Visible inflammation of the rumen wall correlates with caecal lipopolysaccharide concentrations

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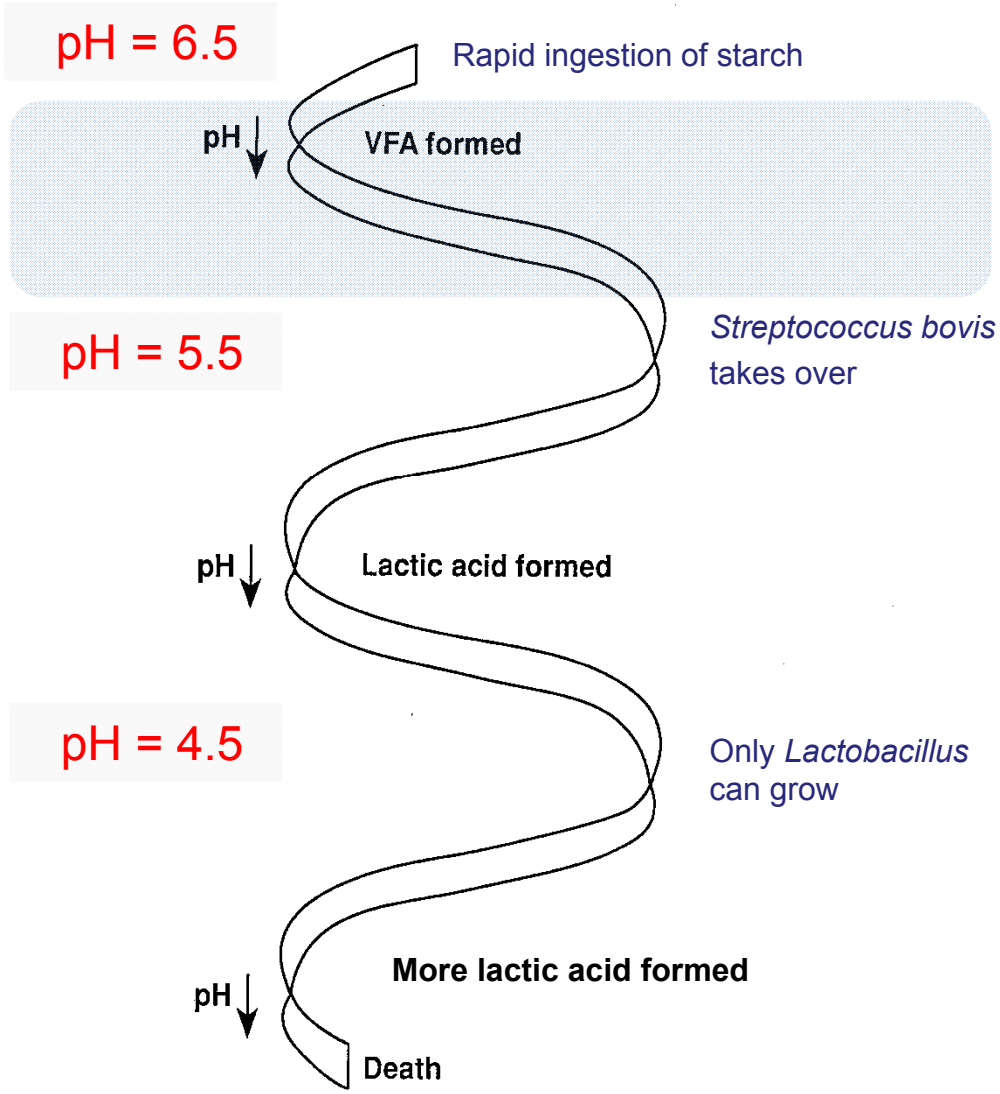
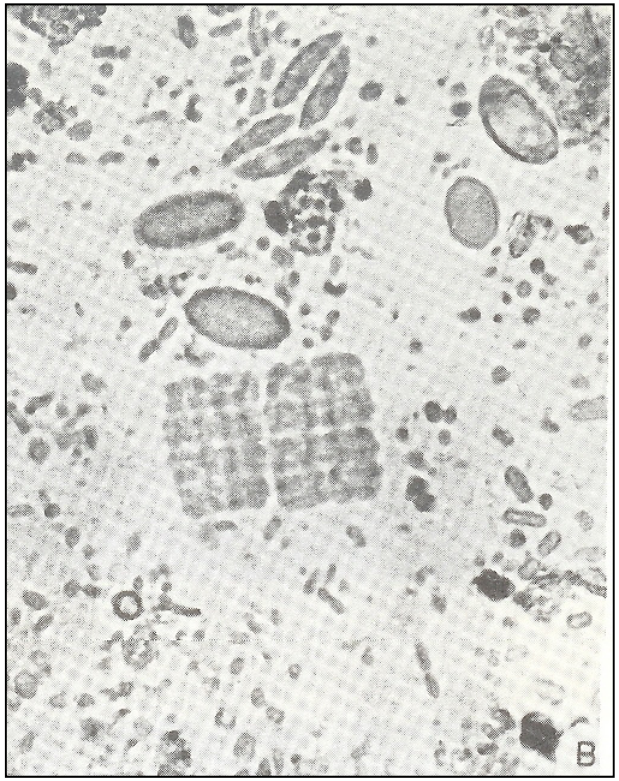
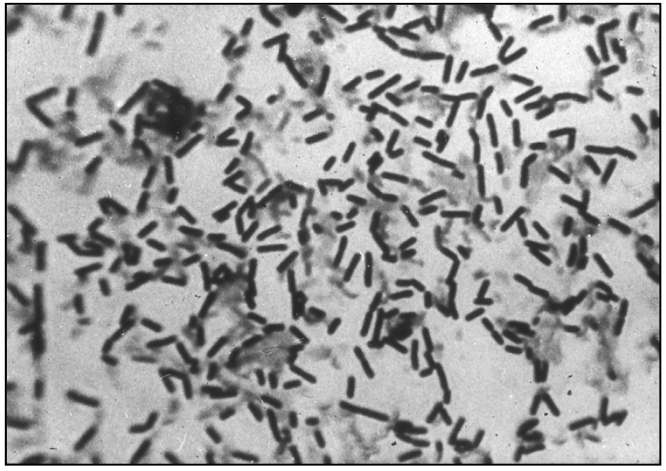
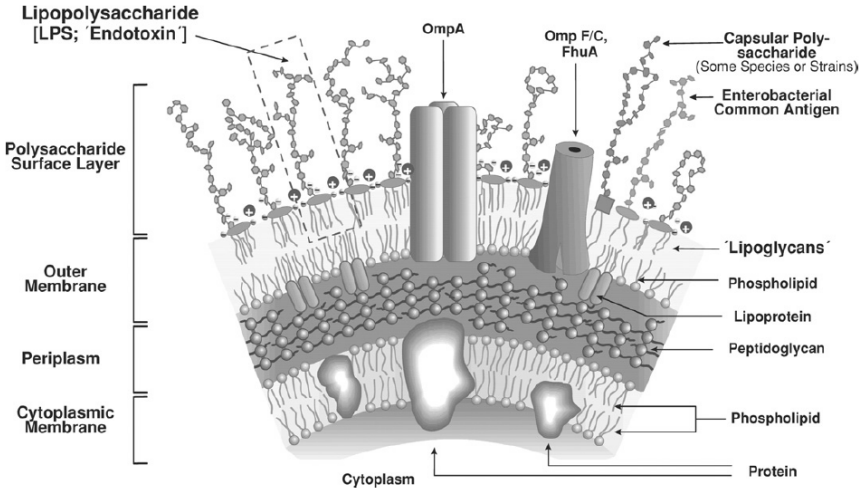
Sub-acute ruminal acidosis





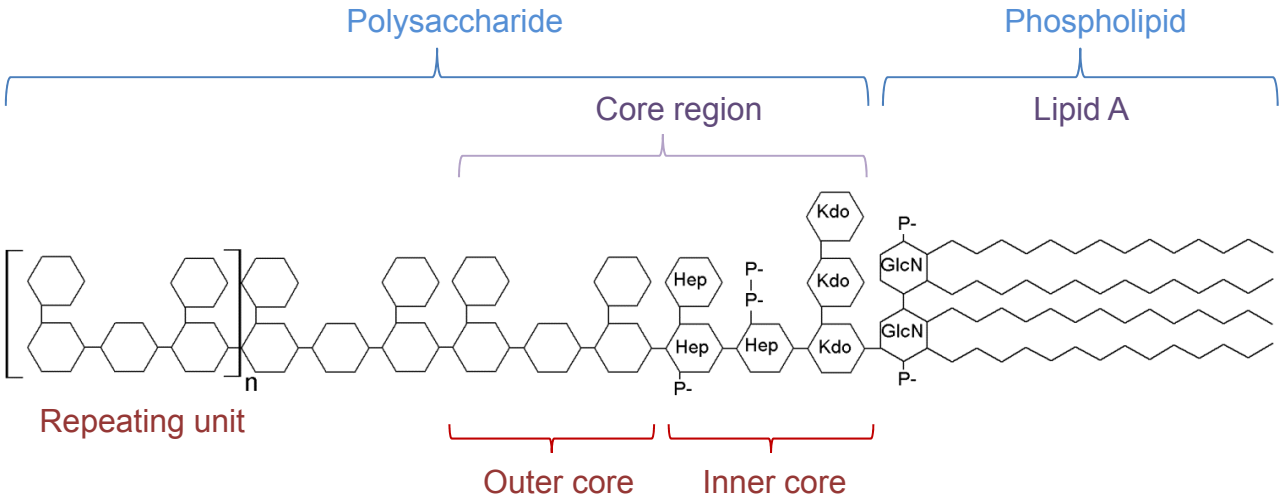


Lipopolysaccharide (LPS) / endotoxin



Component of **Gram negative** bacteria

Released when cells **lyse** – especially at **low pH**

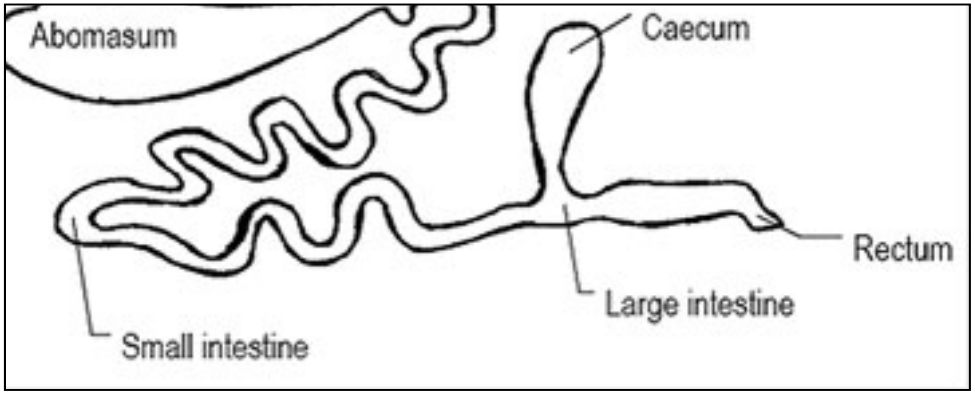


Plaizier et al. 2012. Anim. Feed Sci. Tech. 172:9-21.

Potential role of the hindgut in SARA?

- "**Translocated LPS** during SARA may **aggravate ruminal acidosis**" (Jing et al., 2014)

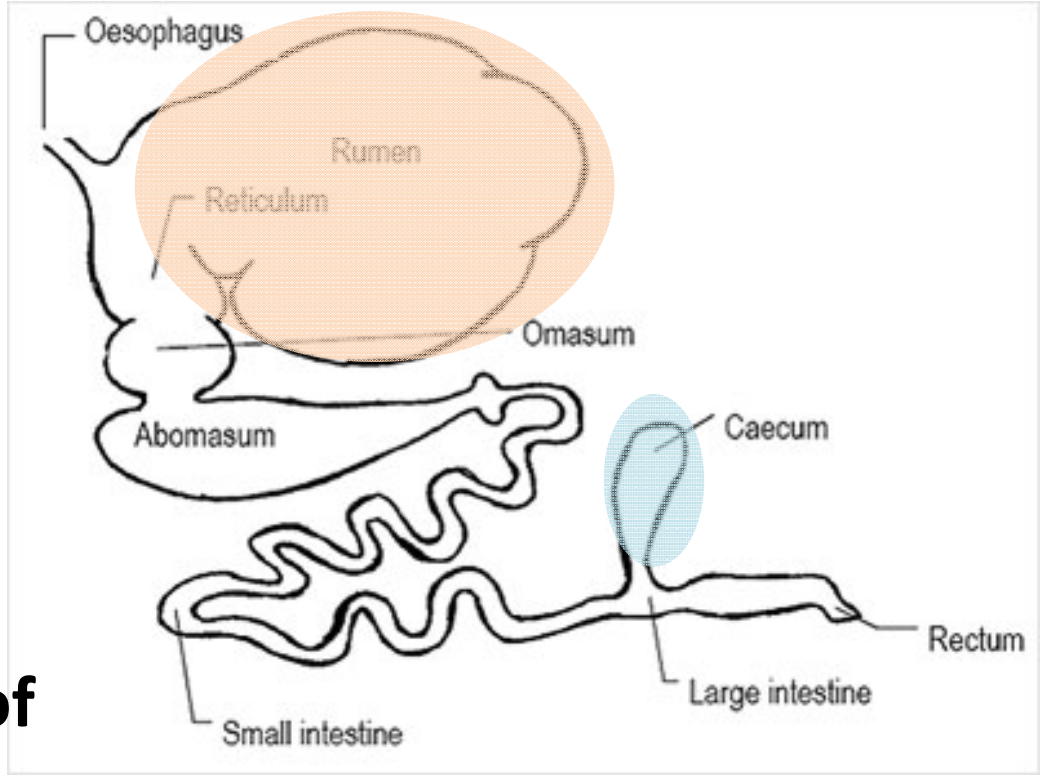
- "The **hindgut is less capable (than the rumen) of maintaining digesta pH during times of increased VFA production**" (Gressley et al., 2011)



Jing et al. 2014. Br. J. Nutr. 112:170-182. Gressley et al. 2012. J. Anim. Sci. 89:1120-1130.

Aims and Objectives

- Determine LPS concentrations
  - In the **rumen** AND **hindgut**
  - In ruminants from **commercial farms** (Low/high risk)



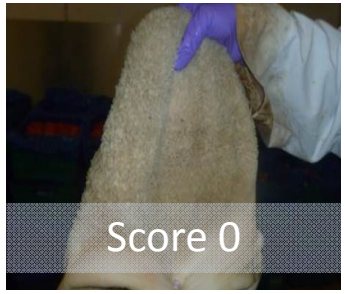
- Record **visible signs of damage**

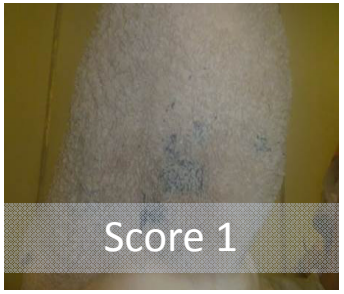
Animal Study

- In total **98** continental crossbred steers and heifers from **5 farms**
- **Rumen damage scores** used to assess condition of rumen wall
  - Both pre- and post-cooking
- **Ruminal fluid** and **caecum content** collected
- Lab analyses: *Limulus*-amebocyte lysate (LAL) assay used to quantify LPS (EU/mL), VFAs quantified by GC

Rumen Scoring

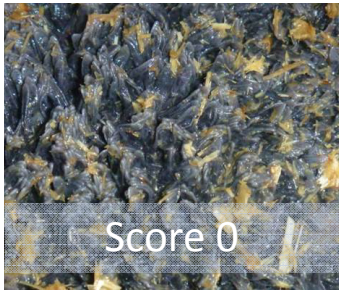
Post-cooking appearance

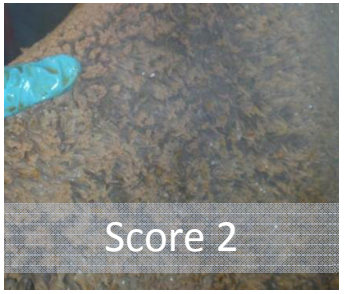




0 = No blackened areas, 1 = very small blackened areas, 2 = small blackened areas, 3 = moderate blackened areas, 4 = large blackened areas

Papillae integrity





0 = No damage, 1 = small areas bare, 2 = larger areas bare, 3 = moderate areas of damage, 4 = large areas of damage.

Rumen Scoring

Papillae pinkness

0 = Black/brown, 1 = grey/brown, 2 = grey/brown small areas with pink tips, 3 = grey/brown large areas with pink tips, 4 = pink.

Papillae shape

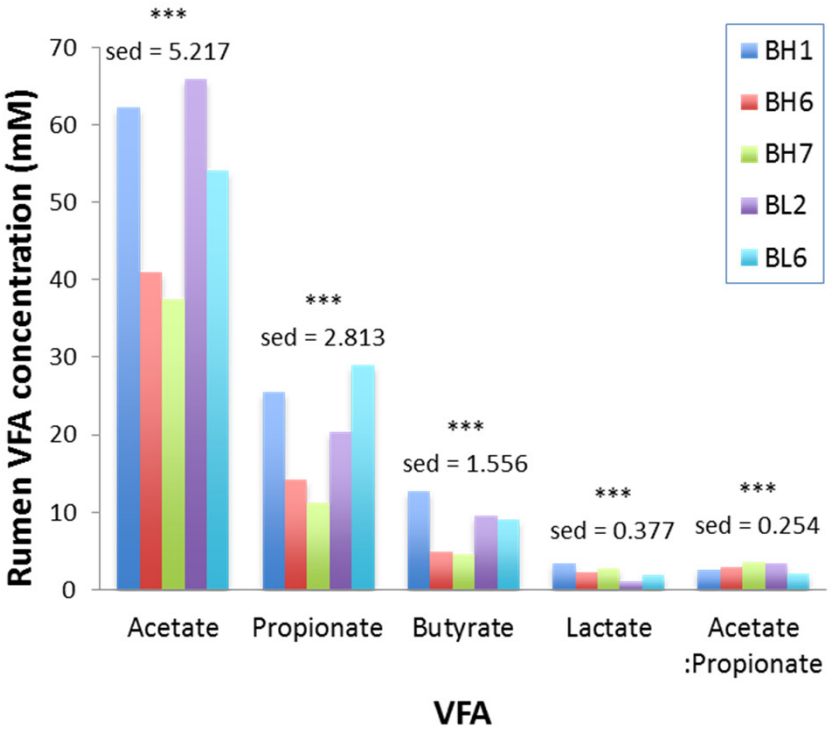
0 = Long & thin, 1 = Long + oval, 2 = Short & thin, 3 = short & oval, 4 = short & brittle.

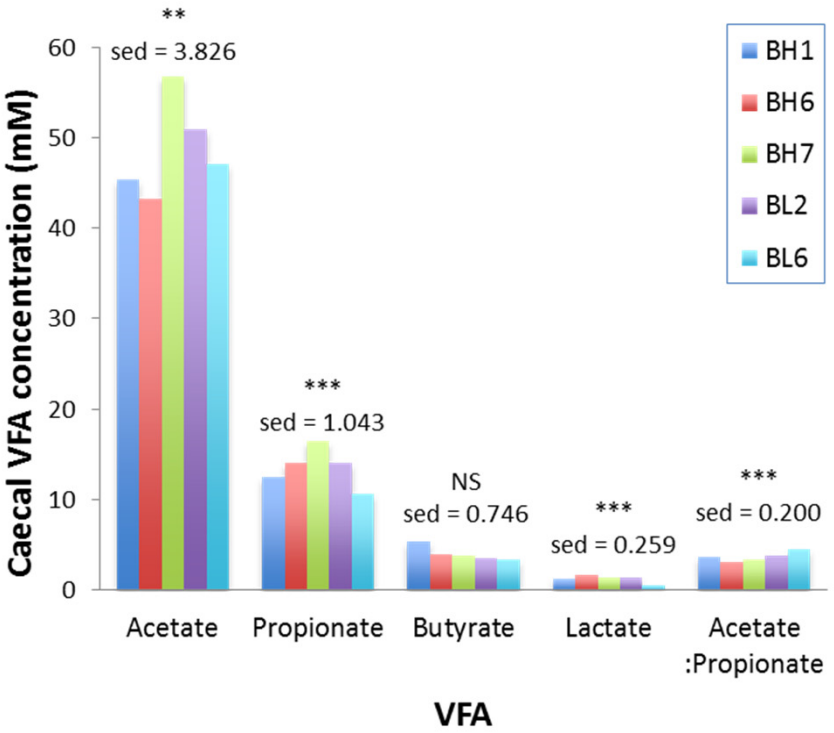
Results – LPS concentration

	Farm						
LPS (10^6 EU/mL)	BH1	BH6	BH7	BL2	BL6	s.e.d.	Sig.
Rumen	0.068	0.136	0.056	0.116	0.072	0.024	0.003
Caecum	0.624	0.125	0.879	0.537	1.976	0.208	<0.001

- **10-fold** higher concentration of **LPS in caecal** compared to **ruminal digesta**
- Significant **differences between farms**
- **High variation**

Results – Volatile Fatty Acids





- Significant **difference between farms**
- **Lactate levels low** – not acute acidosis
- **High variation**

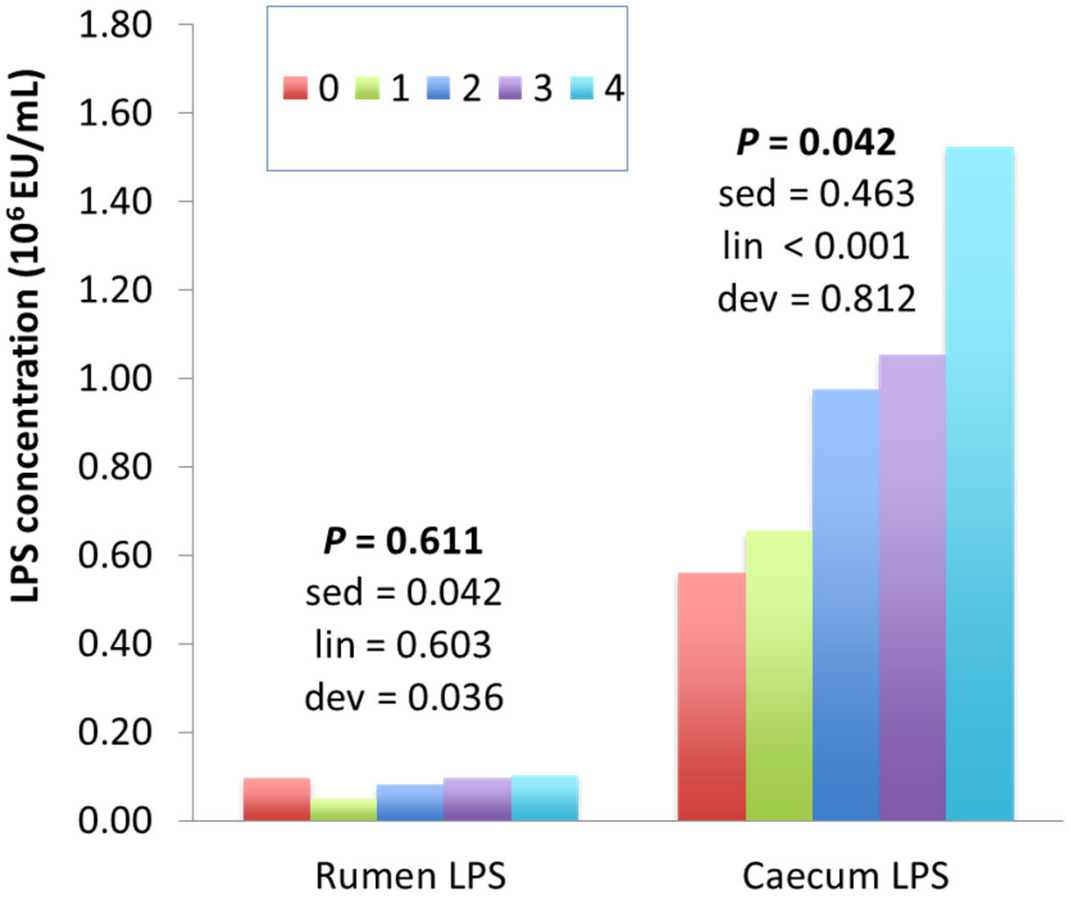
Results – Rumen damage scores

	Papillae integrity								
LPS (10^6 EU/mL)	0 (n = 85)	1 (n = 8)	2 (n = 3)	3 (n =1)	4 (n = 1)	s.e.d.	Sig.	lin	dev
Rumen	0.089	0.080	0.038	0.026	0.438	0.099	<0.001	0.909	<0.001
Caecum	0.823	1.260	0.668	0.576	0.042	0.127	0.599	0.364	0.979

0 = No damage, 1 = small areas bare, 2 = large areas bare, 3 = small areas of damage, 4 = large areas of damage.

- **Papillae integrity** appears to be **related to ruminal LPS** – but results are **not conclusive**
- **No significant results** for:
  - Papillae shape
  - Post-cooking appearance

Results – Rumen damage scores



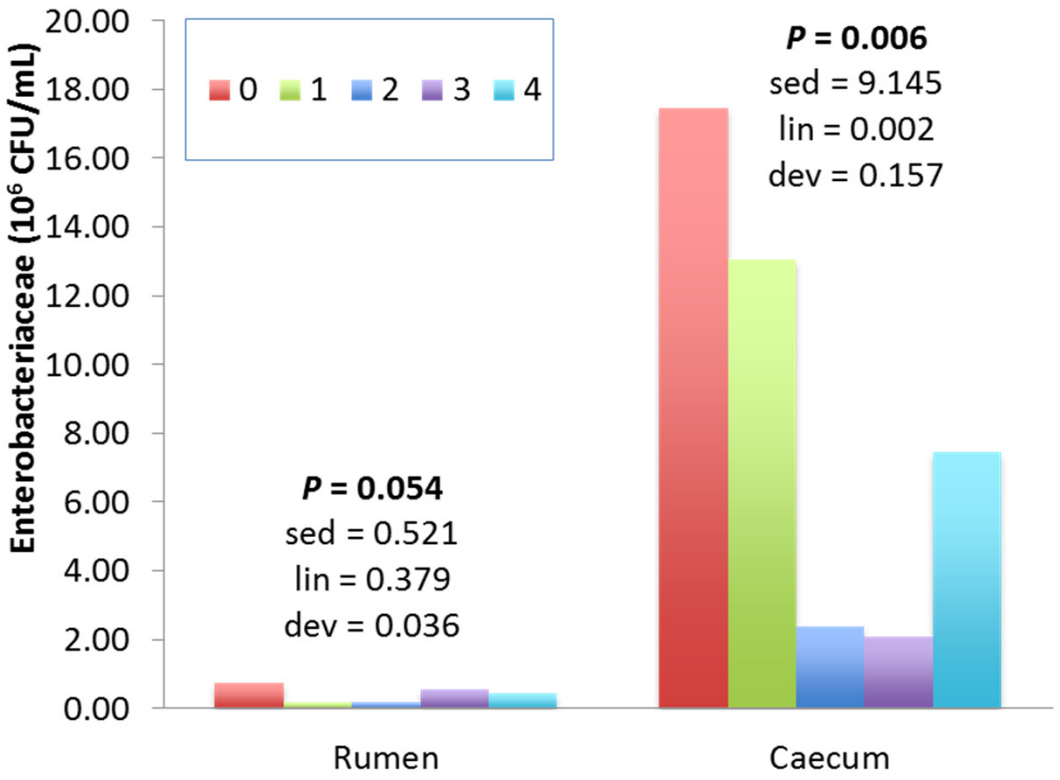
0 = Black/brown, 1 = grey/brown, 2 = grey/brown small areas with pink tips, 3 = grey/brown large areas with pink tips, 4 = pink.

Significant linear relationship between **caecal LPS** and **papillae pinkness**

Example of Score 0

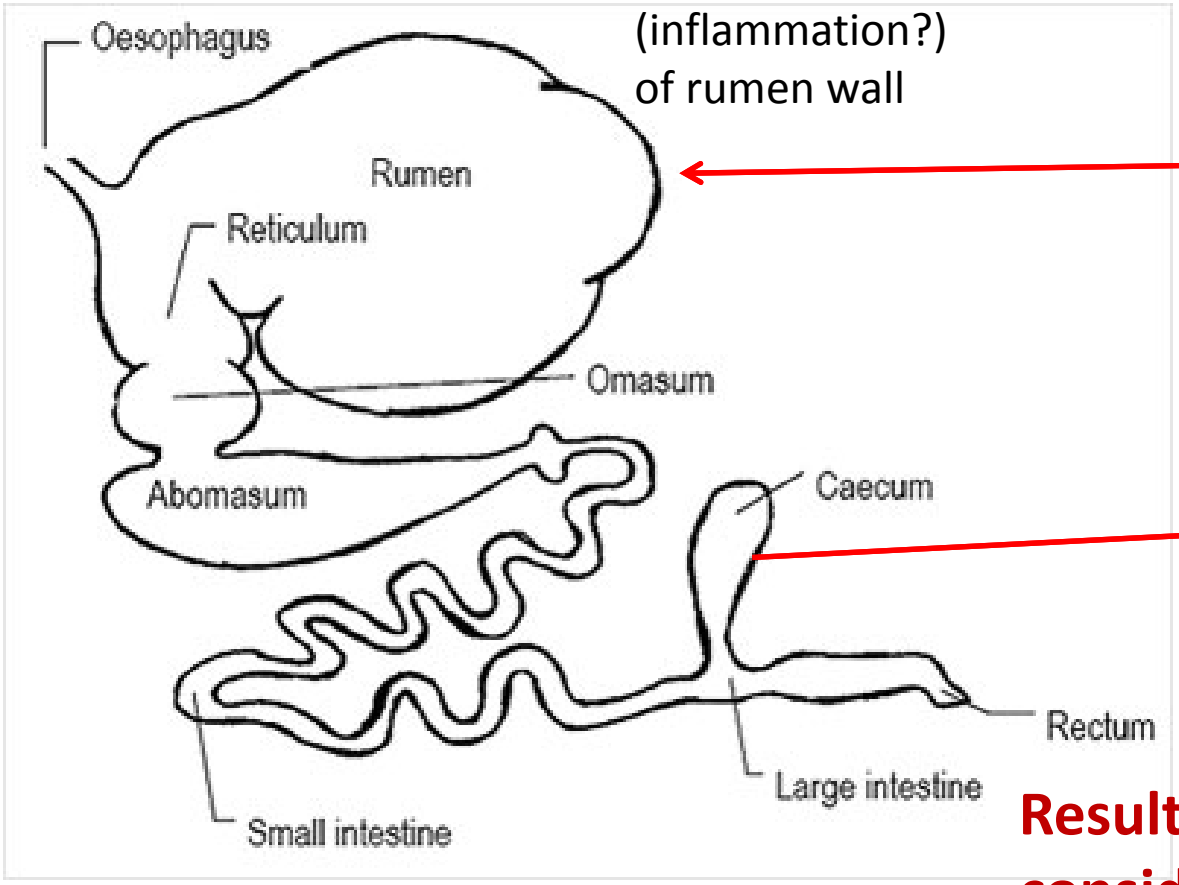
Example of Score 4

Results – Rumen damage scores



0 = Black/brown, 1 = grey/brown, 2 = grey/brown small areas with pink tips, 3 = grey/brown large areas with pink tips, 4 = pink.

LPS and rumen pre-cooking colour



Pinkness (inflammation?) of rumen wall

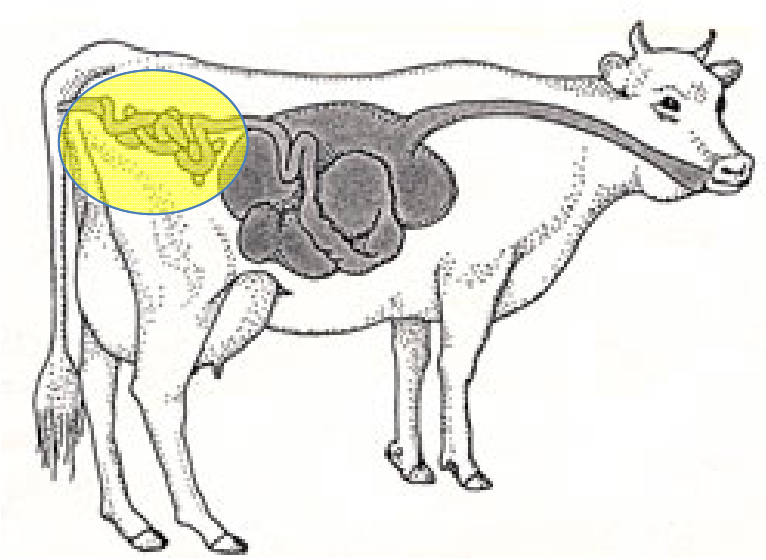
Inflammation cascade

LPS from caecum translocates into bloodstream

Results highlight the need to consider the role of the hindgut in the pathology associated with SARA

Conclusions

- **Caecal LPS** much **higher** than **rumen LPS**
- **Caecal LPS** and not ruminal LPS **correlated with visible inflammation of the rumen wall**
- Thus, some **inflammation associated with SARA** may actually **originate in the lower gut**



Acknowledgements

Rowett Institute of Nutrition and Health
University of Aberdeen
Nest McKain
Shirley Motta
Dinesh Thapa
Thulile Sgwane
Hugh Galbraith

University of Glasgow
Holly Ferguson

University of Strathclyde
Craig Michie
Ivan Andonovic

Harbro
Willie Thomson

Chr Hansen
Ida Hindrichsen
Lars Moelbak

Dairy Co
Jenny Gibbons

Quality Meat Scotland
Uel Morton
Charlotte Maltin

Ab Vista
Nicola Walker

BBSRC

Abattoir Staff

The farmers!