Dietary resistant potato starch alters immunological status and microbial populations in swine to limit *Salmonella*

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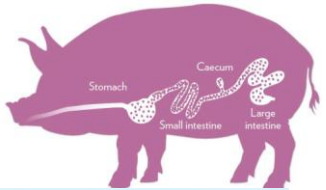
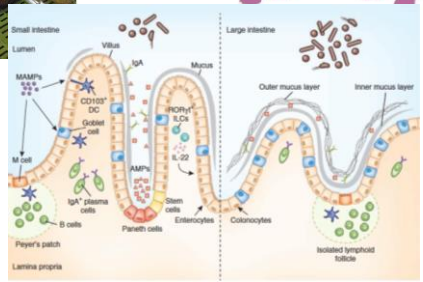




Nature Immunology, 14 (7) July 2013

What is purpose of alterbiotic administration?

*Alterbiotic – bio-approach to modulate intestinal status

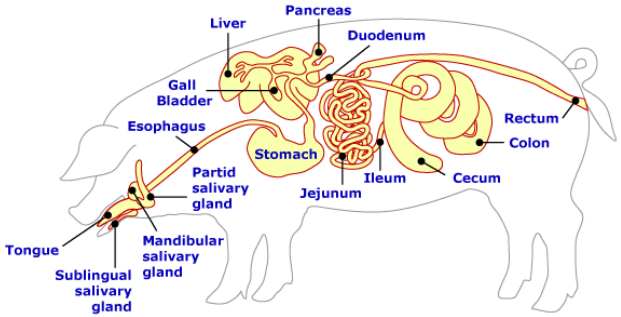
- Promote growth (nutrient uptake)?
- Modulate immune status?
- Enhance intestinal integrity?
- Modulate microbial composition or function?
- Prevent or limit infection/colonization?

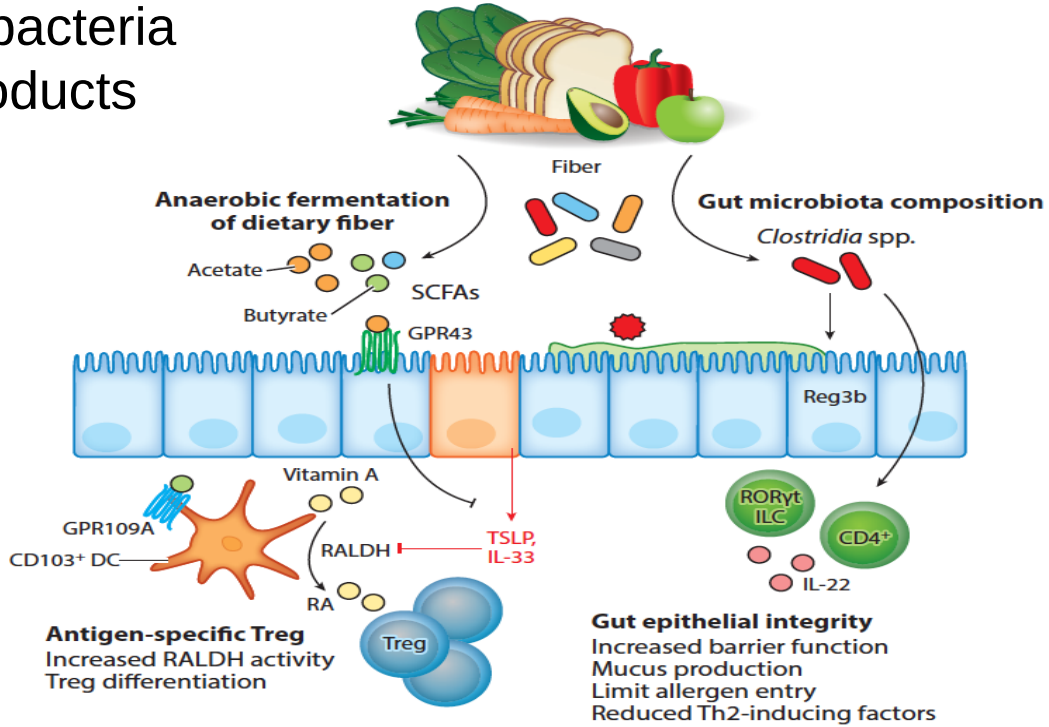
- Determining the mode of action of various alterbiotics will allow for targeted applications in production.

Fermentation products can alter immune cellular responses and status

Enhanced growth of beneficial bacteria producing micronutrient end products (eg., short chain fatty acids):

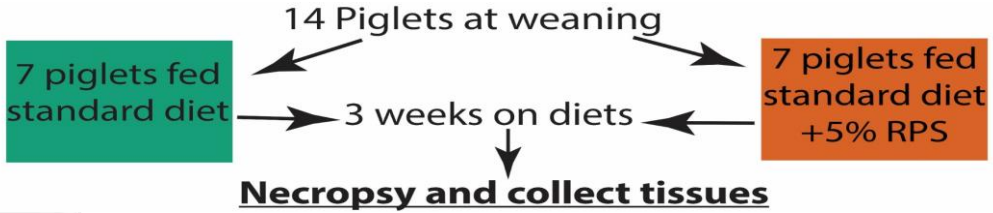
- Butyrate, etc





Dietary resistant starch and immune status

- Does addition of 5% resistant starch (raw potato starch, RPS) to swine diet modulate:
  - Intestinal microbial populations & short-chain fatty acid levels?
  - Intestinal immune status?
    - T-regulatory cell populations? IgA-secreting cells?
    - Local defense proteins or cytokines?



Dietary Resistant Potato Starch Alters Intestinal Microbial Communities and Their Metabolites, and Markers of Immune Regulation and Barrier Function in Swine

Julian Trachsel[1,2], Cassidy Briggs[1,3], Nicholas K. Gabler[4], Heather K. Allen[1] and Crystal L. Loving[1]**

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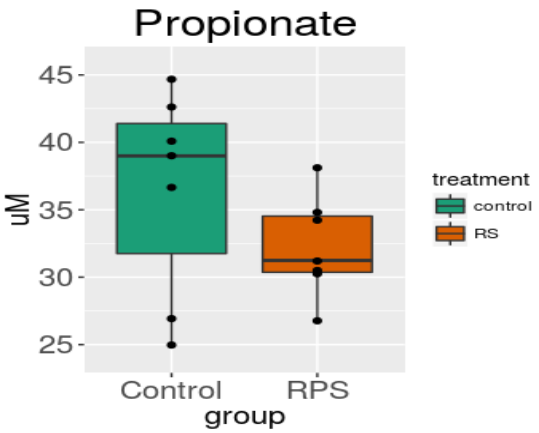
Frontiers in Immunology, 2019

Dietary resistant potato starch (RS) increased cecal SCFA levels



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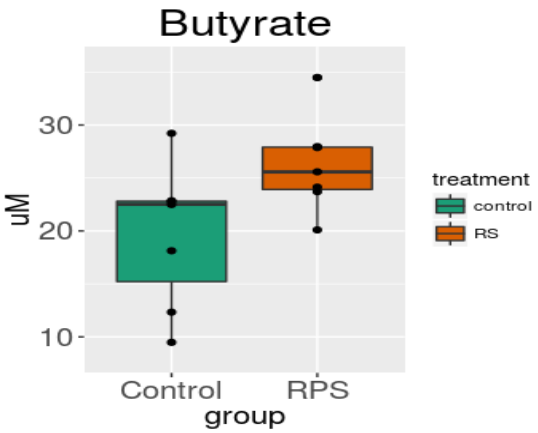

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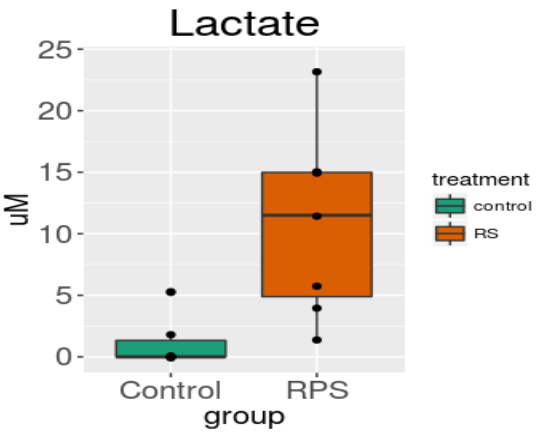
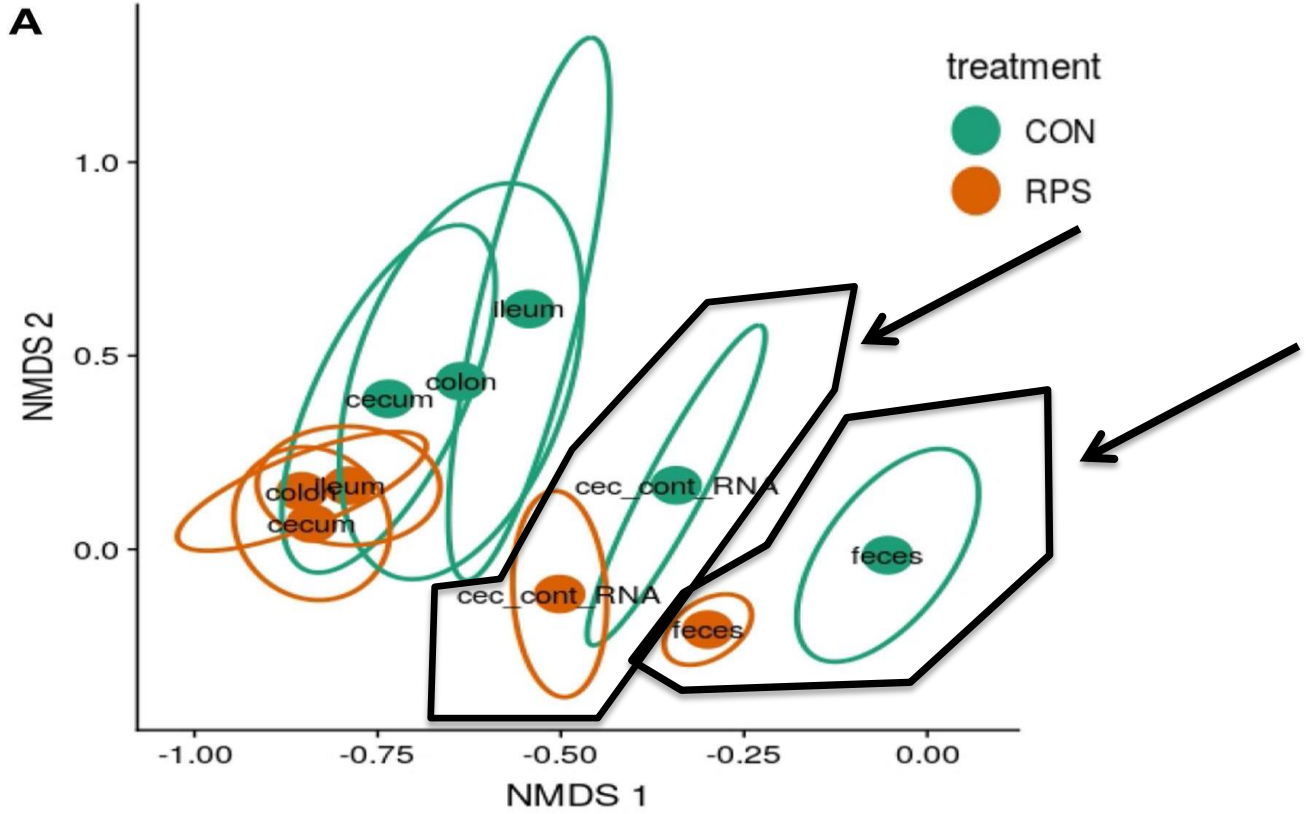


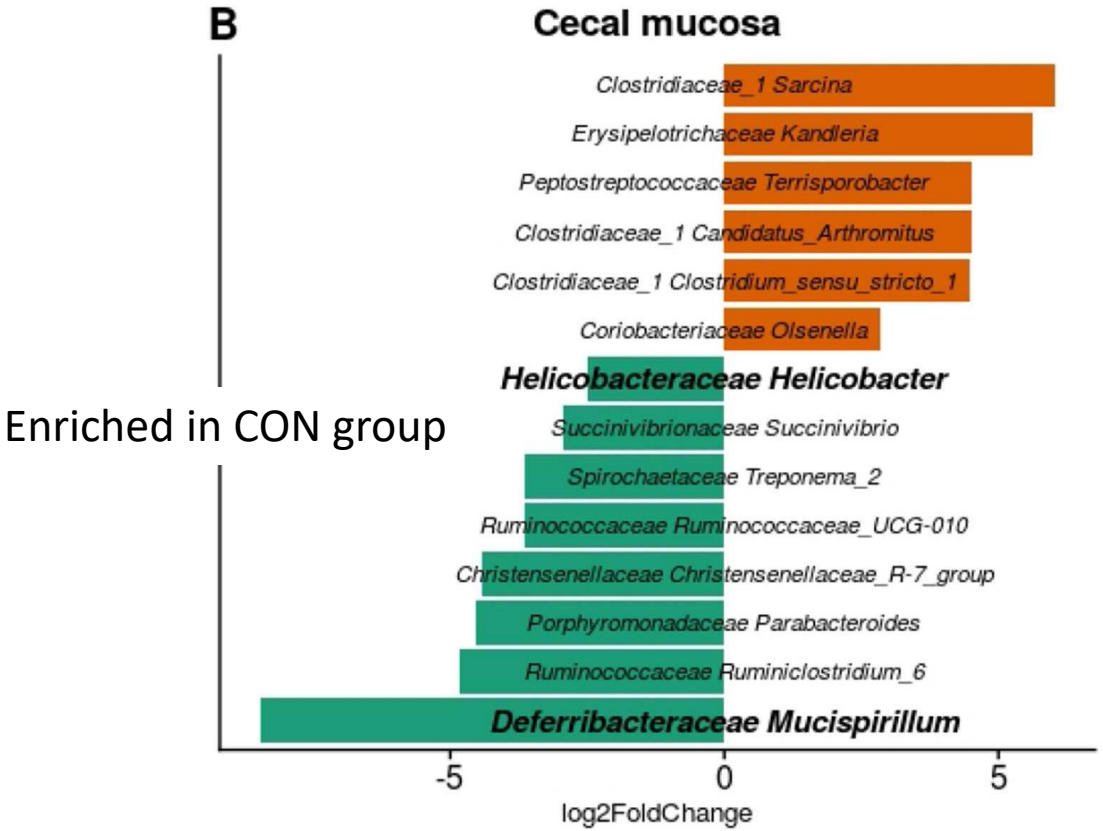
p = 0.01

- Increased butyrate and lactate in cecal contents of pigs fed RPS (raw potato starch)

Dietary RPS modulated microbial community structure



Microbial communities altered by dietary RS

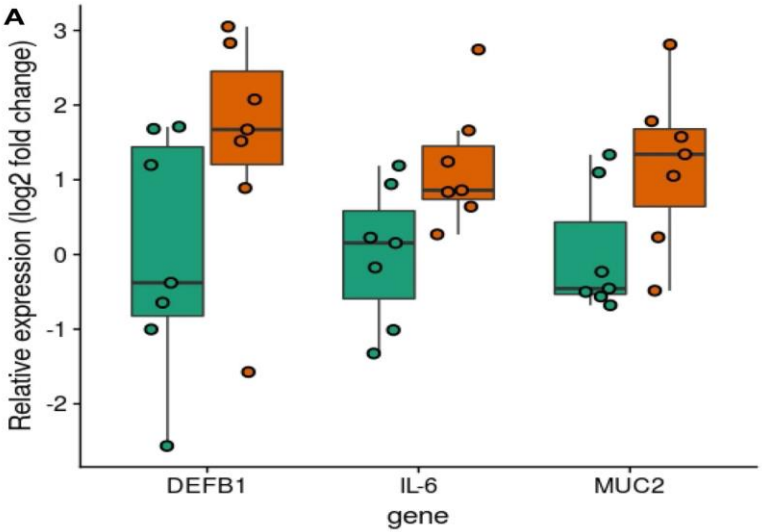


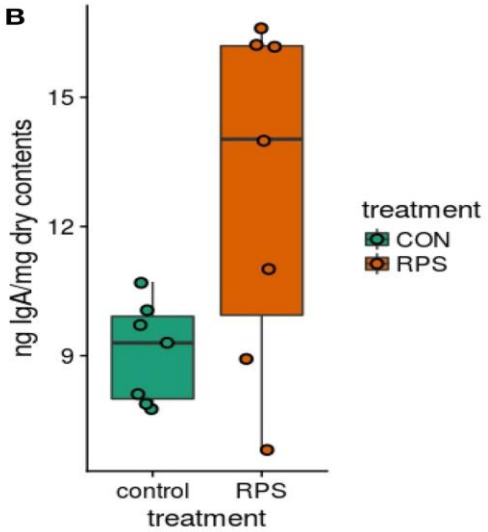
Enriched in RPS group

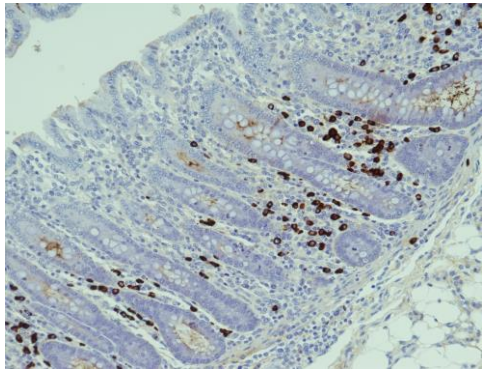
Enriched in CON group

Genera in bold:
harbor species with capacity for respiration

Dietary RPS altered mucosal immune status





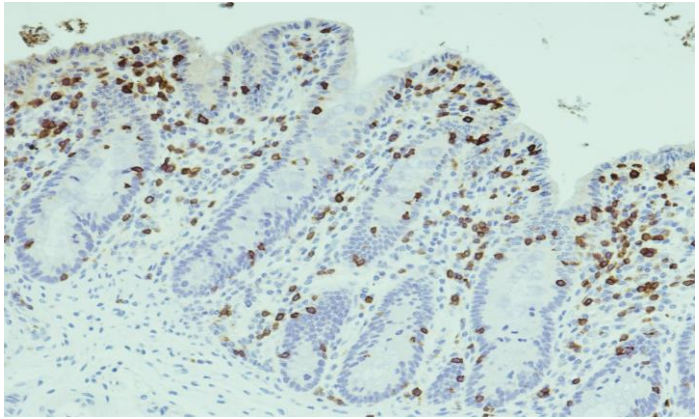


IgA staining - Cecum

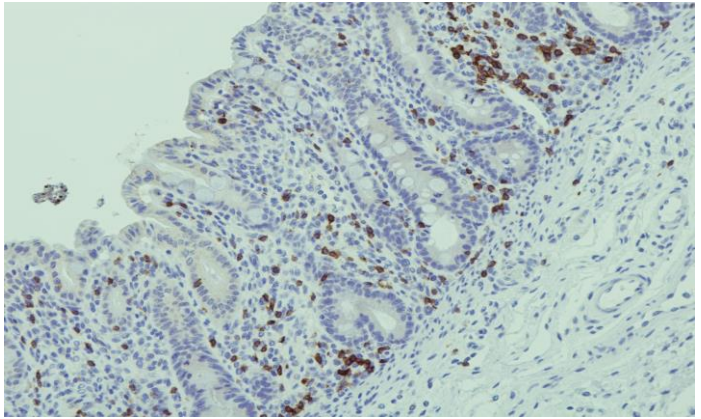
Increased cecal expression of genes associated with epithelial integrity

Increased levels of total IgA in feces, but no increase in IgA+ cells in cecum

RPS did not alter abundance of cecal T cells



Control Pig: CD3+ cells



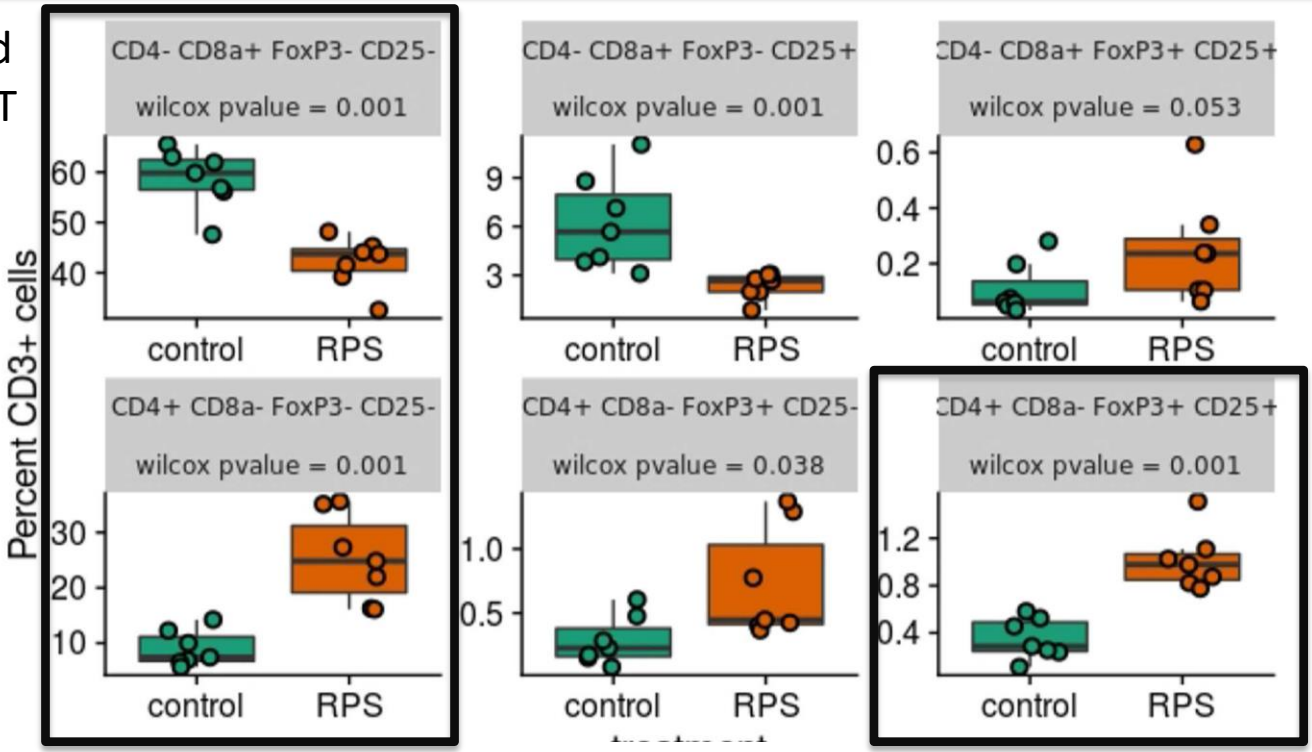
RS Pig: CD3+ cells

- No overall difference in #CD3+ T cells between groups

Dietary RPS altered cecal Treg cell frequency

Decreased cytotoxic T cells

Increased CD4+



Increased T regs

No differences in total CD3+ cells – differences in phenotype of T cells present

Dietary RPS as an alterbiotic

*Alterbiotic – bio-approach to modulate intestinal status

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- ✓ **Enhance intestinal integrity**
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- Determining the mode of action of various alterbiotics will allow for targeted applications in production.

Dietary RPS as an alterbiotic

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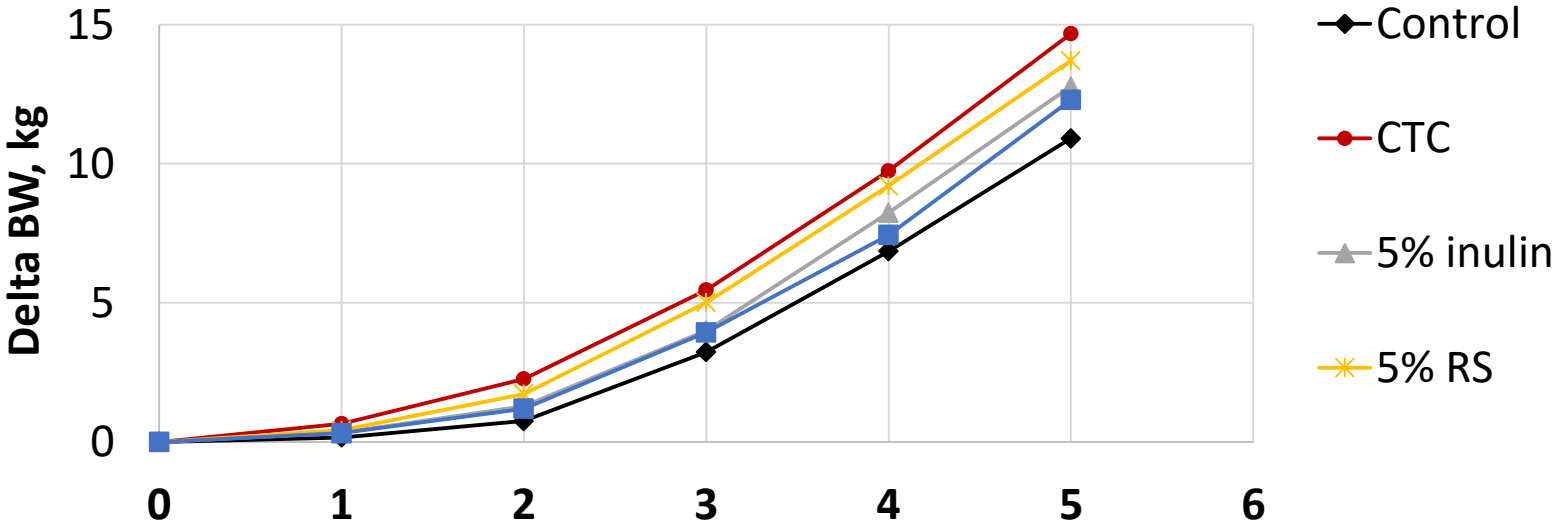
Dietary RPS can alter production parameters

Diet	ADG, kg	ADFI, kg	G:F
Control	0.32[a]	0.37[a]	0.88
CTC	0.43[b]	0.51[b]	0.85
5% inulin	0.37[ab]	0.44[ab]	0.87
5% Resistant Starch (RS)	0.40[b]	0.46[ab]	0.87
0.25% Butyrate	0.36[ab]	0.42[ab]	0.88

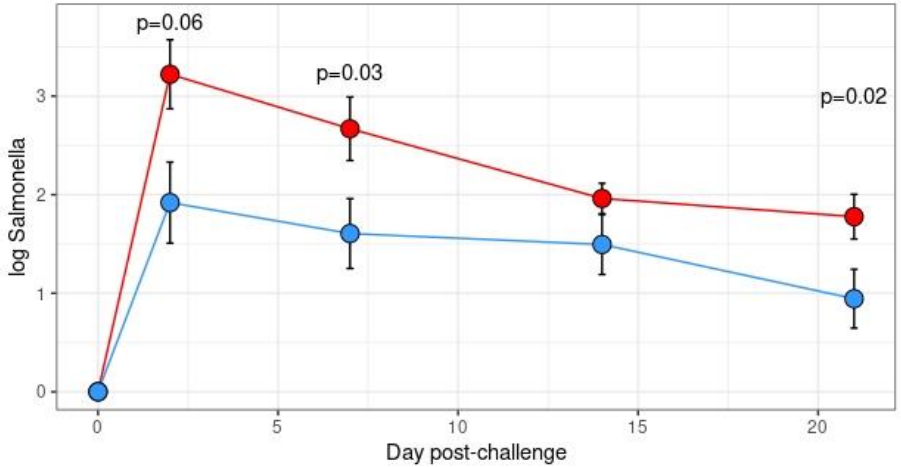


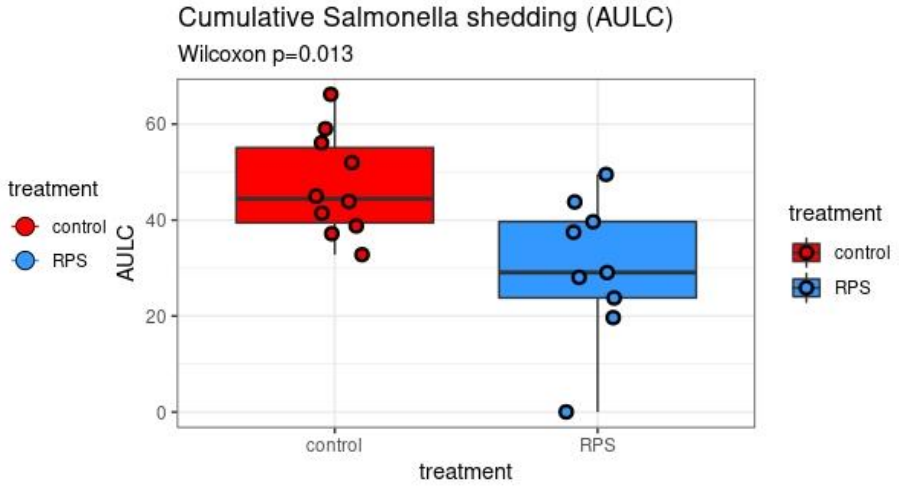
Collaboration with Nicholas Gabler, Iowa State University

Dietary RPS and *Salmonella* shedding

- Nursery pigs fed 5% RPS for 4 weeks
- Oral inoculation with monophasic *Salmonella*
  - Maintained on 5% RPS diet for additional 21 days
  - Fecal shedding overtime
  - SCFA analysis

Dietary RPS reduced *Salmonella* shedding





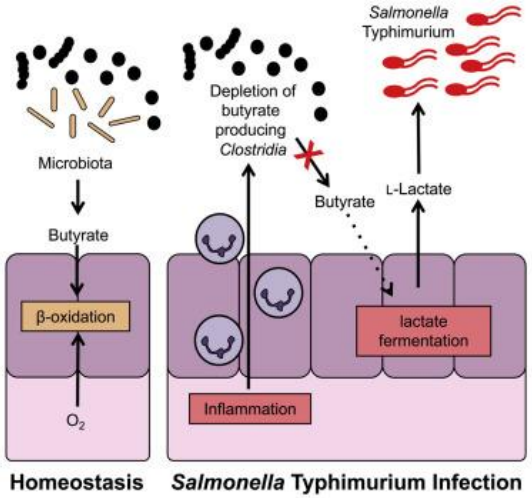
Proposed MOA – limit low level inflammation

Cell Host & Microbe
Volume 23, Issue 1, 10 January 2018, Pages 54-64.e6

Article

Dysbiosis-Associated Change in Host Metabolism Generates Lactate to Support *Salmonella* Growth

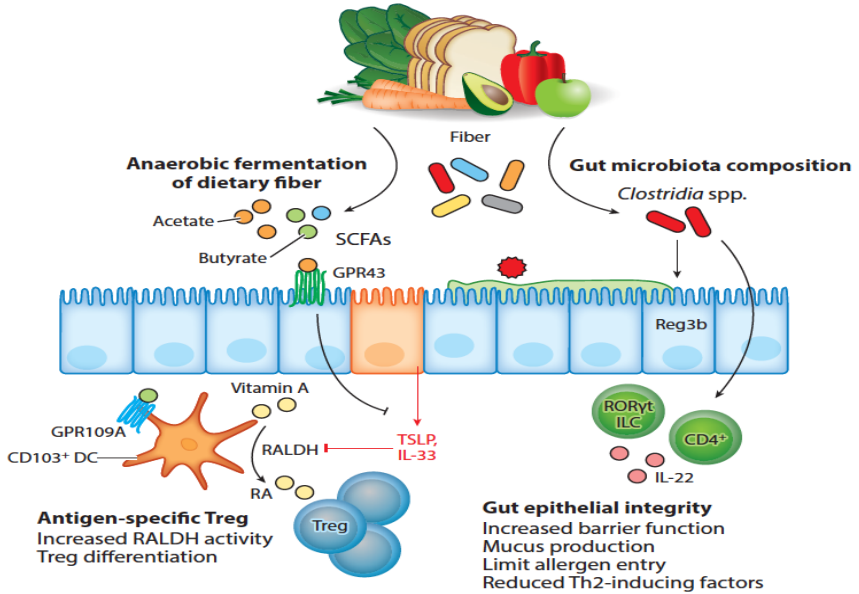
Caroline C. Gillis [1], Elizabeth R. Hughes [1], Luisella Spiga [1], Maria G. Winter [1], Wenhan Zhu [1], Tatiane Furtado de Carvalho [2], Rachael B. Chanin [1], Cassie L. Behrendt [3], Lora V. Hooper [3, 4], Renato L. Santos [2], Sebastian E. Winter [1, 5]



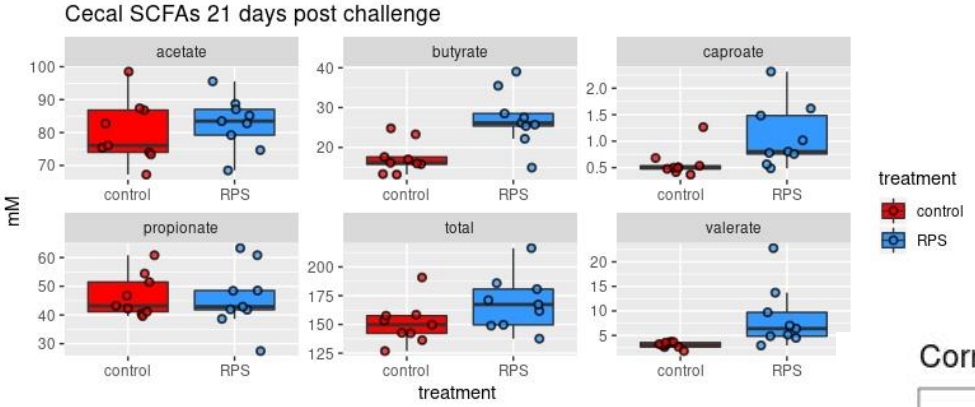
Reduced inflammation

O_2 consumption by epithelial cells = anaerobic environment

Increased gut integrity

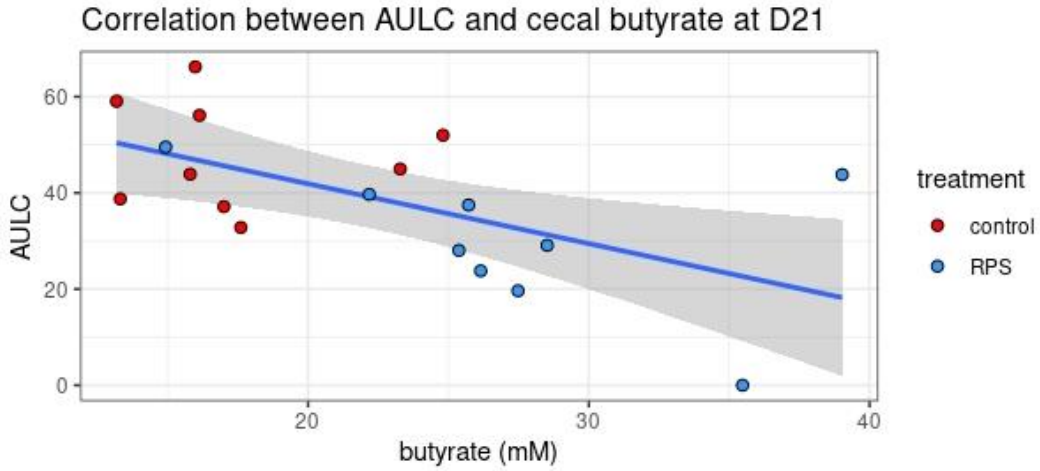


Negative correlation between butyrate and *Salmonella* shedding



Increased cecal butyrate even after Salmonella challenge

Reduced Salmonella shedding with increased buytrate levels



Trachsel et al, unpublished data

Dietary RPS can serve as alterbiotic

- Potential to promote growth
- Potential to modulate microbial communities
  - Modulate immune status
  - Enhance intestinal integrity
- Potential to limit *Salmonella* shedding

- Why potential? – dependent on food web of organisms that utilize RPS as substrate.
- Determining the mode of action of various alterbiotics will allow for targeted use in production.

Thanks to:

Dr. Julian Trachsel
Dr. Heather Allen
Dr. Cassidy Briggs
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Dr. Nicholas Gabler (ISU)
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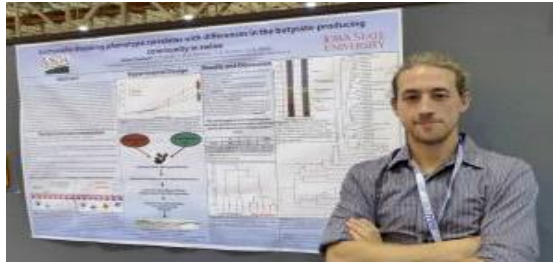
Elli Whalen
Dr. Shyamesh Kumar
Dr. David Alt
Animal Care Staff



Dr. Julian Trachsel

Dr. Kristen Byrne
Innate Training/immunomodulation
Poster MI11 & IM2

Dr. Shawn Bearson
Dr. Brad Bearson
Poster VA3
DIVA Salmonella vaccine

My peeps