

Post-rumen health and its implications on health and performance

Victoria Sanz Fernández, DVM PhD

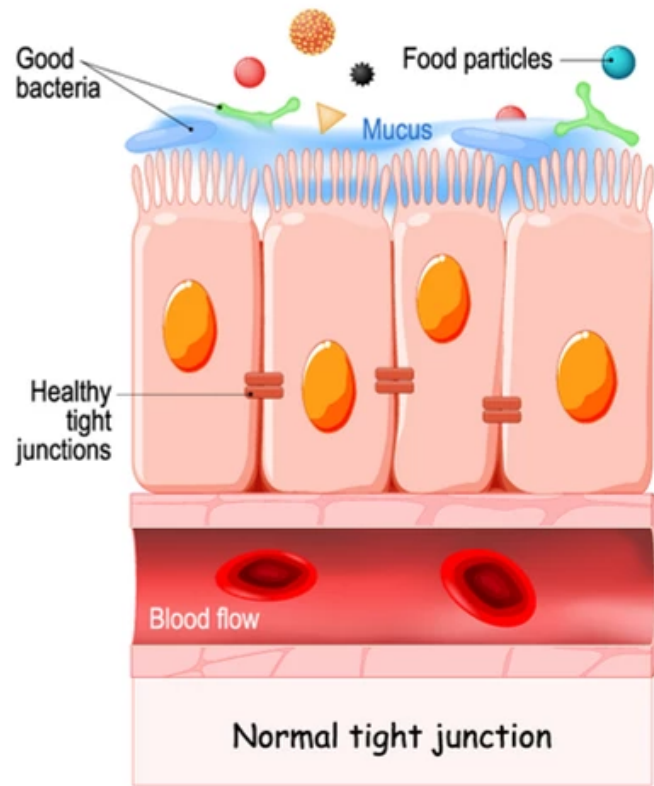
Ruminant Research Center, Trouw Nutrition R&D

A photograph of a cow with black and white patches standing in a field. The image is overlaid with a semi-transparent blue gradient that covers the bottom half of the frame. The text "Leaky gut and inflammation" is written in white, monospace-style font across the middle of the image.

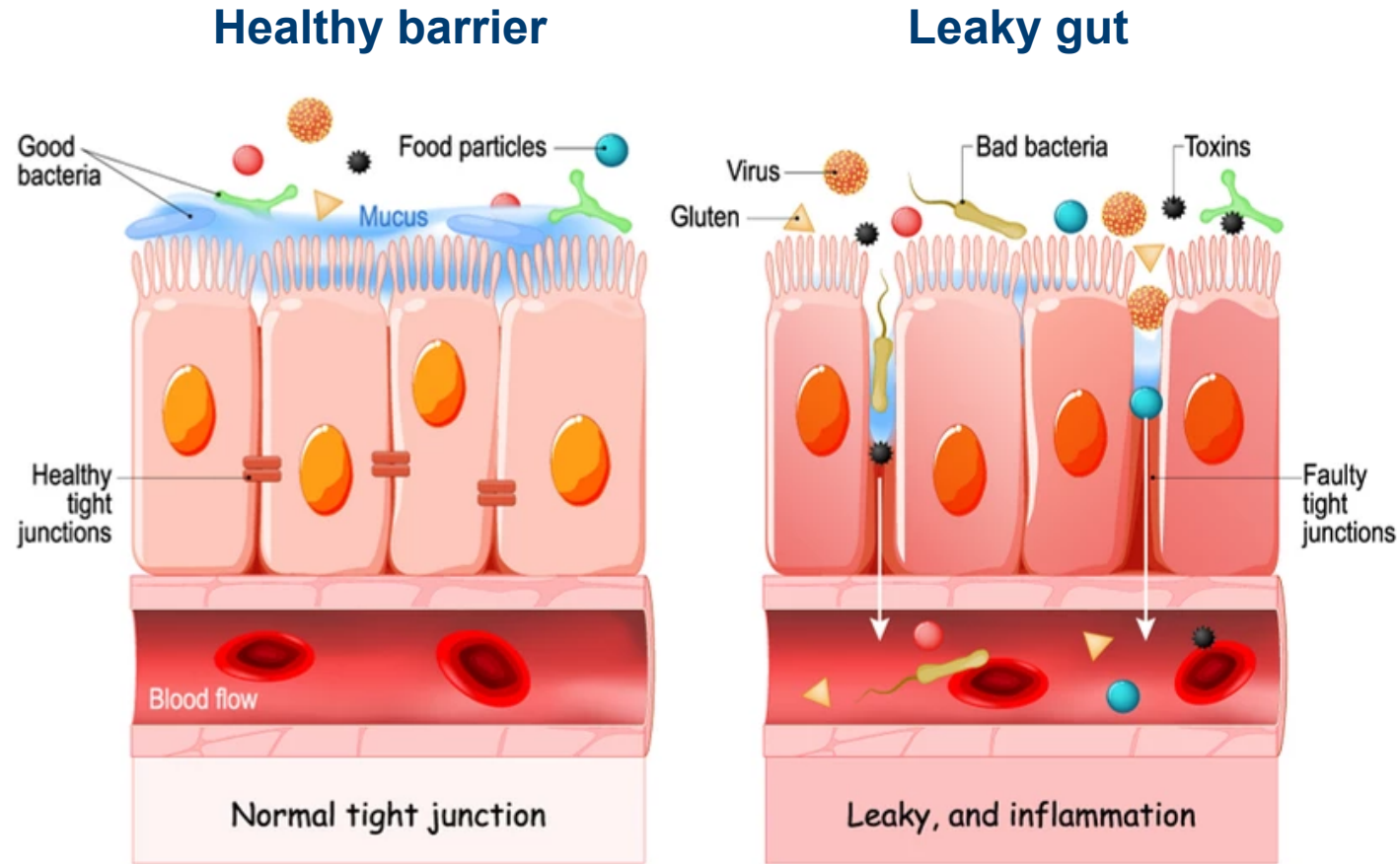
Leaky gut and inflammation

Intestinal health & inflammation

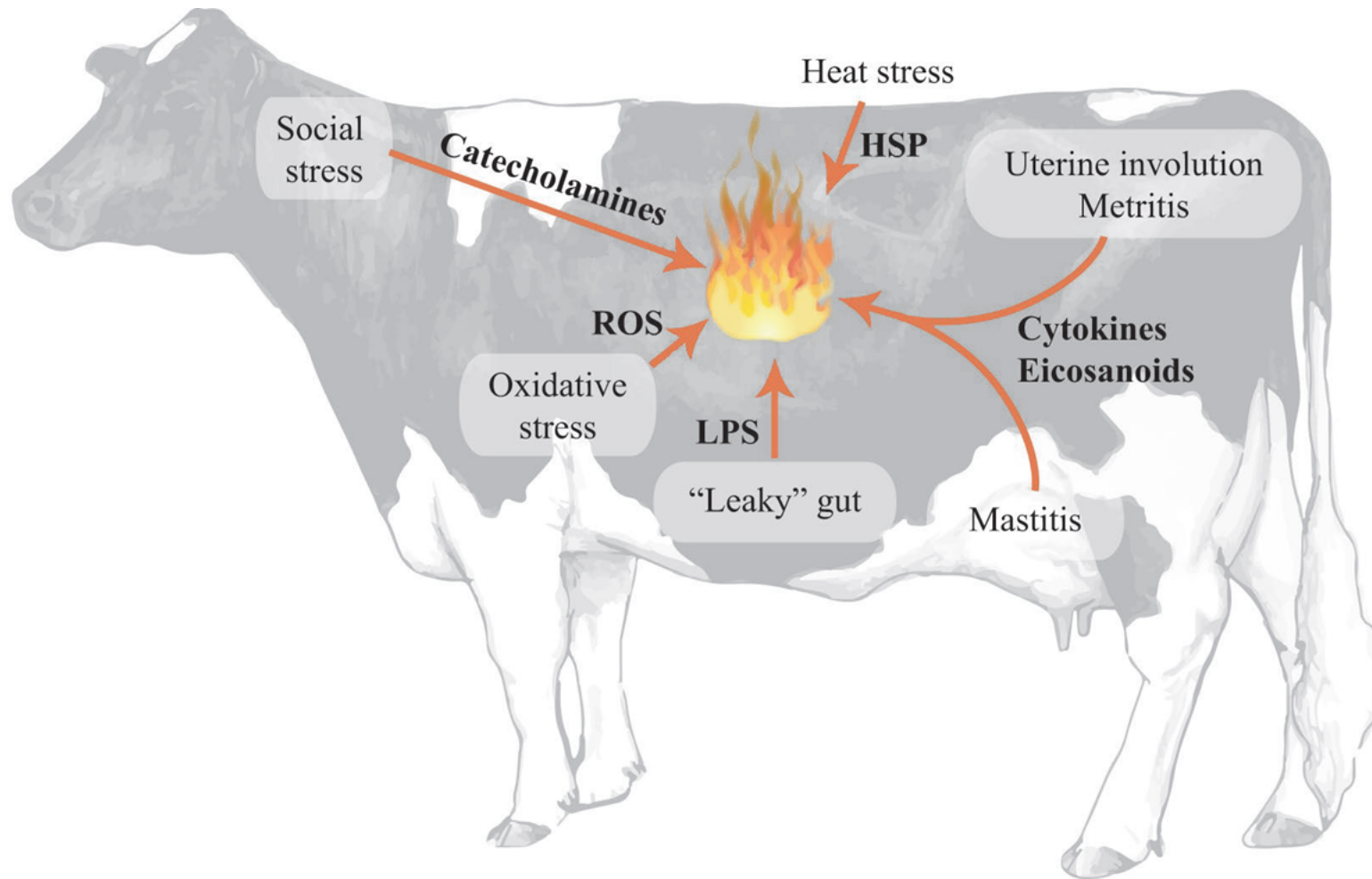
Healthy barrier



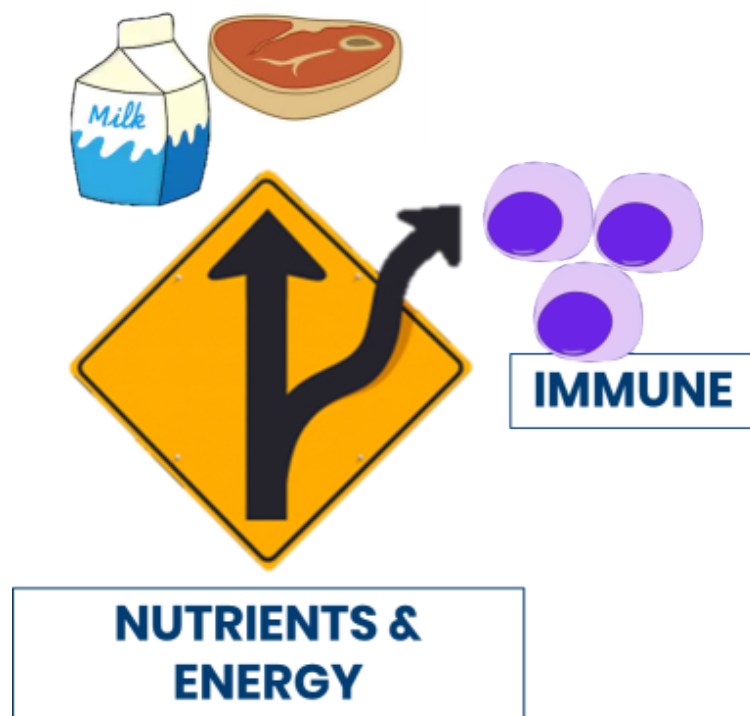
Intestinal health & inflammation



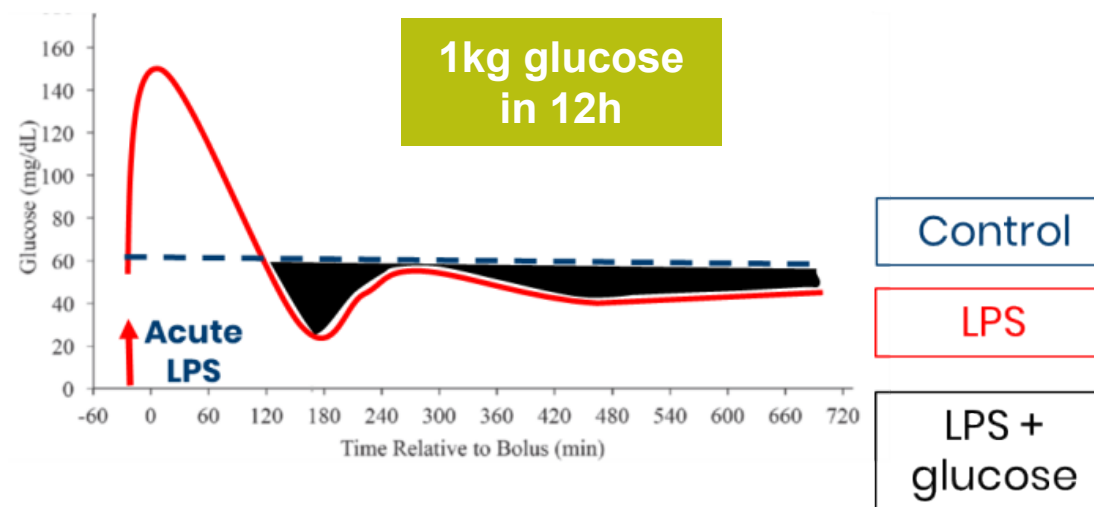
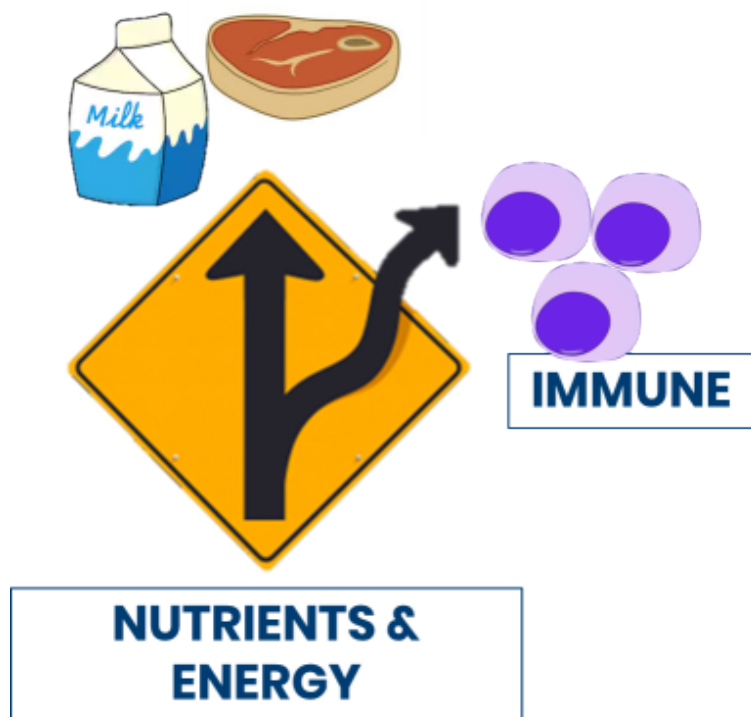
Leaky gut as a source of inflammation



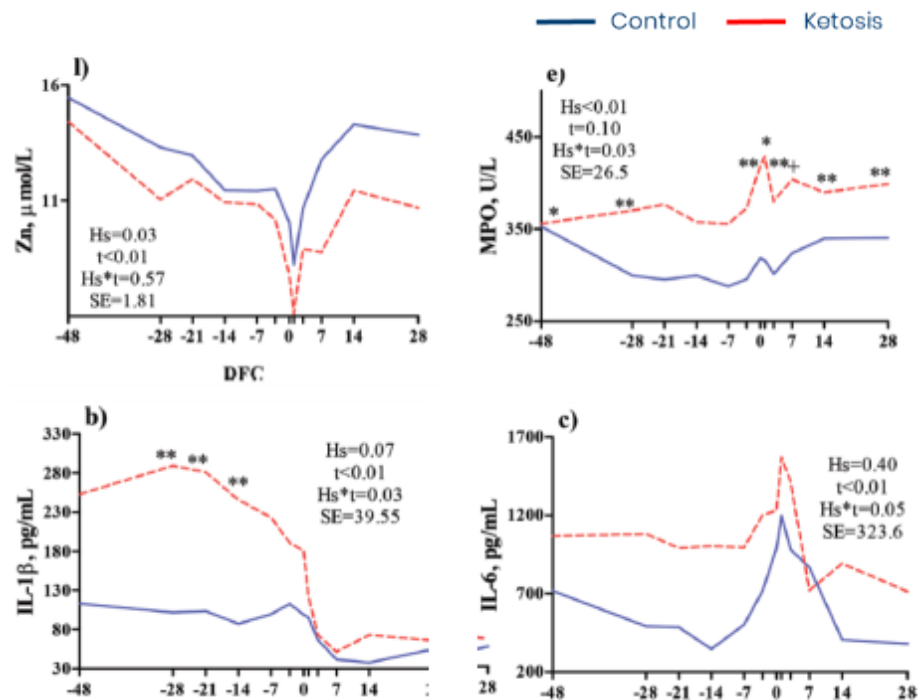
Cost of inflammation



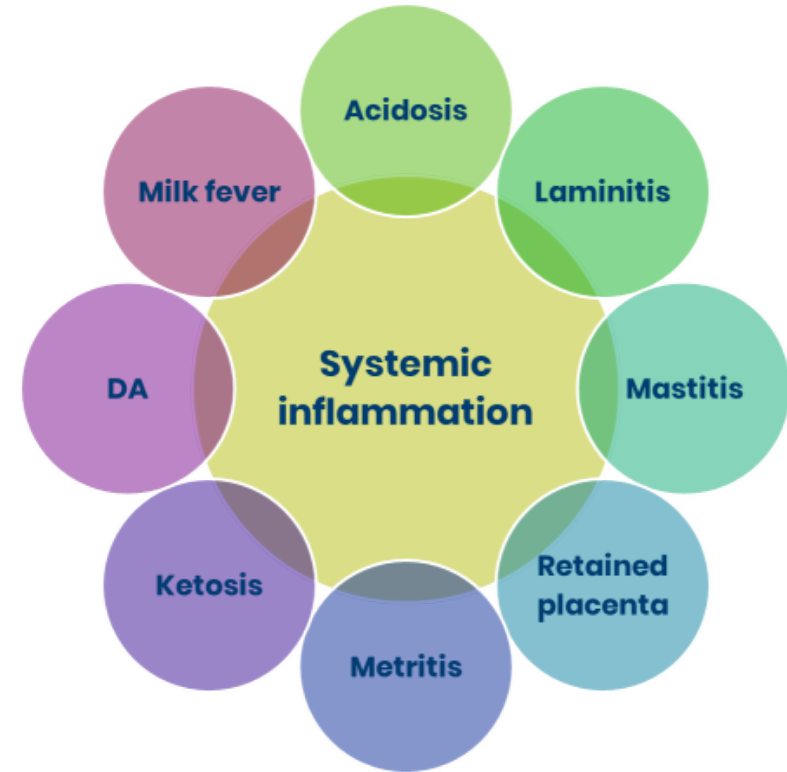
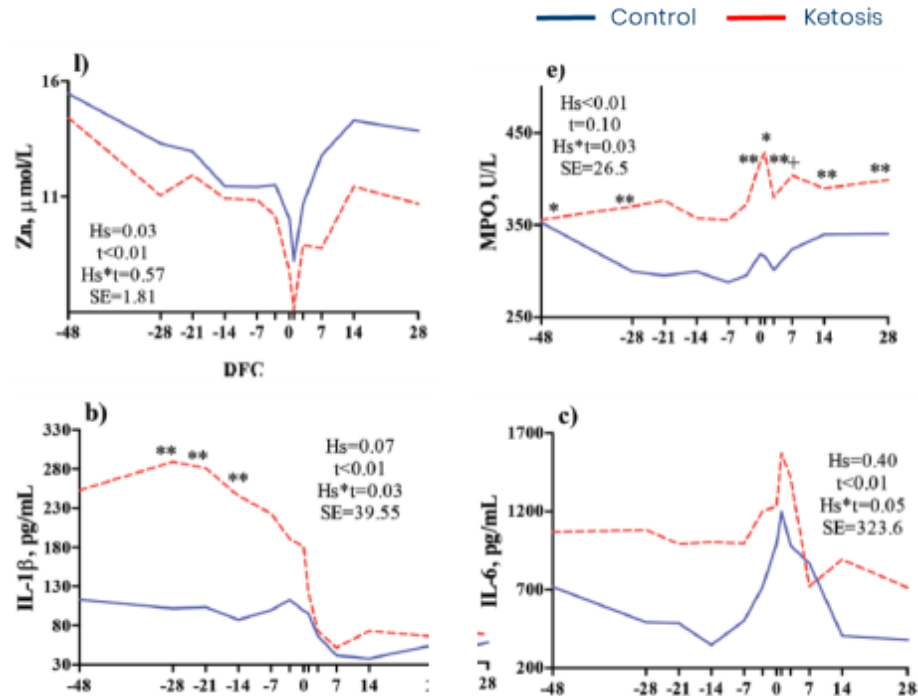
Cost of inflammation



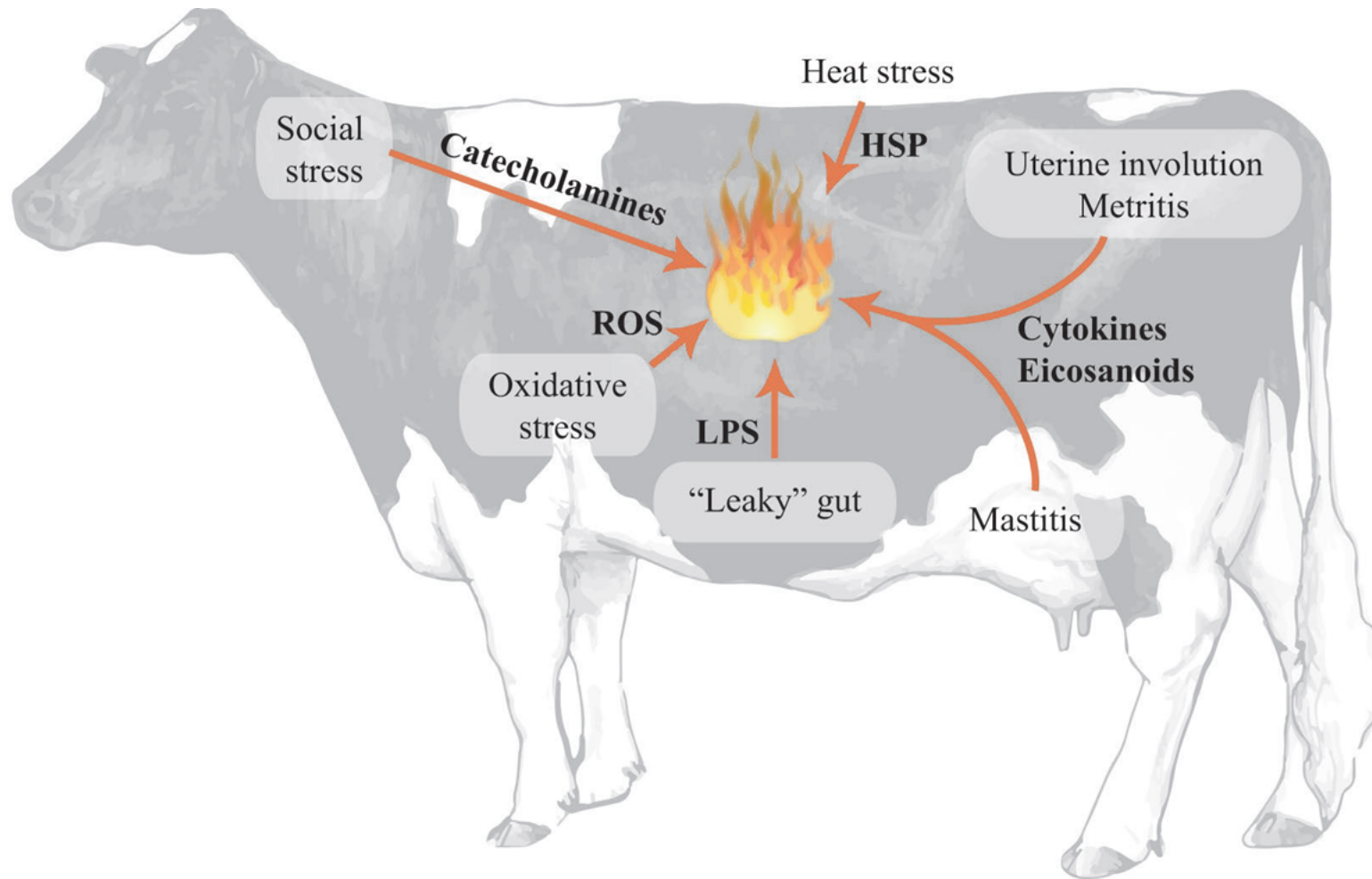
Inflammation & metabolic disease



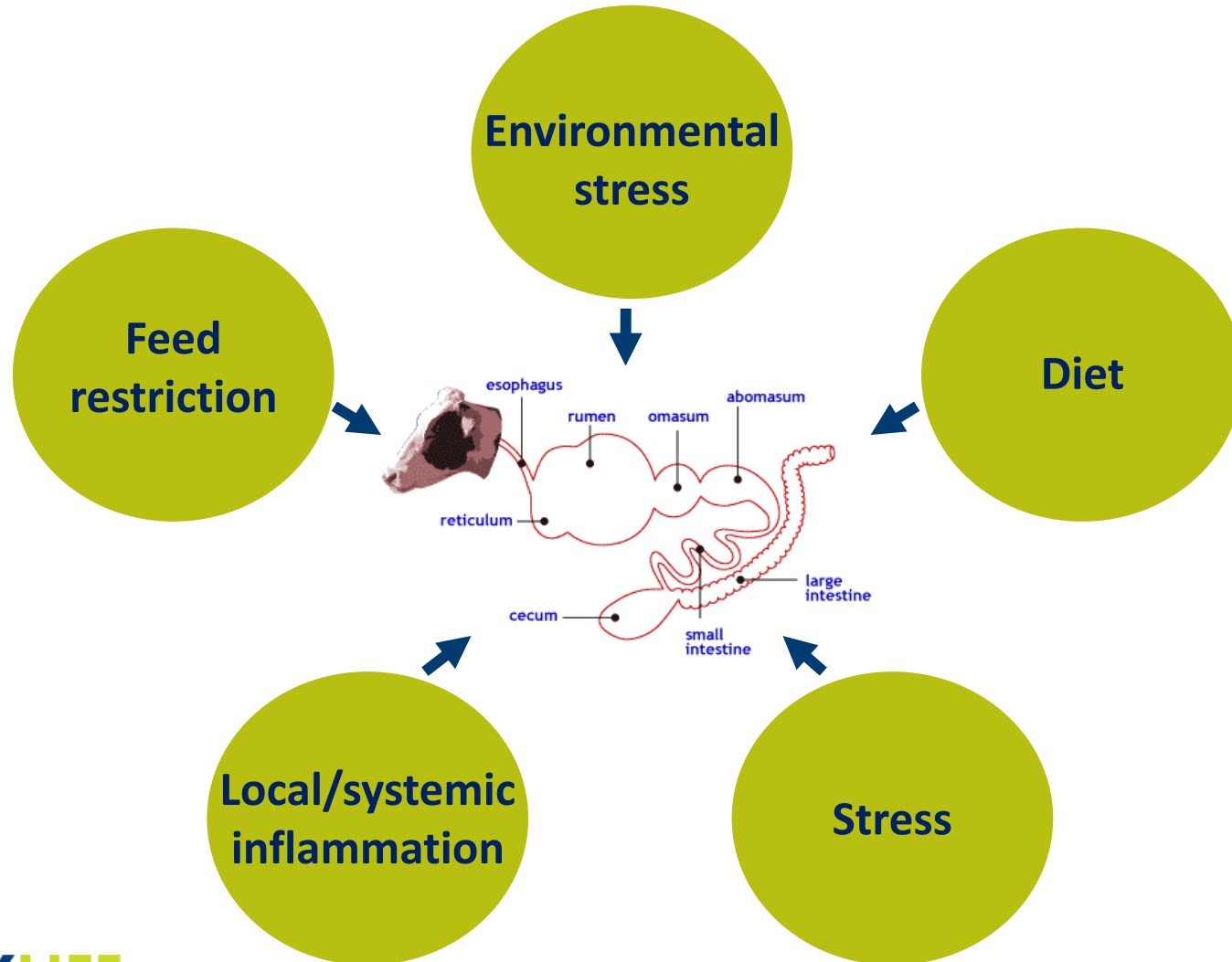
Inflammation & metabolic disease



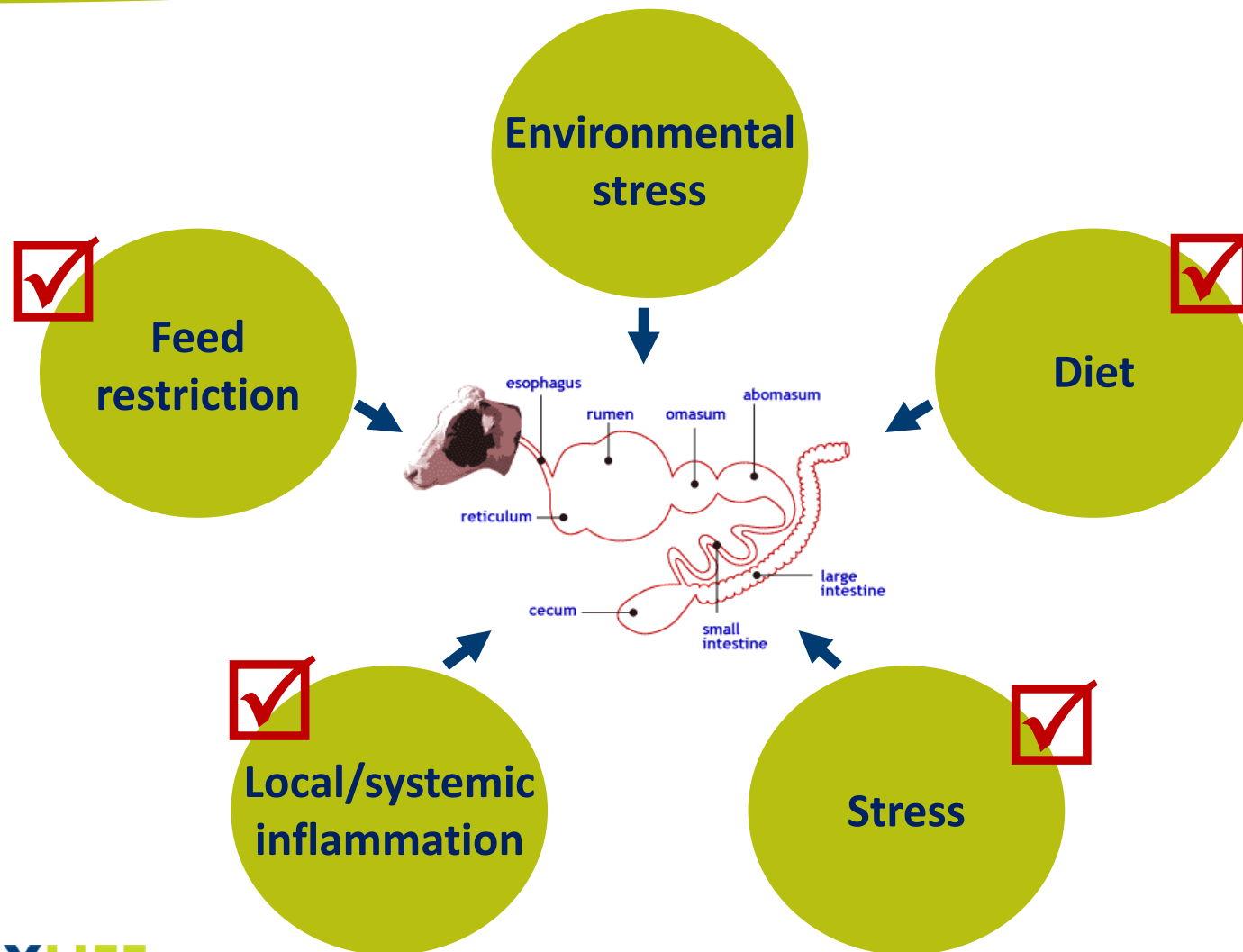
Leaky gut as a source of inflammation



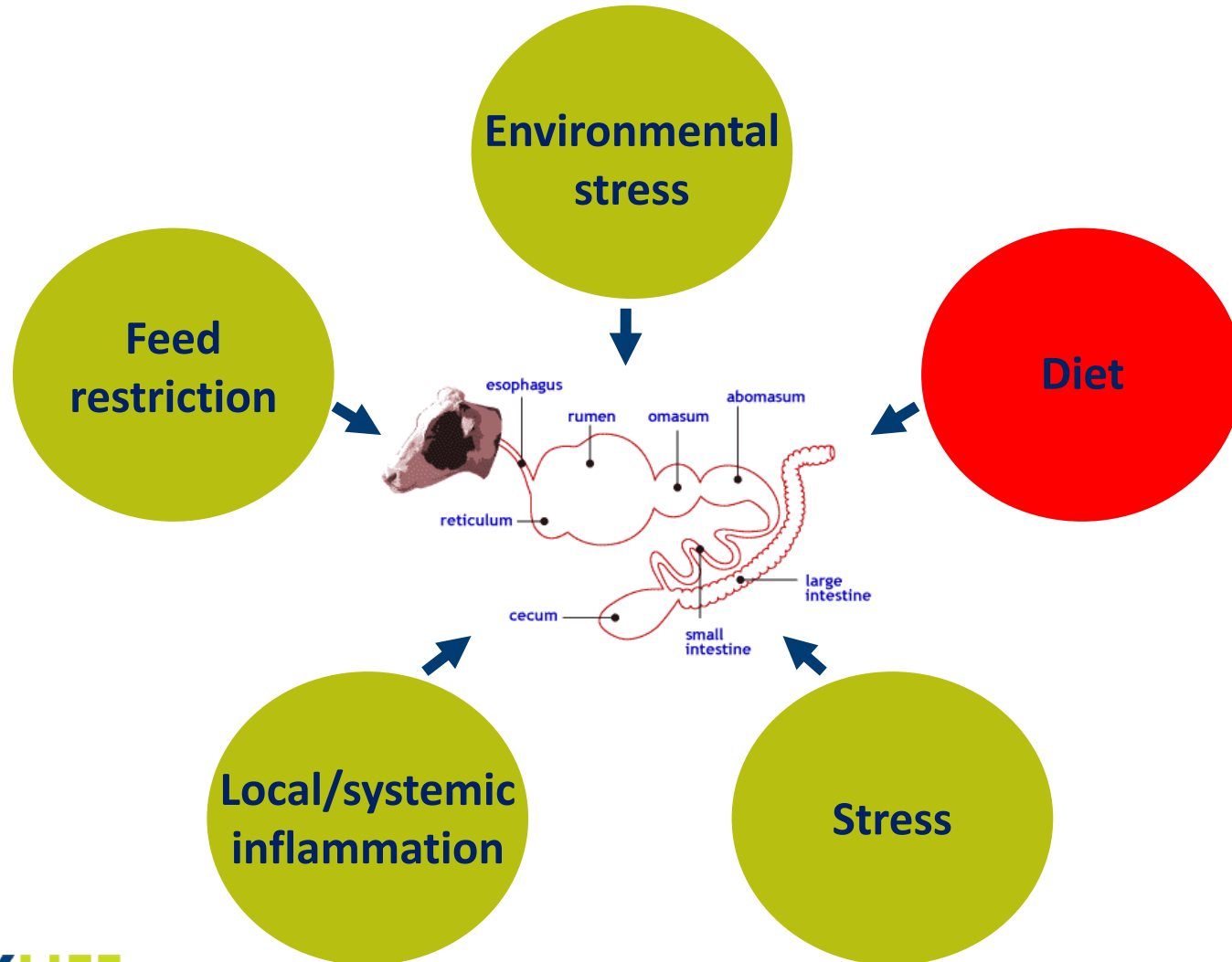
Factors affecting intestinal health



Factors affecting intestinal health



Factors affecting intestinal health



Lactation ration

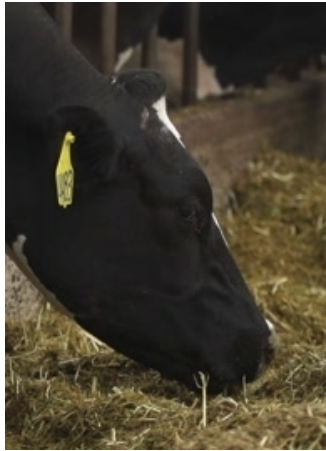
- Abrupt introduction
- High fermentability
 - > ↓ pH
- Microbial proliferation/lysis
 - > ↑ endotoxin/LPS

A photograph of a goat lying down in a bed of straw. The entire image is covered with a semi-transparent green overlay. The text "Acidosis develops similarly in the rumen and the hindgut" is written in white, monospace-style font across the middle of the image.

Acidosis develops similarly in the rumen
and the hindgut

High starch diets and acidosis along the GI tract

Lactation ration
(↑↑ starch)



Rumen

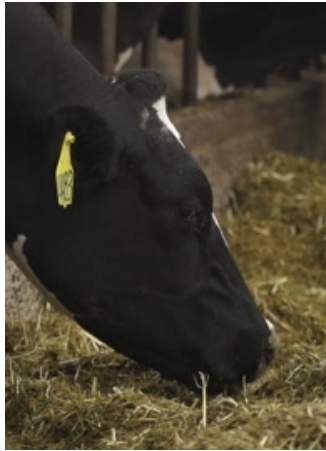
- ↑↑ **Starch:**
- ↑ fermentation
 - ↓pH
 - ↑microbial prolif./lysis
 - ↑endotoxins/LPS



**ACIDOSIS
LEAKY
GUT**

High grain diets and acidosis along the GI tract

↑↑ Starch



Rumen

- ↑↑ Starch:
- ↑ fermentation
 - ↓ pH
 - ↑ microbial prolifer./lysis
 - ↑ endotoxins/LPS

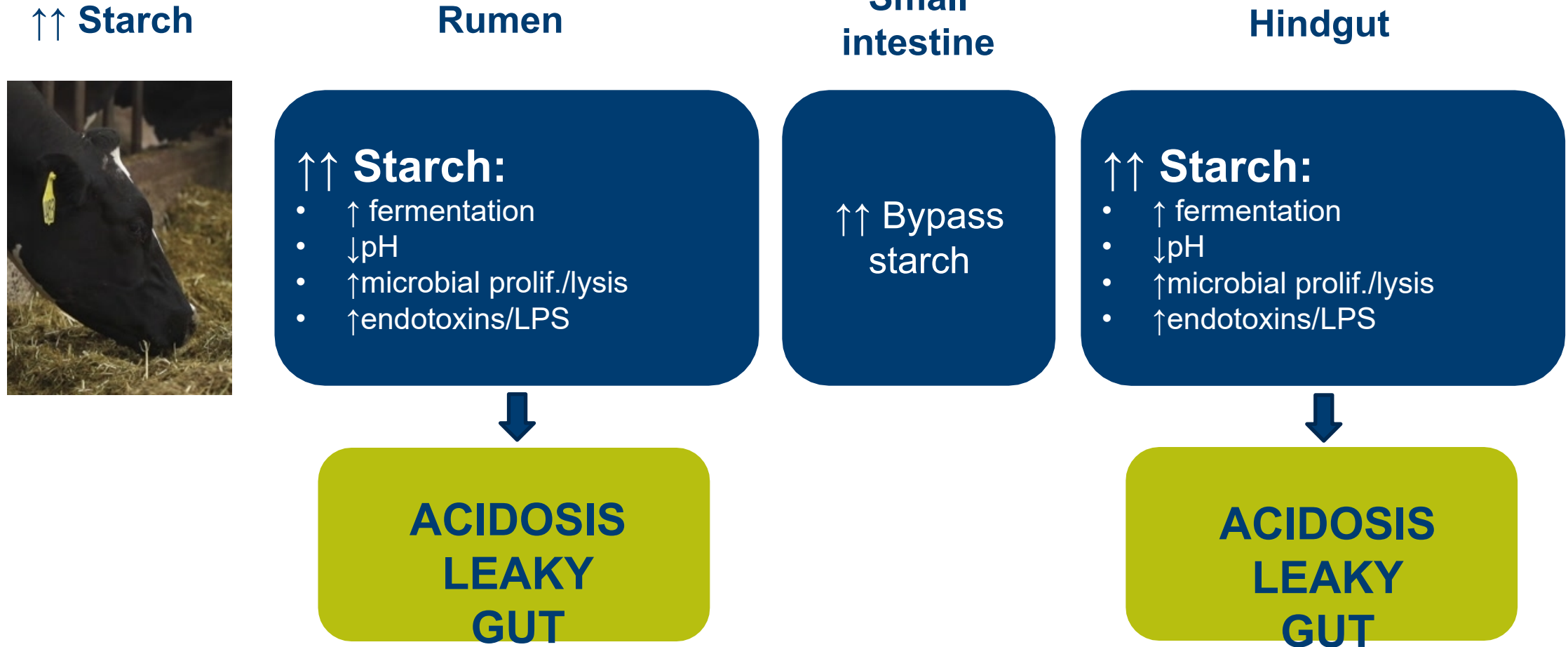
Small intestine

↑↑ Bypass starch



**ACIDOSIS
LEAKY
GUT**

High grain diets and acidosis along the GI tract

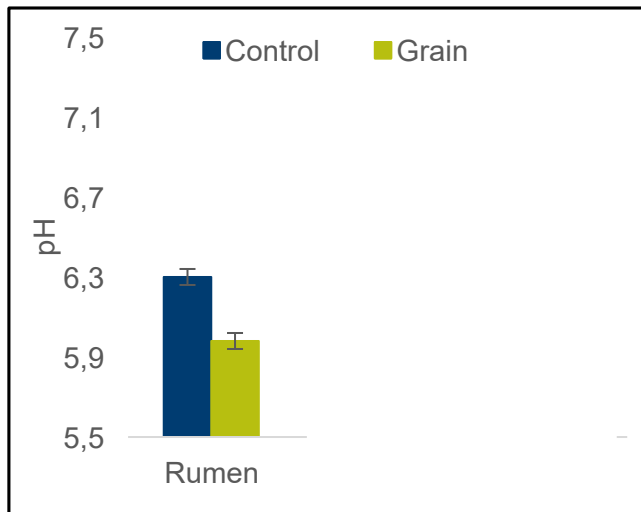


High grain diets and acidosis along the GI tract

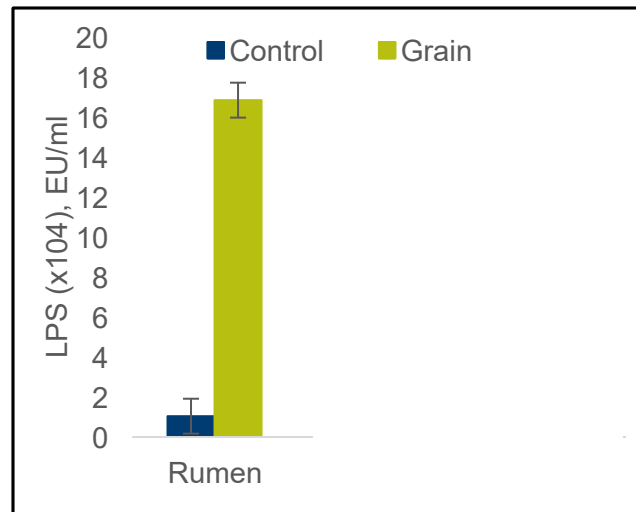
Treatments:

1. Control (↑NDF, ↓starch): 70% forage, 30% supplement
2. SARA (↓NDF, ↑starch): 36% forage, 30% wheat:barley pellet, 34% supplement

↓pH



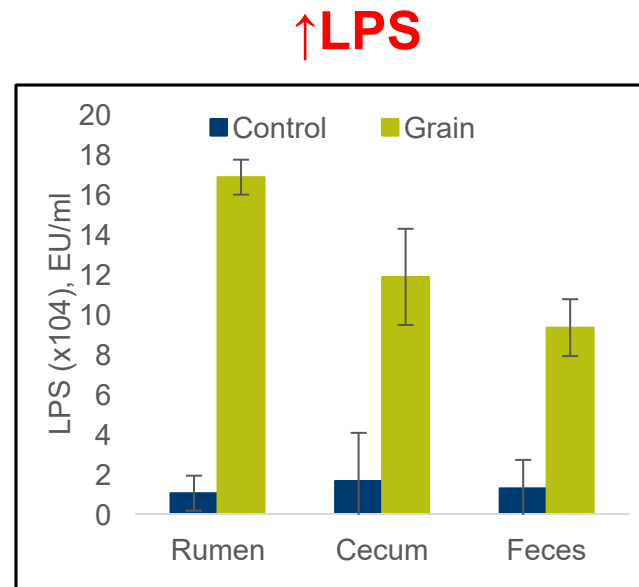
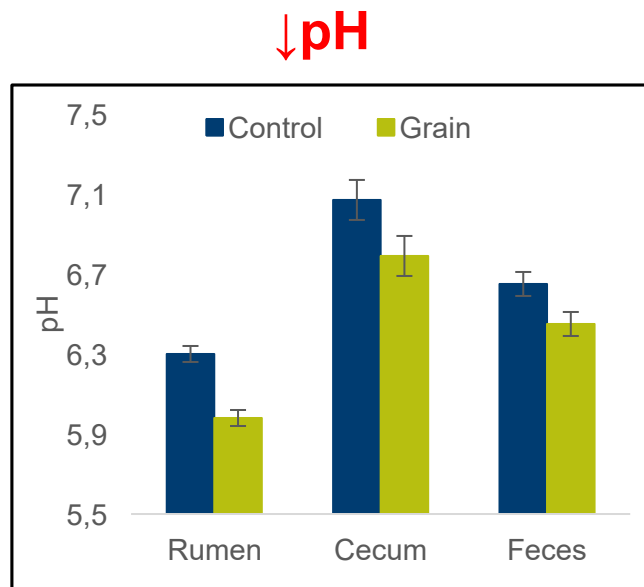
↑LPS



High grain diets and acidosis along the GI tract

Treatments:

1. Control (↑NDF, ↓starch): 70% forage, 30% supplement
2. SARA (↓NDF, ↑starch): 36% forage, 30% wheat:barley pellet, 34% supplement

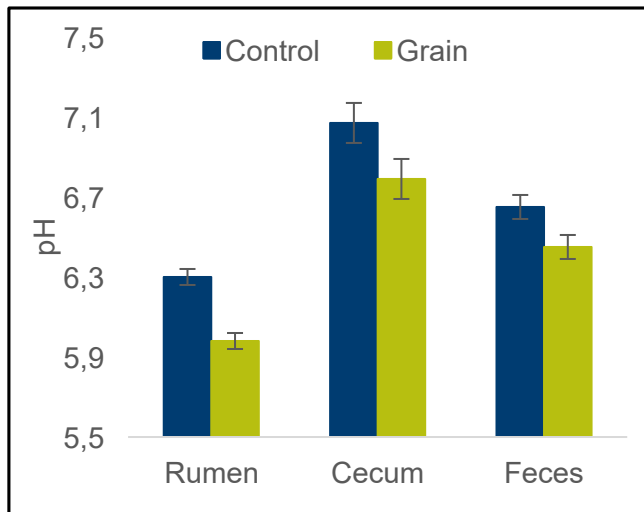


High grain diets and acidosis along the GI tract

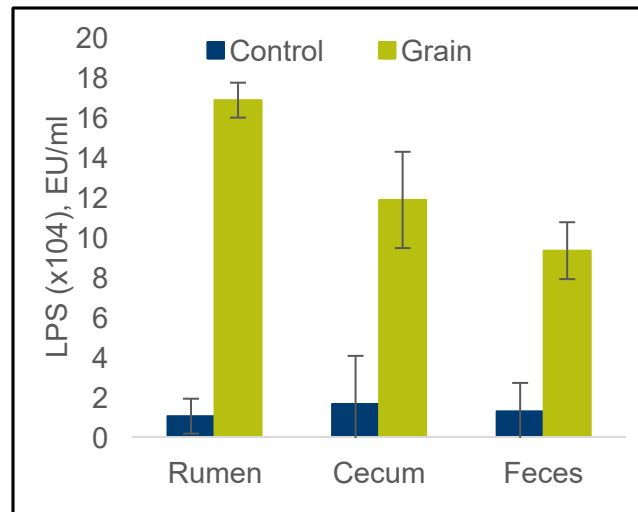
Treatments:

1. Control: 70% forage, 30% supplement
2. Subacute ruminal acidosis: 36% forage, 30% wheat:barley pellet, 34%, supplement

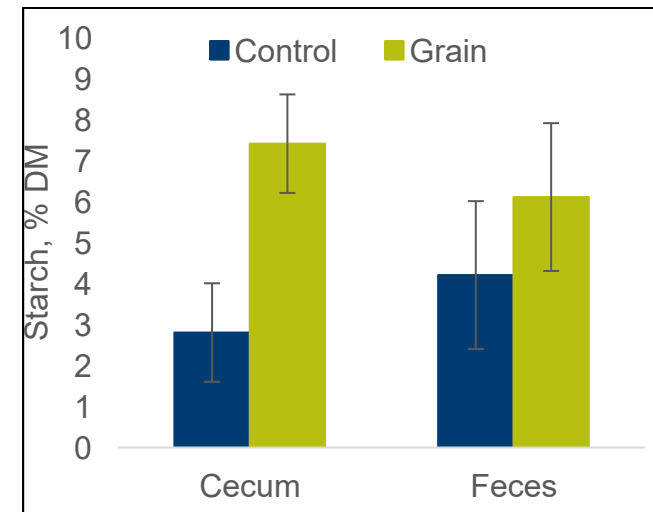
↓pH



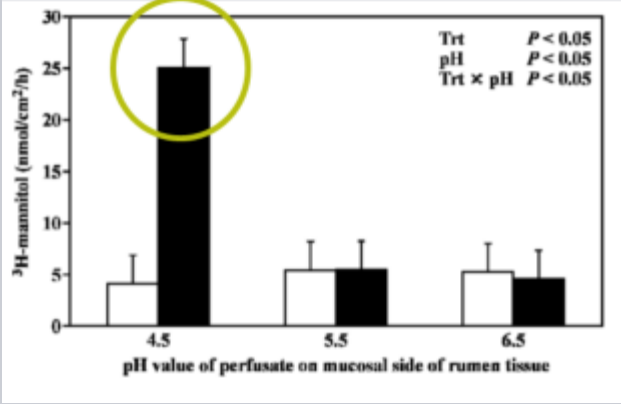
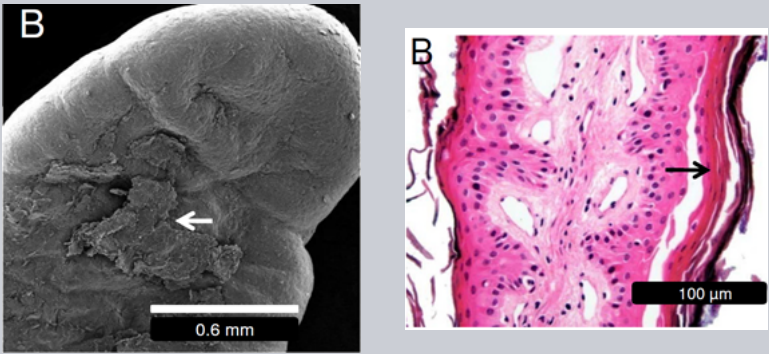
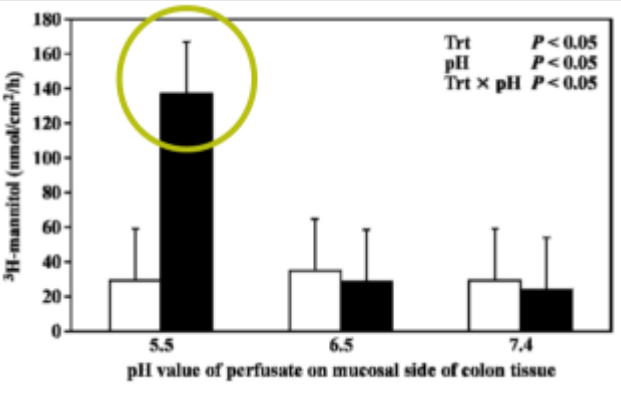
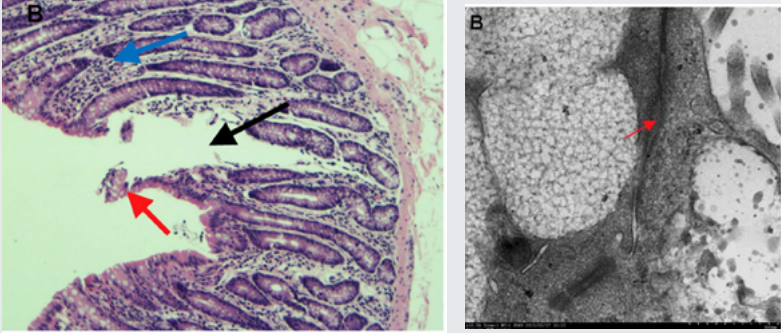
↑LPS



↑ Starch



Acidosis & gut health

	Permeability	Microscopic	Macroscopic
Rumen	 3H-mannitol (nmol/cm²/h) pH value of perfusate on mucosal side of rumen tissue Trt $P < 0.05$ pH $P < 0.05$ Trt $\times$ pH $P < 0.05$		
Hindgut	 3H-mannitol (nmol/cm²/h) pH value of perfusate on mucosal side of colon tissue Trt $P < 0.05$ pH $P < 0.05$ Trt $\times$ pH $P < 0.05$		

The hindgut might be more vulnerable

1. Structural differences

2. Differences in buffering capacity:

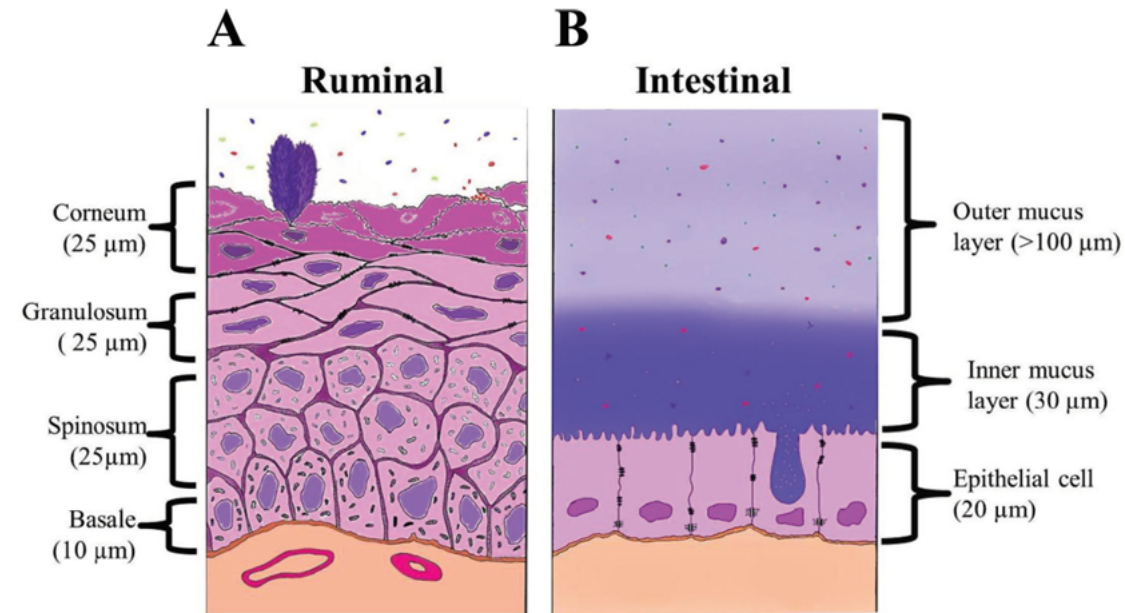
a. Lack of **saliva** and **protozoa** in the hindgut

b. Presence of **mucus layer** in the hindgut

- pH microclimate near the epithelium
unresponsive to digesta pH

3. Differences in immunity

- **Attenuated** in the rumen vs. **robust** in the hindgut



Hindgut acidosis and leaky gut

Hindgut acidosis and leaky gut



Treatments (n=4):

1. Control:

Abomasal saline

2. Hindgut acidosis:

Abomasal cornstarch



Period 1					Washout			Period 2				
D0	D1	D2	D3	D4	D1	D2	D3	D0	D1	D2	D3	D4

Hindgut acidosis and leaky gut



Treatments (n=4):

1. Control:

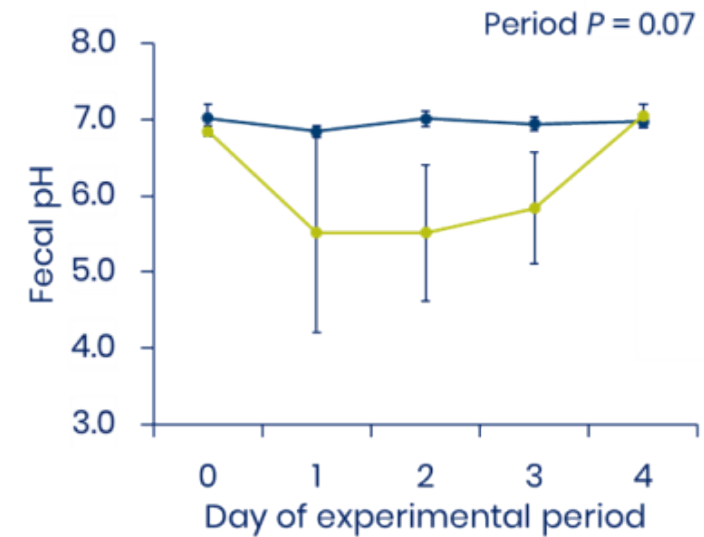
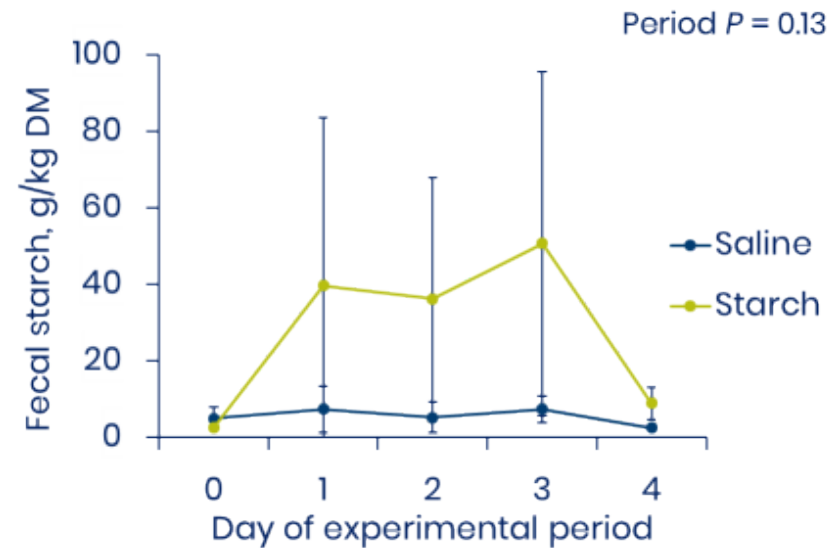
Abomasal saline

2. Hindgut acidosis:

Abomasal cornstarch



Period 1					Washout			Period 2				
D0	D1	D2	D3	D4	D1	D2	D3	D0	D1	D2	D3	D4



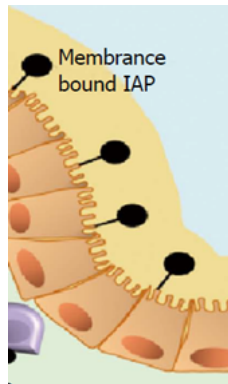
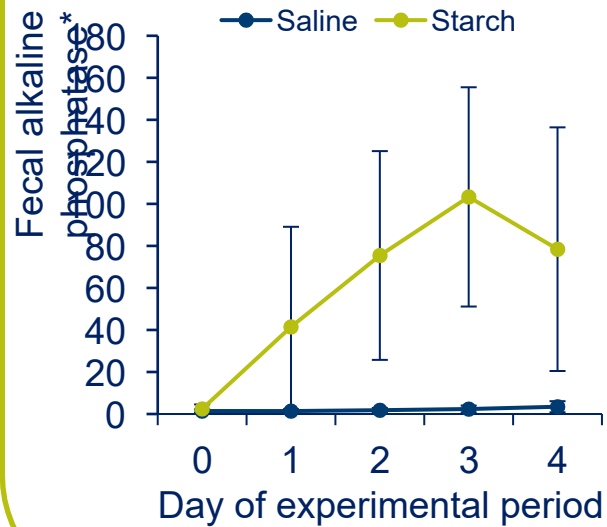
Hindgut acidosis and leaky gut

Saline

Starch

Period 1					Washout			Period 2				
D0	D1	D2	D3	D4	D1	D2	D3	D0	D1	D2	D3	D4

Intestinal damage



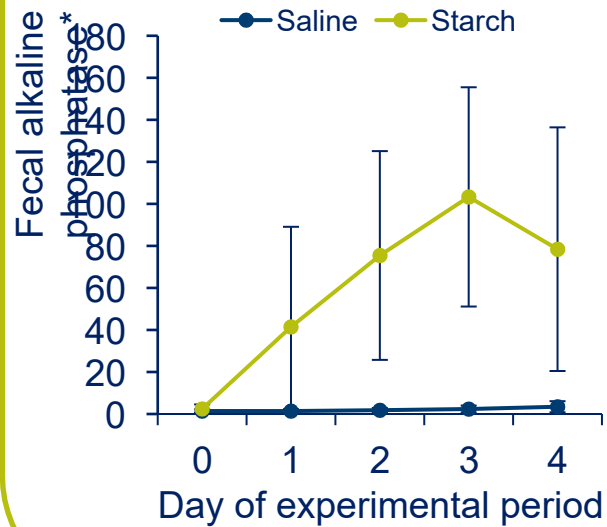
*activity, mOD 405nm/min

Hindgut acidosis and leaky gut

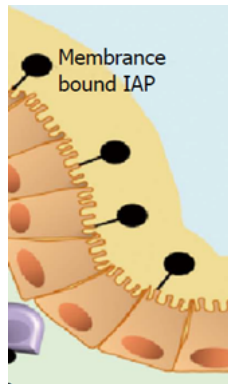


Period 1					Washout			Period 2				
D0	D1	D2	D3	D4	D1	D2	D3	D0	D1	D2	D3	D4

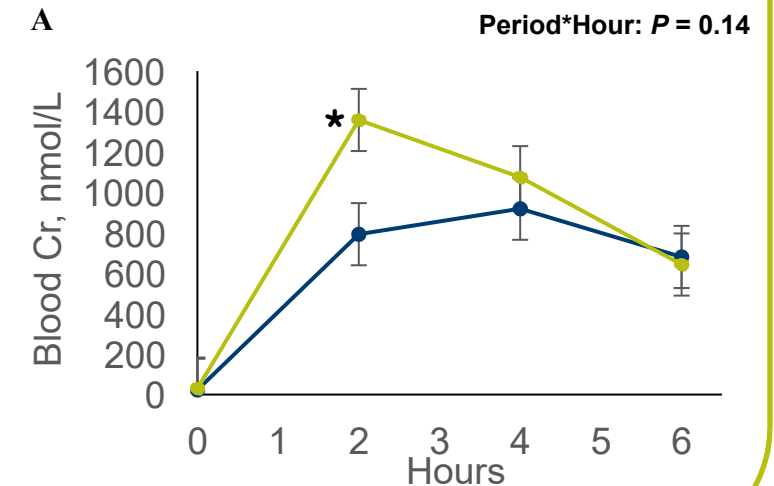
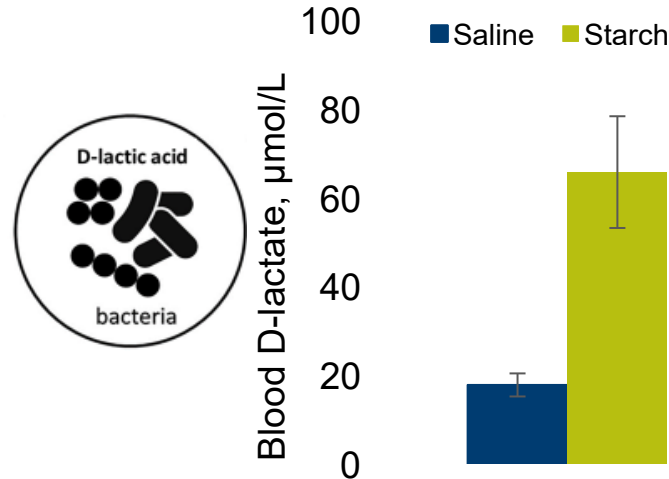
Intestinal damage



*activity, mOD 405nm/min



Increased intestinal permeability



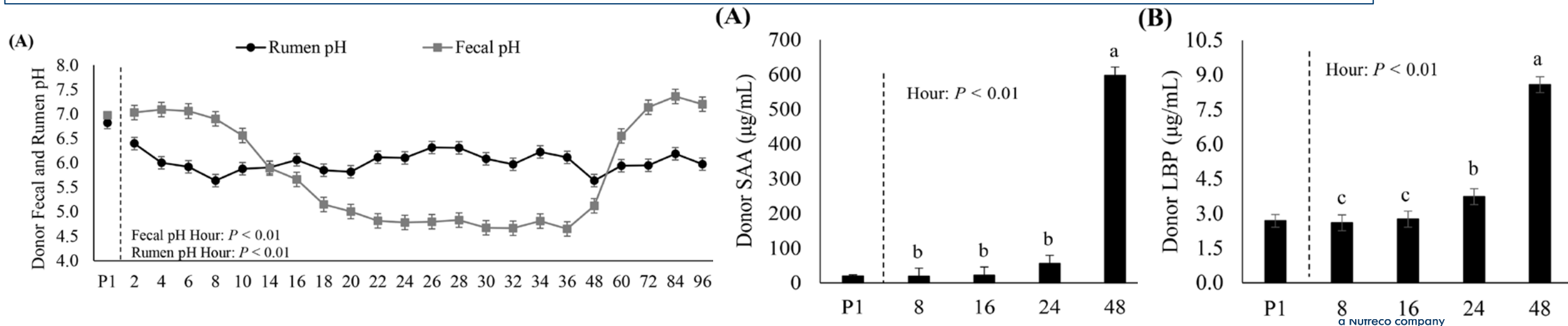
Does hindgut acidosis trigger systemic inflammation?

- Experimentally inducing SARA (with a high grain diet) results in systemic inflammation
(e.g., Gozho et al., 2005 & 2007; Khafipour et al., 2009; Li et al., 2012; Abeyta et al. 2023)
- Postruminal infusion of starch fails to induce systemic inflammation.
(e.g., Sanz-Fernandez et al., unpublished; Abeyta et al. 2023a,b,c; van Gastelen et al. 2021a,b)

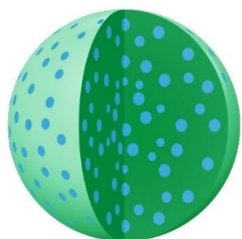
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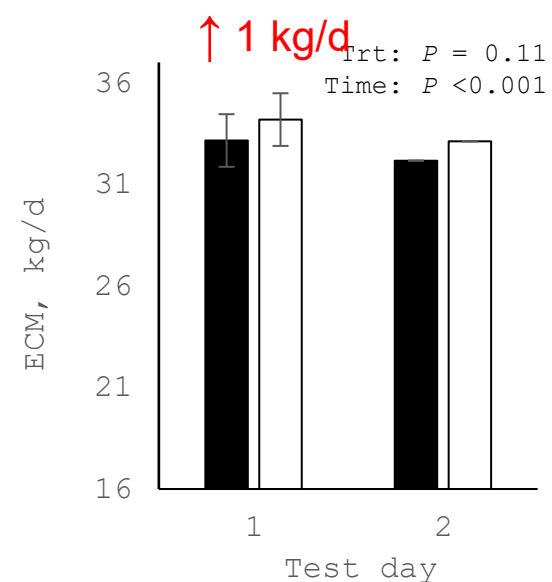
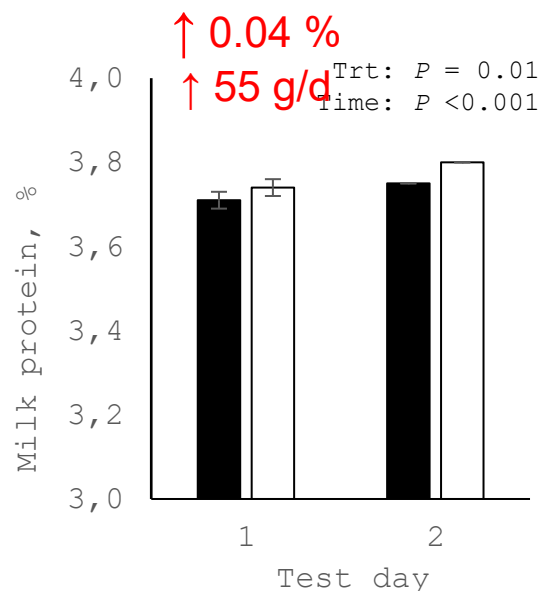
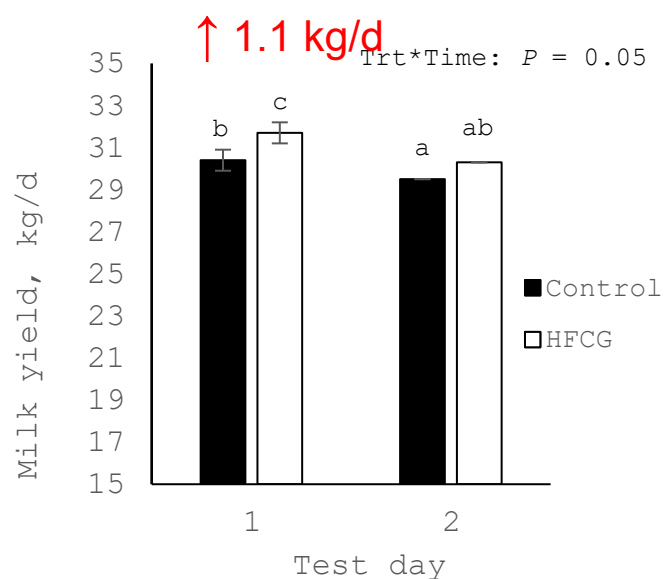
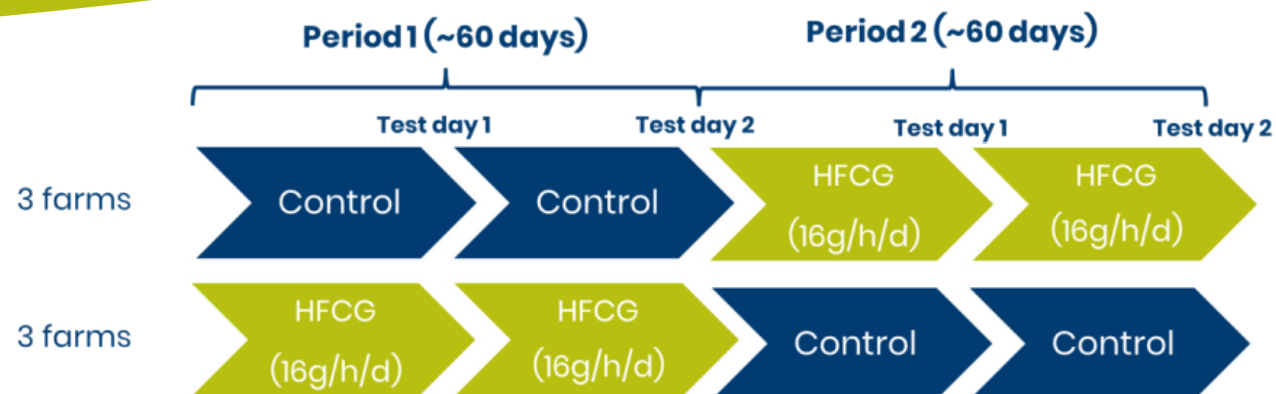
SARA inductions: 2.75% BW ground corn after 16 h of 75% feed restriction (Abeyta et al., 2023)



Cost of poor hindgut health

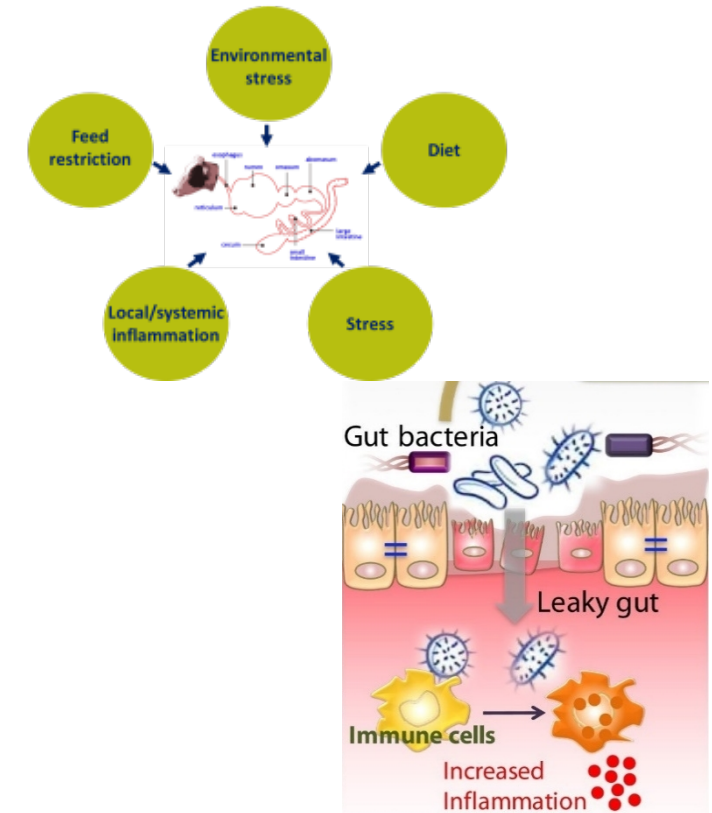
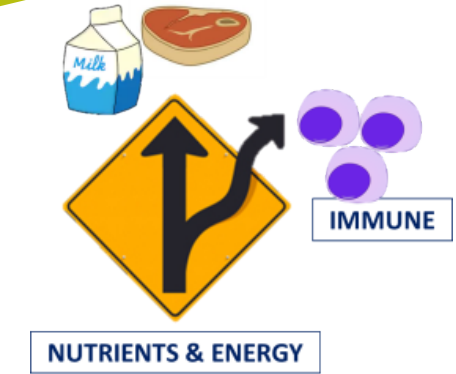


Fat-embedded Ca gluconate:
Novel postruminal prebiotic



Conclusions

- Inflammation is a costly process from an energy and nutrient point of view
 - Inflammation is associated with metabolic disease
- Multiple factors in the productive cycle of cows represent a challenge for gastrointestinal health
 - The GI tract likely contributes to inflammation around calving
- Poor hindgut health negatively impacts whole body energetics and performance



A woman with dark hair tied back, wearing a blue lab coat, is smiling and looking towards a cow. She is holding the cow's head. The background is a barn with other cows. The entire image has a yellow overlay.

Thank you

HEALTHYLIFE

 **trouw nutrition**
a Nutreco company