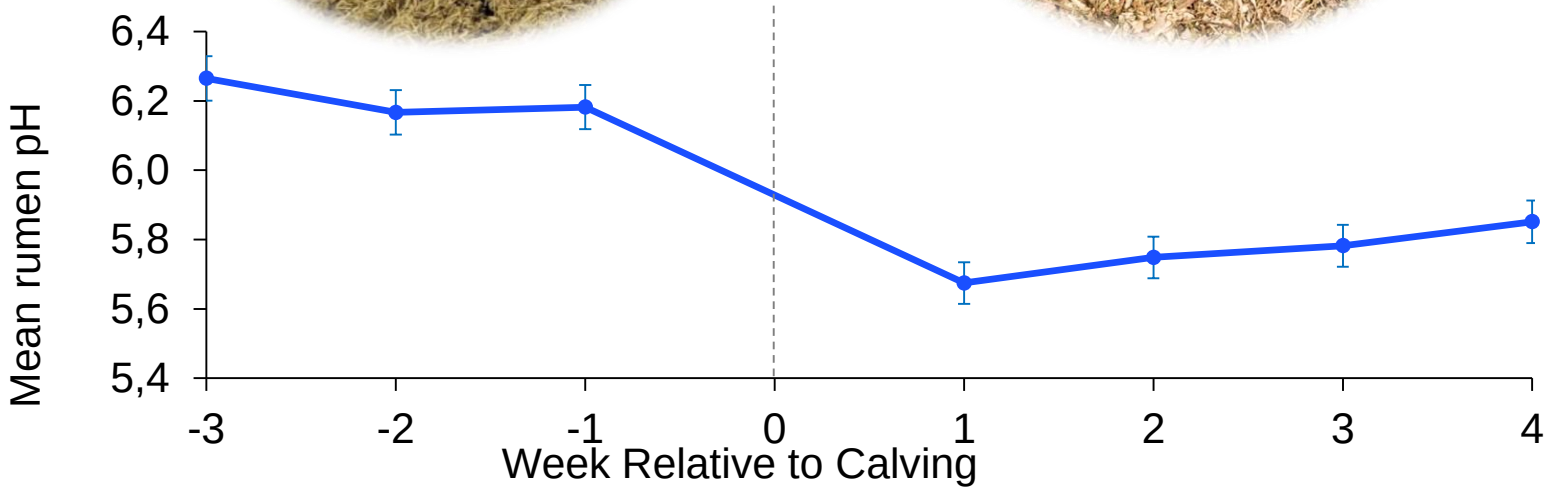
Disruption to the rumen may result in cattle changing their intake pattern…



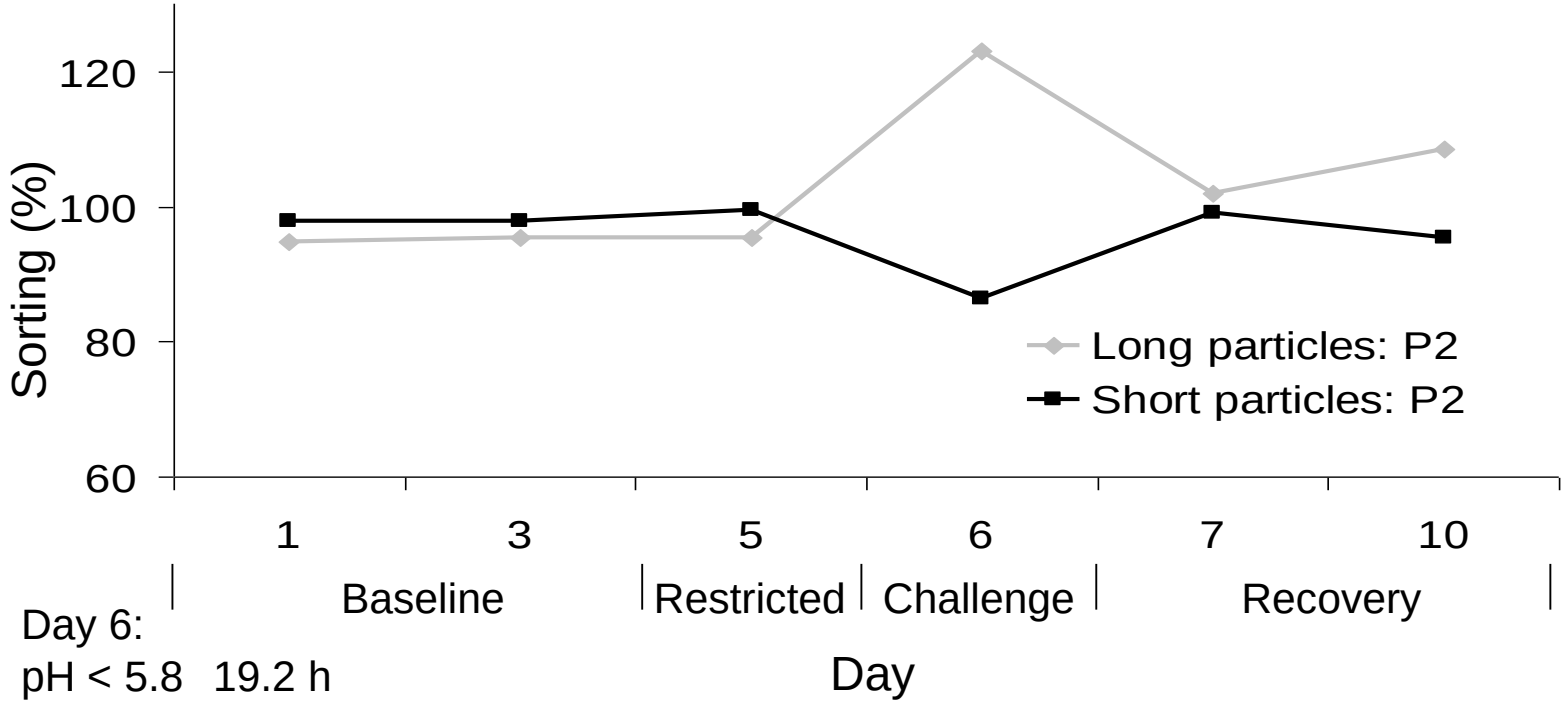
K. A. Beauchemin, unpublished data – cited in Schwartzkopf-Genswein et al. 2003. J. Anim. Sci. 81:E149–E158

This is particularly important for dairy cows at transition…





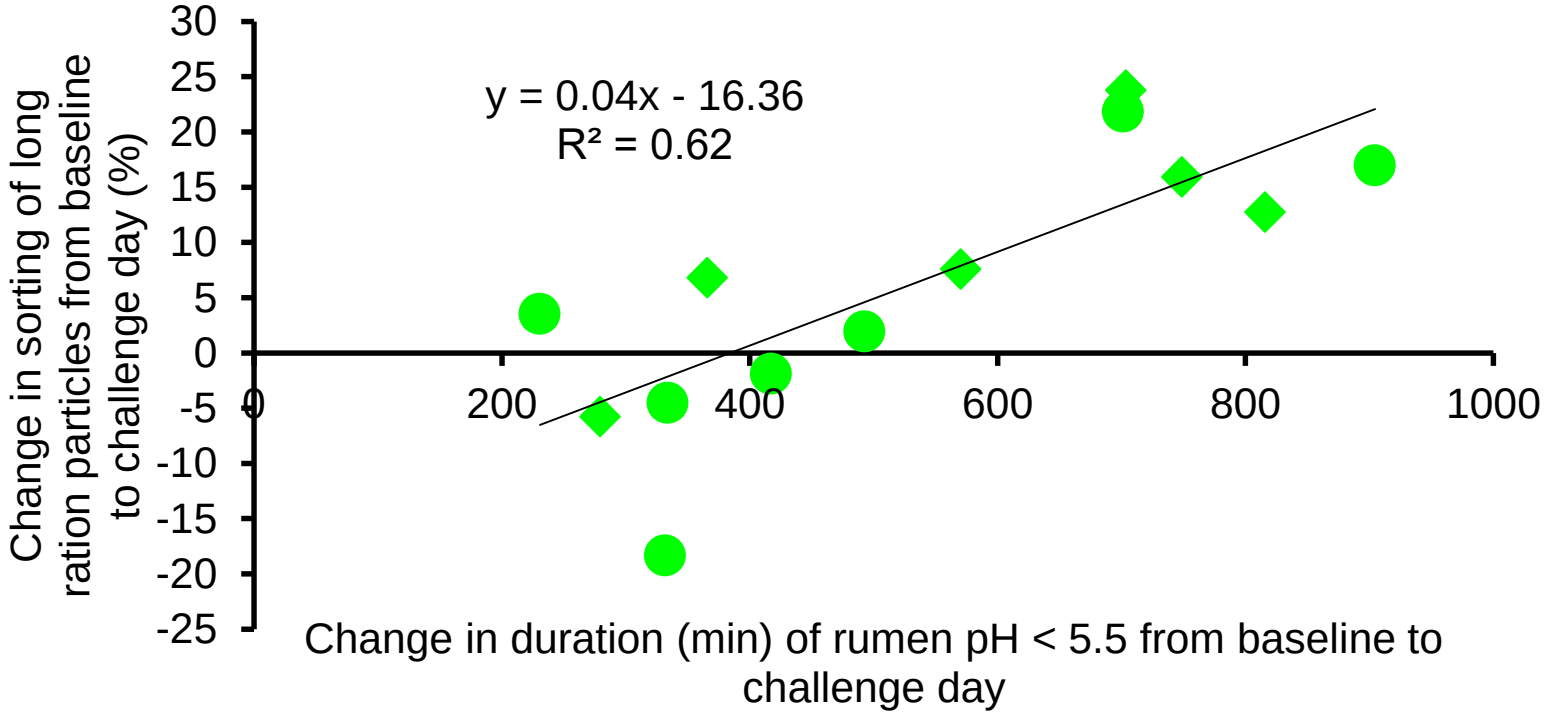
Cows will alter their sorting behavior in response to a low ruminal pH event…



Day 6:
pH < 5.8 19.2 h
pH < 5.2 10.9 h

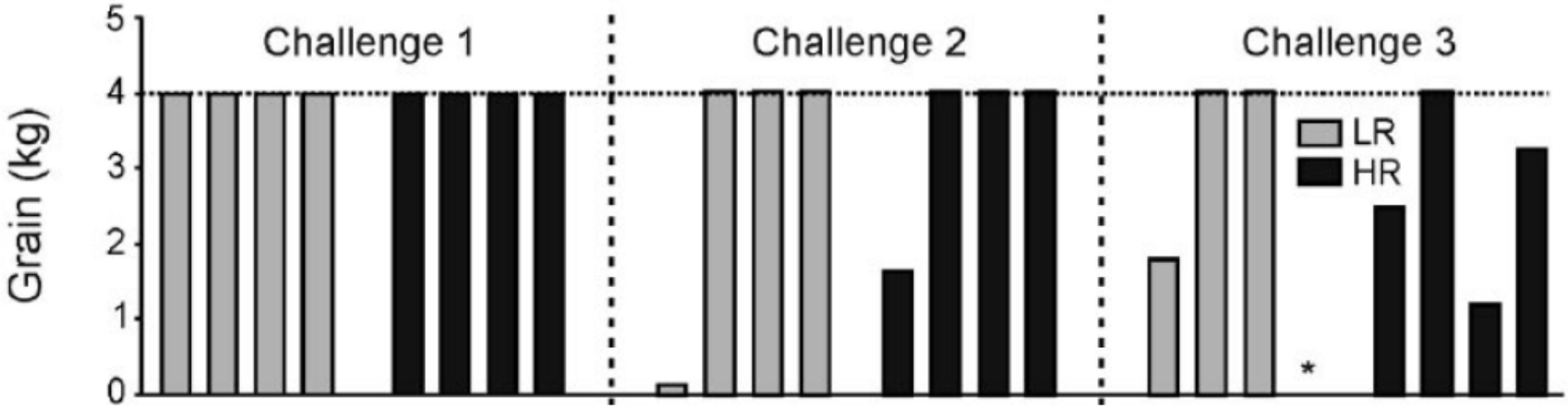
DeVries et al. 2008 J. Dairy Sci. 91:3958-3967

Cattle may increase sorting for effective fibre with increasingly low ruminal pH…



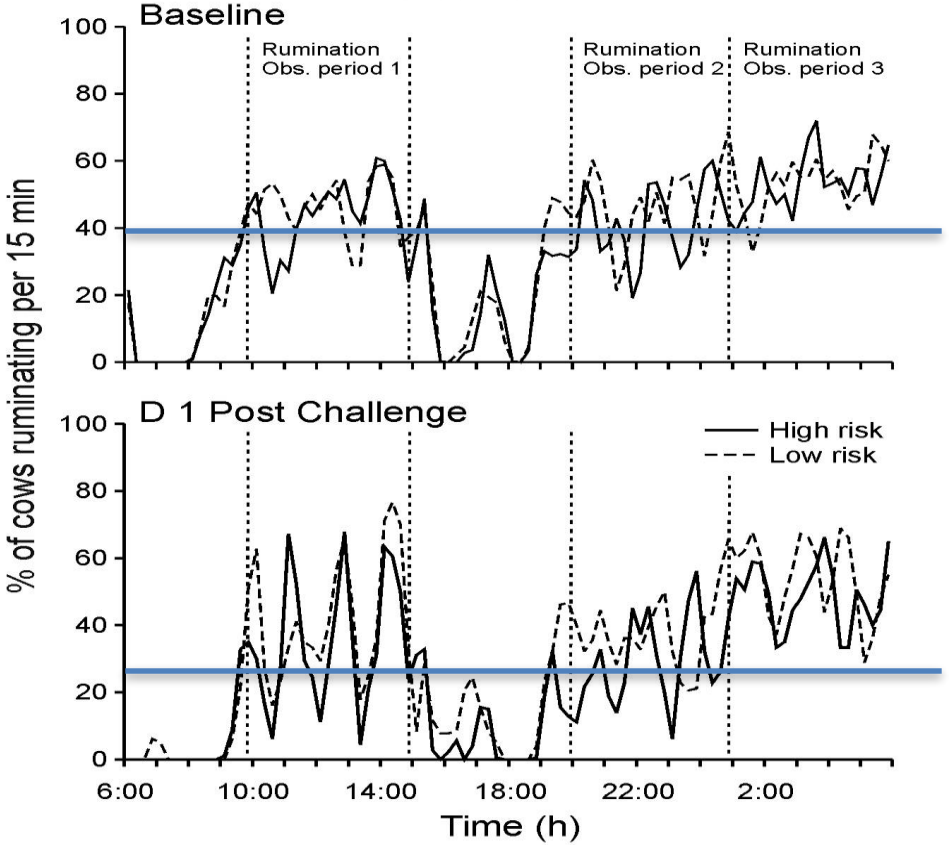
Data from DeVries et al. 2014. Anim. Prod. Sci. 54:1238-1242

Cattle may learn from their eating mistakes!



Data from Dohme et al. 2008 J. Dairy Sci. 91:3554-3567

Changes in rumination can indicate problems with rumen health…



Healthy

Ruminal acidosis

DeVries et al. 2009. J. Dairy Sci. 92:5067-5078

How can we modify eating behavior and rumen health through nutrition and management?

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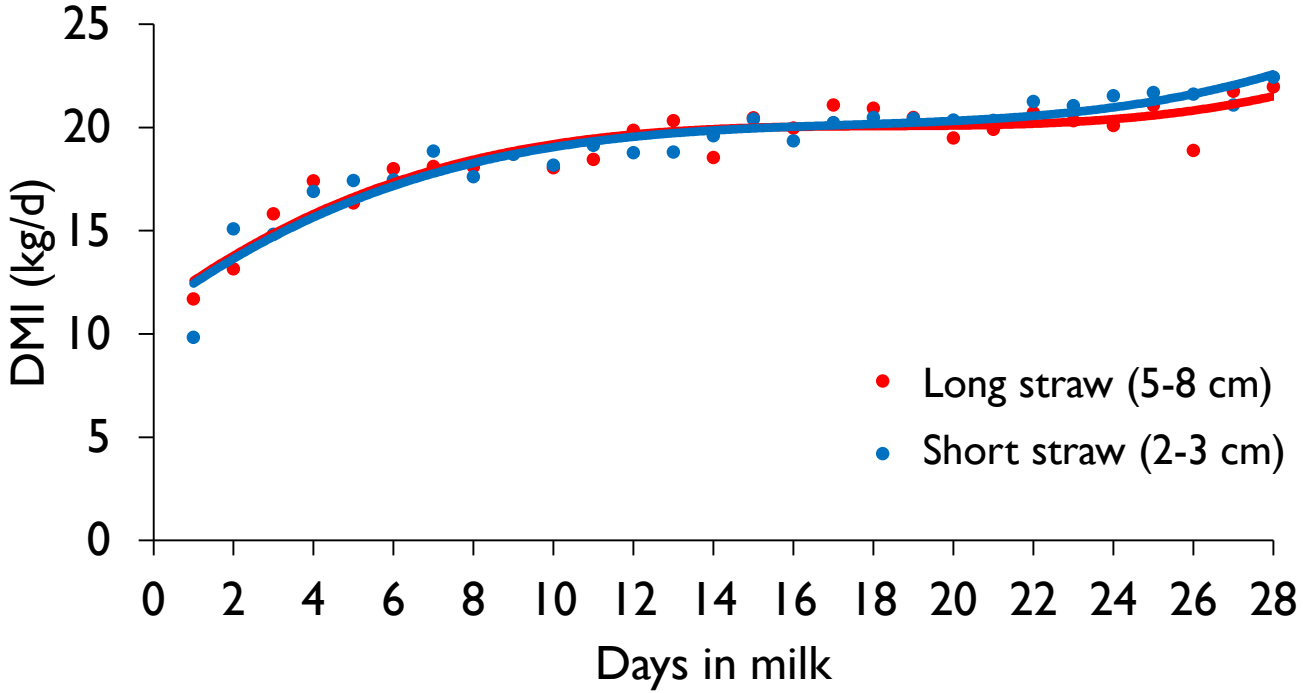
- Diets should be formulated encourage consistent consumption of small, frequent meals, are difficult to sort, and stimulate rumination

How can we modify eating behavior and rumen health through nutrition and management?

- Diets should be formulated encourage consistent consumption of small, frequent meals, are difficult to sort, and stimulate rumination
  - Proper forage management

Impact of straw particle size in fresh cow diets…



Coon et al. 2018. J. Dairy Sci. 101:6375-6387

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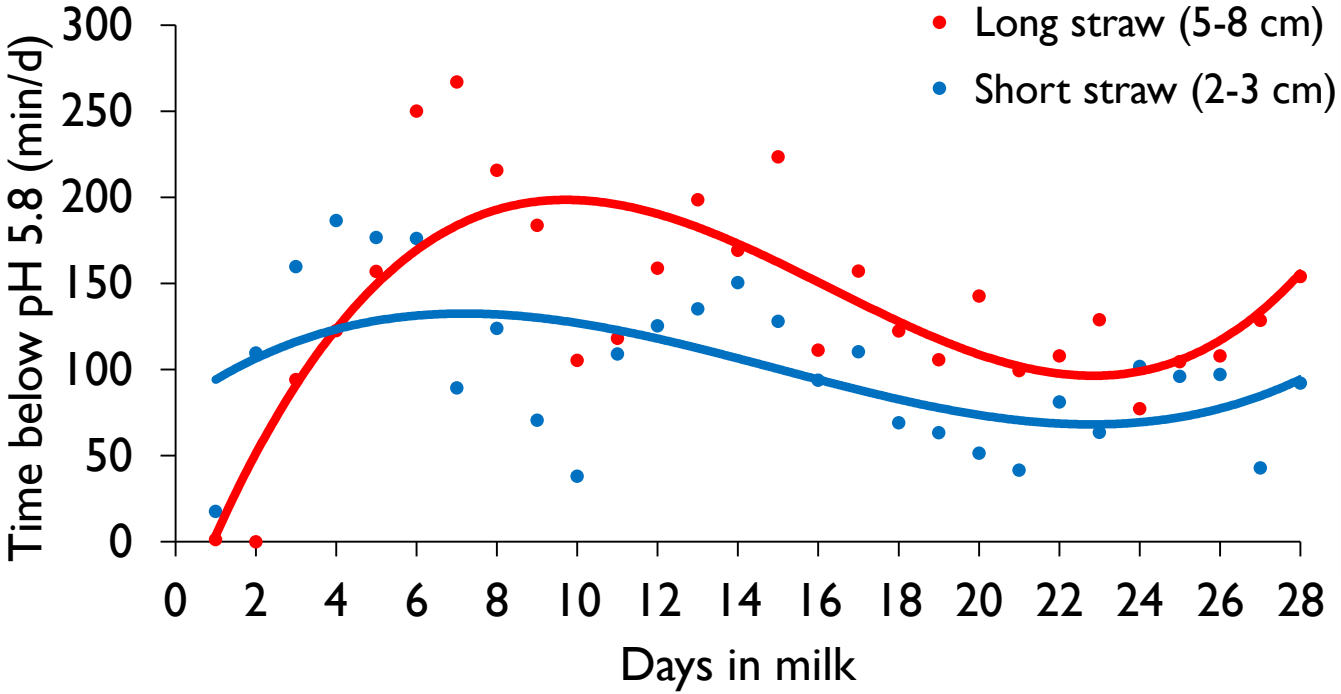

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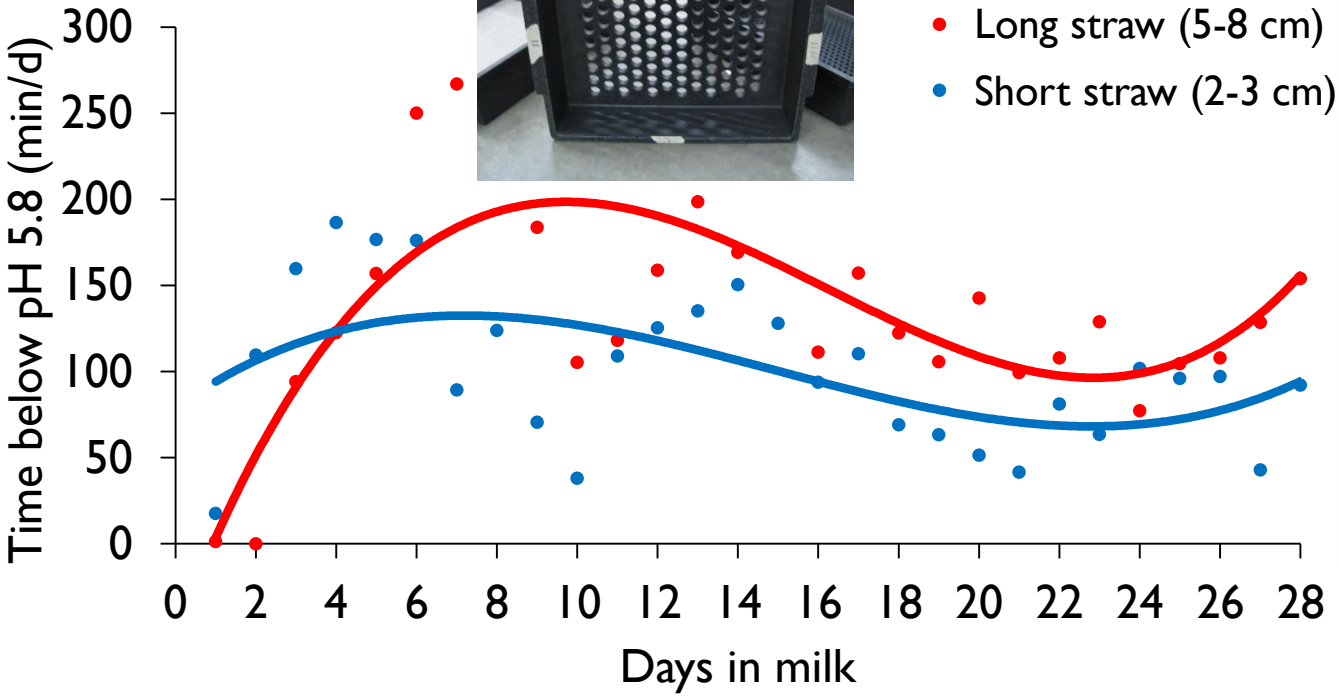


Coon et al. 2018. J. Dairy Sci. 101:6375-6387

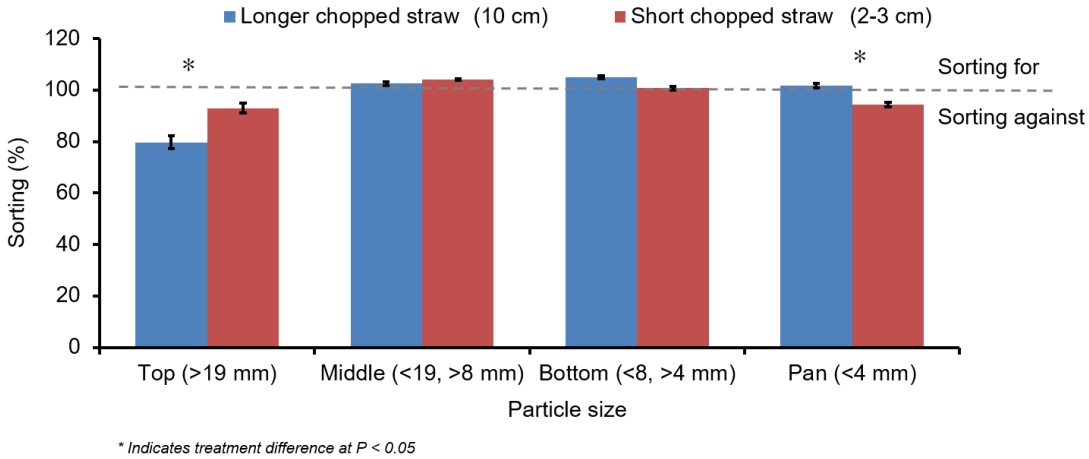
Impact of straw particle size in dry cow diets…

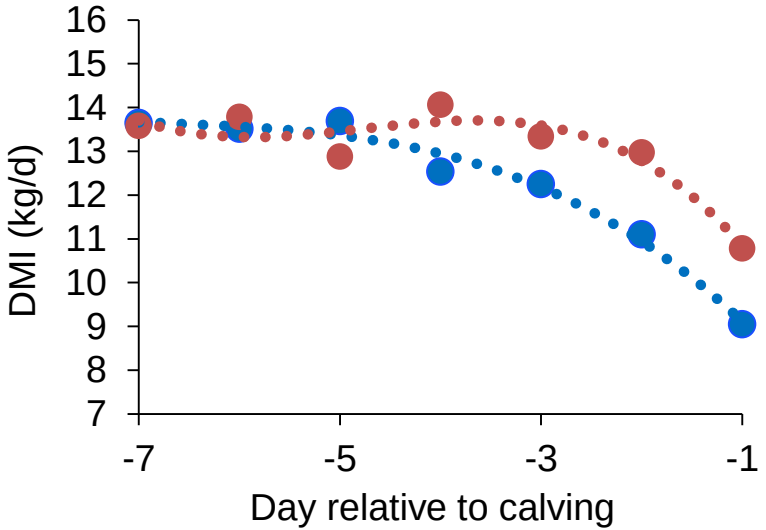
Longer chopped straw (10 cm)

Short chopped straw (2-3 cm)

Havekes et al. 2020. J. Dairy Sci. 103:254-271

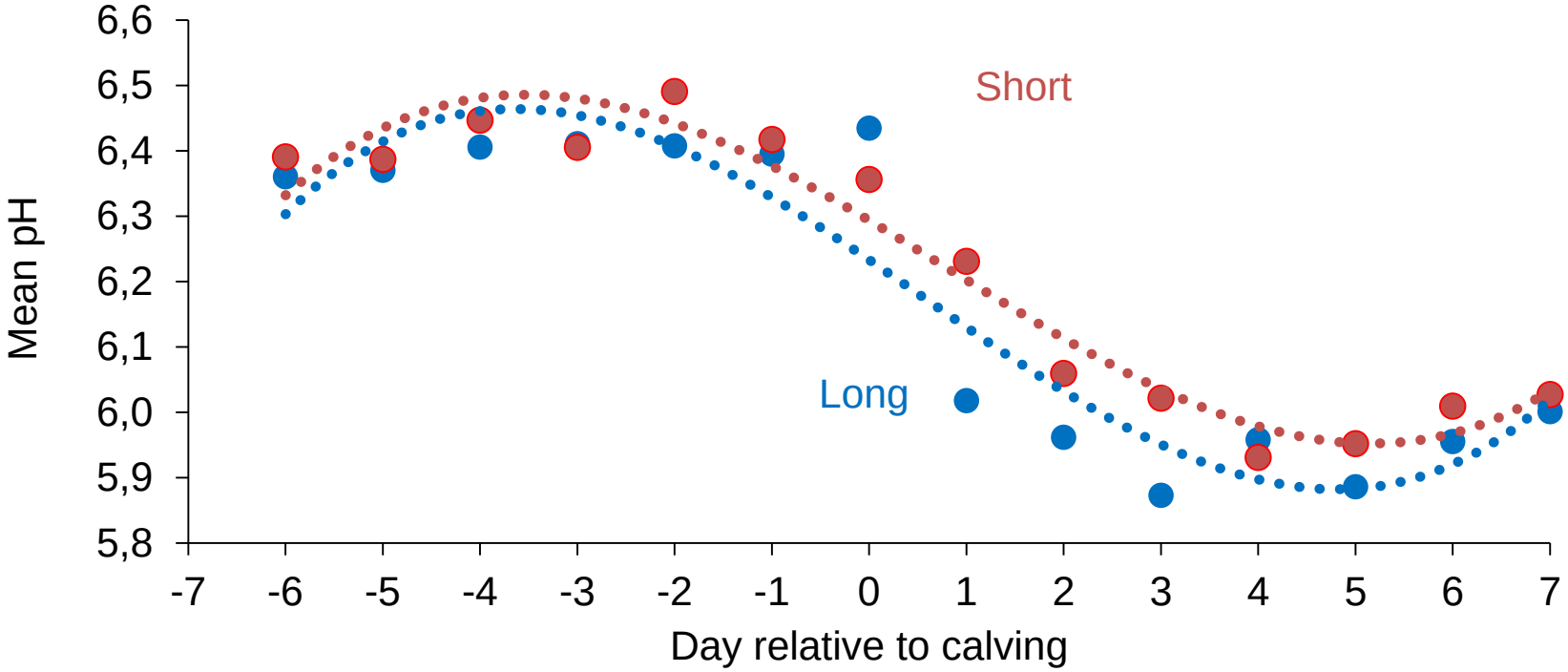
Cows on shorter straw diet sorted their dry diet less and maintained more consistent intake…





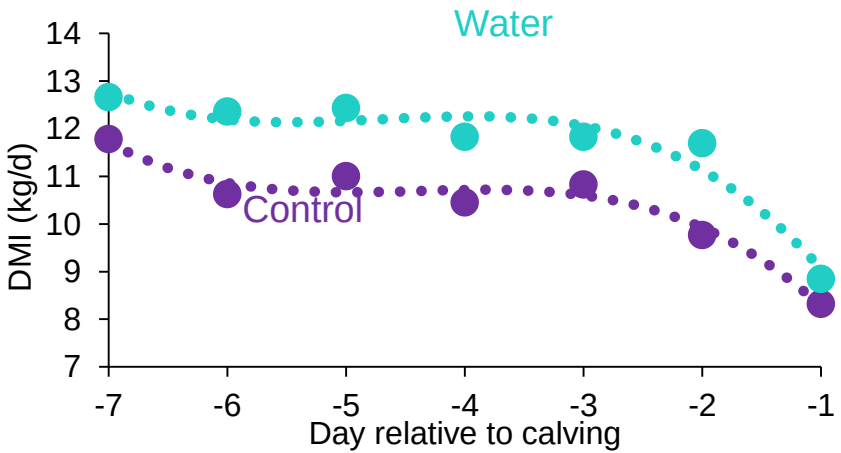
Havekes et al. 2020. J. Dairy Sci. 103:254-271

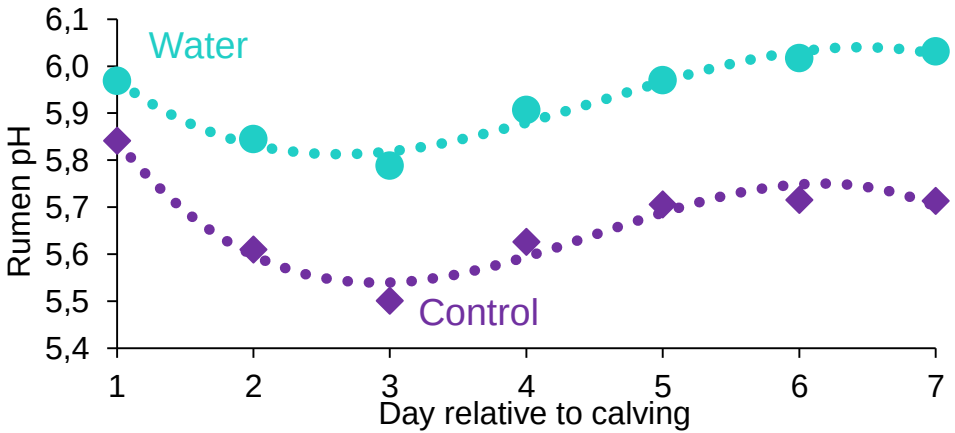
Cows on shorter straw diet had a lesser drop in reticulorumen pH post-calving…



Havekes et al. 2020. J. Dairy Sci. 103:254-271

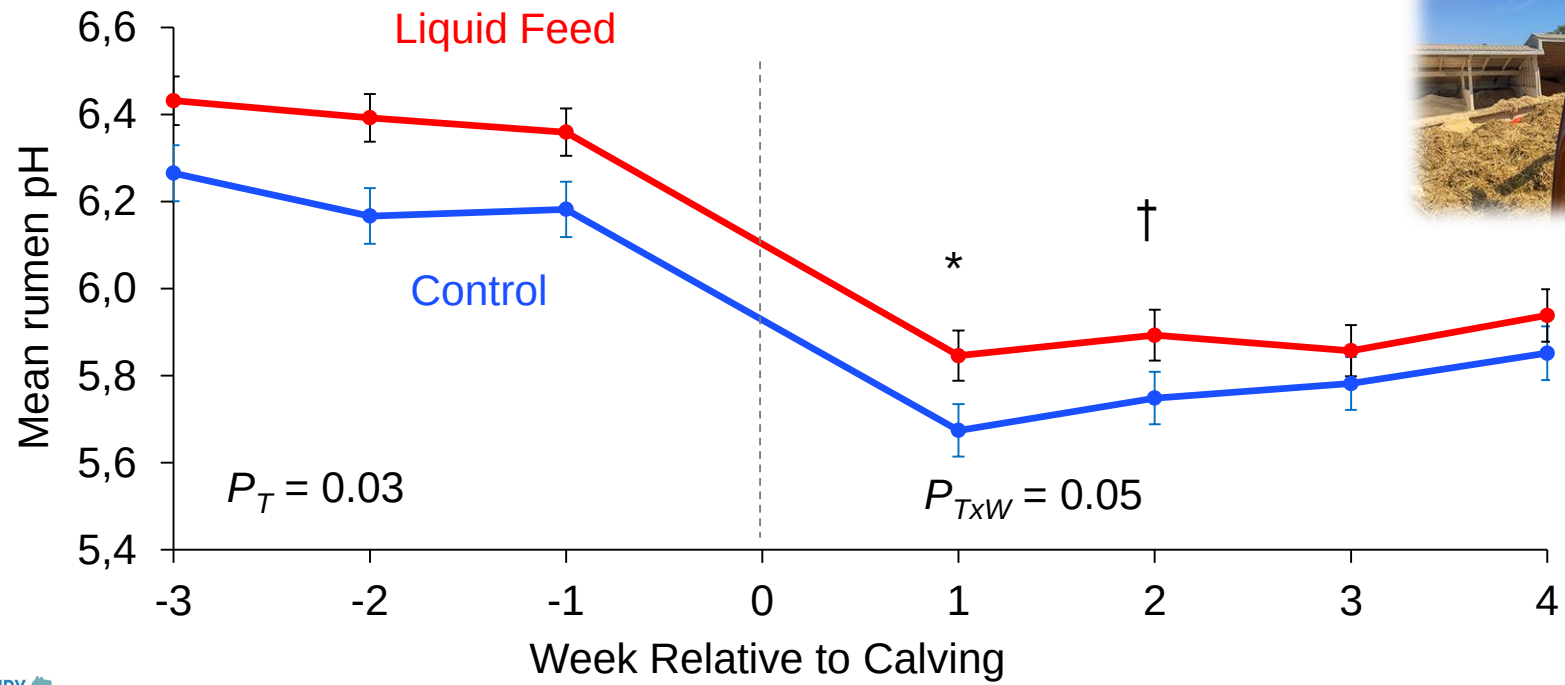
Similar results with adding water to a high-straw dry cow diet…more consistent intake pre-calving leading to more consistent rumen pH post-calving





Havekes et al. 2020. J. Dairy Sci.103:1500-1515

Adding molasses-based liquid feed to a high-straw dry cow diet…improved rumen pH and more consistent intake pre-calving leading to more consistent rumen pH post-calving

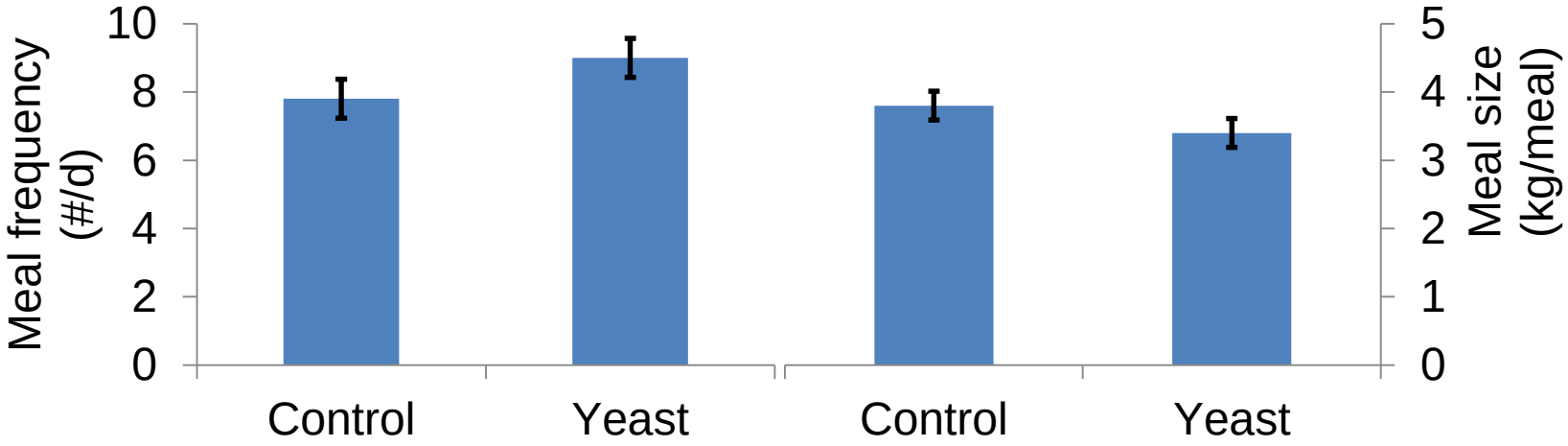


Havekes et al. 2020. J. Dairy Sci. 103:5070-5089

How can we modify eating behavior and rumen health through nutrition and management?

- Diets should be formulated encourage consistent consumption of small, frequent meals, are difficult to sort, and stimulate rumination
  - Utilize feed additives which stabilize rumen conditions
    - Monensin (Erickson et al., 2003; Lunn et al., 2005; Mullins et al., 2012)
    - Sodium bicarbonate (Gonzalez et al., 2008)
    - Yeast supplements (Bach et al., 2007; DeVries and Chevaux, 2014; Yuan et al., 2015)

Greater frequency of smaller meals with yeast supplementation, leading to improved rumination and milk fat %



Data from DeVries and Chevaux. 2014. J. Dairy Sci. 97:6499-6510

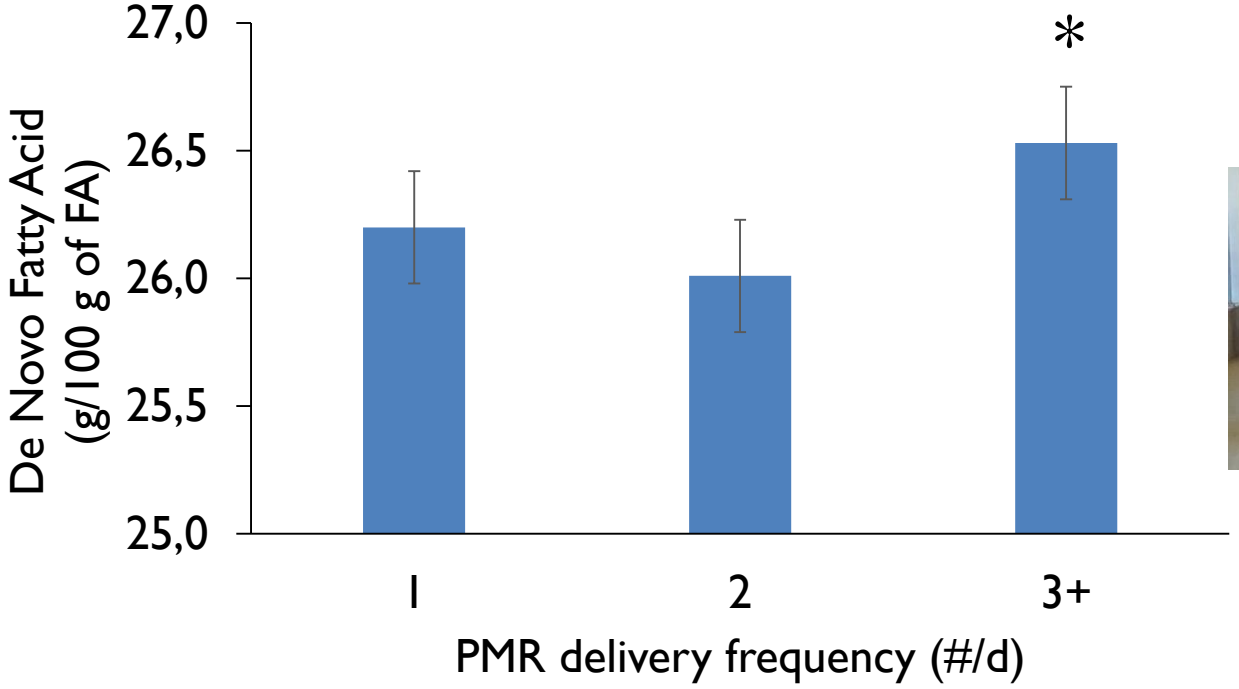
How can we modify eating behavior and rumen health through nutrition and management?

- Diets should be formulated encourage consistent consumption of small, frequent meals, are difficult to sort, and stimulate rumination
  - Utilize feed additives which improve energy metabolism, liver health, and and help stabilize intake
    - Chromium (Smith et al., 2005; Malik et al., 2023)
    - Niacin (Zimbelman et al. 2010; 2013)
    - Choline and rumen-protected B vitamins (Arshad et al., 2020; Evans et al., 2023)

How can we modify eating behavior and rumen health through nutrition and management?

- Manage feed and its access to ensure consistent eating behavior

More frequent feed delivery = more consistent consumption = improved rumen health



*P=0.05

Castro et al. 2022. J. Dairy Sci. 105:5097-5108

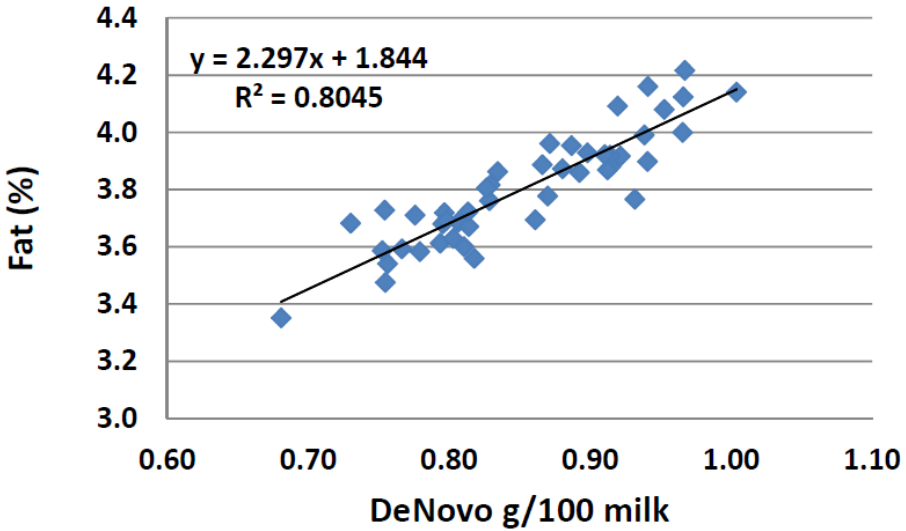
More eating space = improved eating behavior = improved milk composition

- Field study of Canadian dairy herds
  - Mean = 56 cm (22 inch)/cow (range 36 to 99 cm/cow)
  - For every 10 cm (4 inch) increase in feed bunk space…
    - +0.06% milk fat

Sova et al. 2013. J. Dairy Sci. 96:4759-4770

More eating space = improved eating behavior = improved milk composition

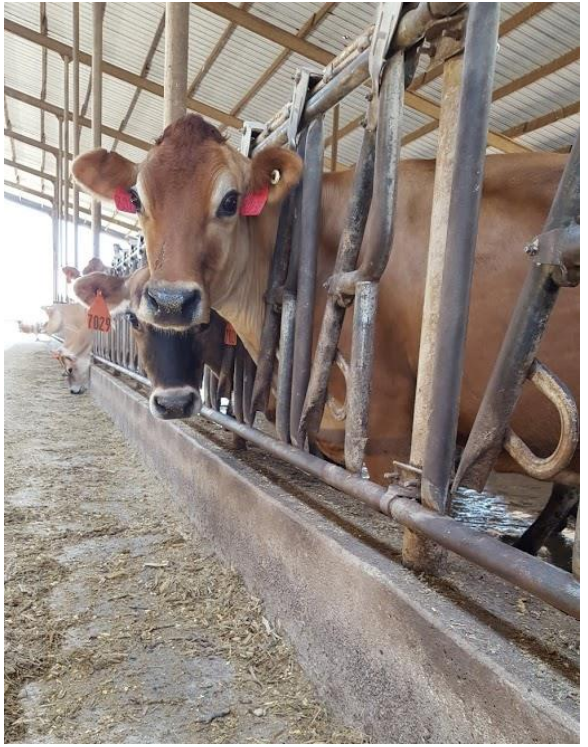
- High de-novo herds tended to be 10x more likely to have >46 cm (18 inches)/cow of bunk space



Woolpert et al. 2017. J. Dairy Sci. 100:5097-5106

Poor feed availability and access = greater negative impact on rumen health

- Overcrowding and feed restriction (0100 to 0600 h):
  - Up to 9 h/d greater time with depressed rumen pH < 5.8
  - Reduced NDF digestion rate by up to 50%



Campbell and Grant, 2016

Take home messages:

- Feeding behavior of dairy cattle is related to rumen health and function
  - Eating patterns and diet selection may lead to poor rumen health
  - Cattle may change their feeding behavior in response to poor rumen health
  - There are dietary and management opportunities to alter feeding behavior and rumen health

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NSERC
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Agriculture and
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Questions???

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