Strategies to Replace Antibiotics for Animal Productivity

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APC
An LGI Company

Why Remove Antibiotics

- Increase in the incidence of antibiotic resistant bacteria threatens our health
  - Use of antibiotics in livestock feed
  - Use of antibiotics in consumer products
  - Use of antibiotics in human medicine
- Consumer demand
  - A segment of consumers are demanding food from animals that are not fed antibiotics.

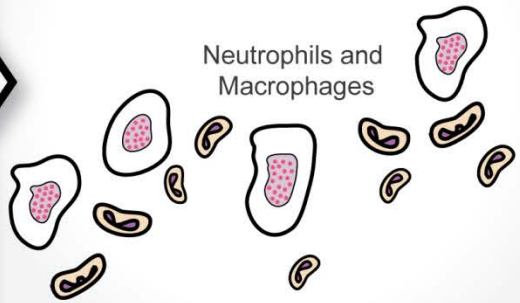
Role of Antibiotics in Animal Production

- Antibiotics
  - Treat an existing infection
  - Prevent a potential infection

Stressors:

- Weaning
- Dietary Transition
- Co-mingling
- Pathogen Exposure
- Social

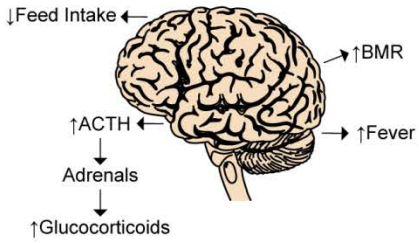
The immune response begins at local tissue sites with recruitment of inflammatory cells.



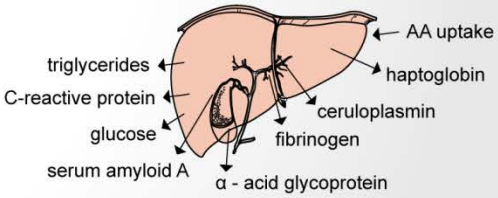
These stimulated cells produce pro-inflammatory cytokines, affecting multiple tissue cells including the brain, the HPA axis, the liver, adipose tissue, muscle and bone.

IL-1
IL-6
TNF-α

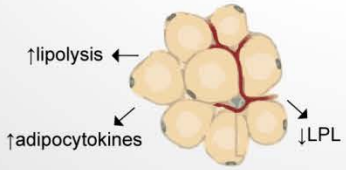
Hypothalmic-Pituitary-Adrenal Axis



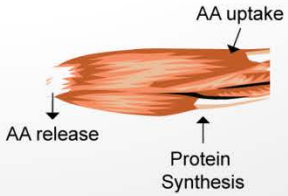
Stimulation of the Acute Phase Protein Response



Adipose Tissue



Skeletal Muscle



Bone

Role of Antibiotics in Animal Production

- Antibiotics
  - Treat an existing infection
  - Prevent a potential infection
- Energy that would be diverted to the immune system is available for productive functions.
  - Increased growth rate
  - Improved feed efficiency

Alternatives to Antibiotics

- Change husbandry practices to prevent exposure to pathogens.
- Strategic use of vaccinations to improve the animals resistance to infection.
- Non antibiotic feed additives
  - Enzymes
  - Pro- and Pre-biotics
  - Micronutrients, ie, Zn, Cu
  - Functional ingredients:
    - oligo saccharides
    - MCFA / VFA
    - Functional Proteins

Considerations

- Ease of implementation
- Consistency of response
- Cost

Functional Protein: Spray Dried Animal Plasma (SDAP)

- SDAP is produced by separating the cellular fraction from whole blood and subsequent spray drying, retaining functionality of the proteins present in plasma.

- In 2008, the ASAS identified Spray-Dried Plasma as one of the 10 most important discoveries in Swine Nutrition in the past 100 years

Percentage improvement in performance of pigs fed plasma protein compared to other protein sources

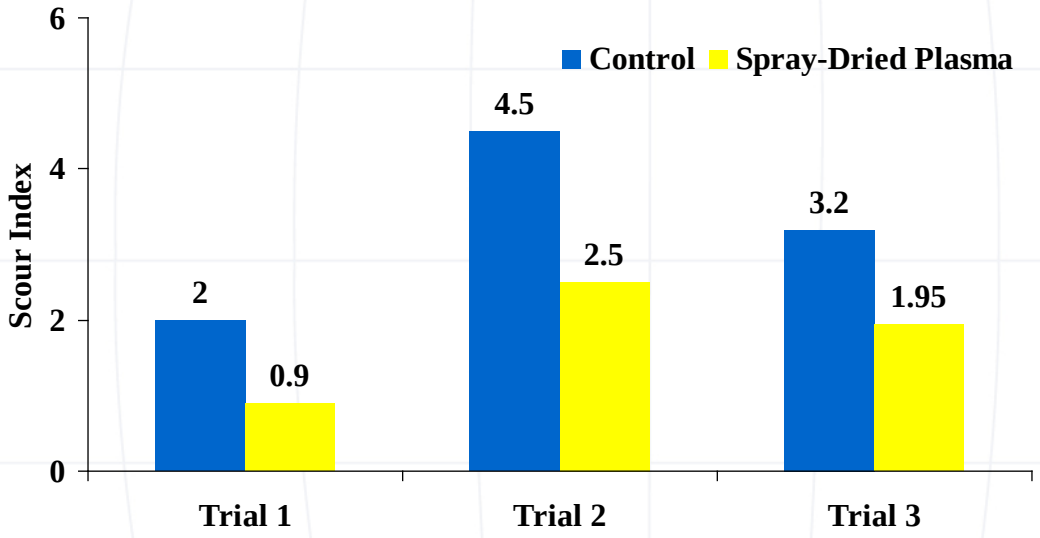
(D 0-14 after weaning)

Reference	n[1]	ADG	ADFI	FCR
Coffey and Cromwell, 2001 (Plasma vs other proteins)	79	+25.0	+21.0	+4.0
Van Dijk, 2001 (Plasma vs Milk protein sources)	38	+23.9	+24.5	+0.1
Van Dijk, 2001 (Plasma vs Soy protein sources)	14	+38.1	+28.8	+7.9

[1] Number of experiments

Coffey and Cromwell, 2001. Pig News and Information 22(2):39N-48N.
Van Dijk, 2001. Livestock Production Science 68:263-274.

Decreased Scour Score
Three Experiment Summary in Pigs



Gatnau and Zimmerman, 1993. Unpublished Data

FPs During Disease Challenge

- Studies in multiple species
- Studies with both enteric and respiratory challenges
- Adding FP improves:
  - Fecal score (less diarrhea)
  - Average daily gain
  - Survival
  - Feed efficiency

Species	Pathogen	Results	Author	Year
Pigs	E. coli	↓ fecal score	Borg et al.	1999
Pigs	Salmonella	↓ fecal score	Borg et al.	1999
Pigs	E. coli	↑ ADG, ↓ mortality	Bosi et al.	2001
Pigs	E. coli	↑ ADG, ↓ IgA	Bosi et al.	2004
Pigs	E. coli	↑ ADG, ↑ Lactobacilli	Torrallardona et al.	2003
Pigs	E. coli	↑ ADG	Campbell et al.	2001
Pigs	E. coli	↓ shedding	Deprez et al.	1996
Pigs	Rotavirus	↓ diarrhea	Corl et al.	2007
Pigs	E. coli	↓ fecal score	Nollet et al.	1999
Pigs	LPS	↓ cytokine mRNA expression	Touchette et al.	2002
Pigs	E. coli	↑ ADG, ↓ fecal score	Van Dijk et al.	2002
Pigs	Gastric ulcers	↓ clinical symptoms, ↑ ADG	Crenshaw et al.	2003
Pigs	PRRS	↑ feed efficiency	Escobar et al.	2006
Pigs	PCVAD	↑ survival	Messier et al.	2007
Pigs	PCVAD	↑ ADG, ↓ clinical symptoms	Morés et al.	2007
Calves	Coronavirus	↑ recovery	Arthington et al.	2002
Calves	Crypto. parvum	↓ scours, ↓ shedding	Hunt et al.	2002
Calves	E. coli	↑ survival, ↑ ADG, ↓ scours	Nollet et al.	1999
Calves	E. coli	↑ survival, ↑ ADG, ↓ scours	Quigley & Drew	2000
Shrimp	WSSV	↑ survival, ↑ ADG	Russell & Campbell	2000
Trout	Yersinia ruckeri	↑ survival, ↑ ADG	Aljaro et al.	1998
Poults	Pasteurella multocida	↑ survival, ↑ ADG	Campbell et al.	2004
Broilers	Necrotic Enteritis	↑ survival, ↑ feed efficiency, ↑ ADG	Campbell et al.	2006

SDAP is an Alternative to Antibiotics

Effect of feed medication on the performance response of piglets to SDP in the two weeks after weaning

Medication	0-14 days Post-Weaning			
	n	ΔADG (g/d)	ΔADFI (g/d)	ΔFGR (g/g)
YES	110	+36*	+43*	-0.02
NO	33	+41*	+32*	-0.34*

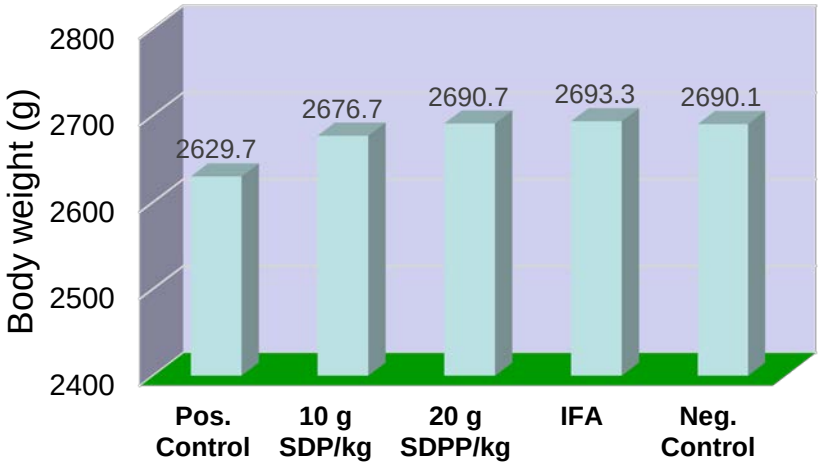
Pigs perform well in the absence of antibiotics when they are fed plasma.

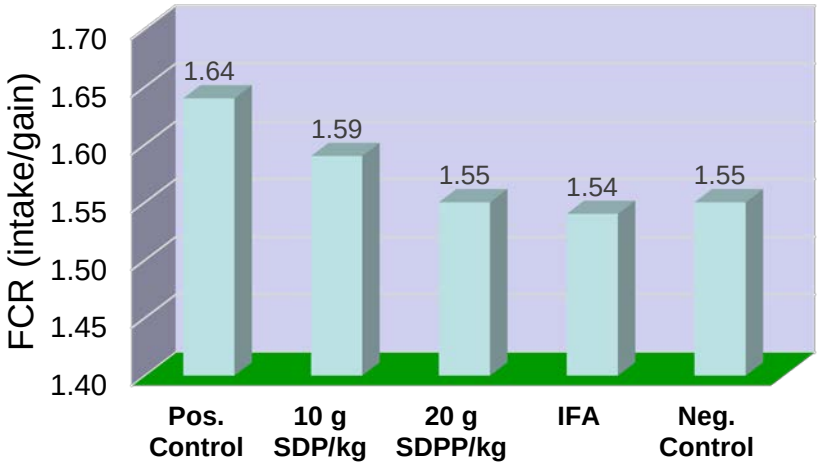
- **Higher average daily gain**
- **Higher average daily feed intake**
- **Improved feed efficiency**

N: Number of trials.
** p<0.05. Statistical significance of improvement over control without plasma*

Torrallardona, 2010, Asian-Australian J. Anim. Sci. 23:131-148

Plasma vs ATB during *Salmonella* Challenge





1. Positive Control – no supplement
2. Antibiotics - 0.05 % Salinomycin and 0.033% Zinc bacitracin
3. Low SDPP -10 g/kg diet
4. High SDPP - 20 g/kg diet
5. Negative Control - no supplement, not challenged.

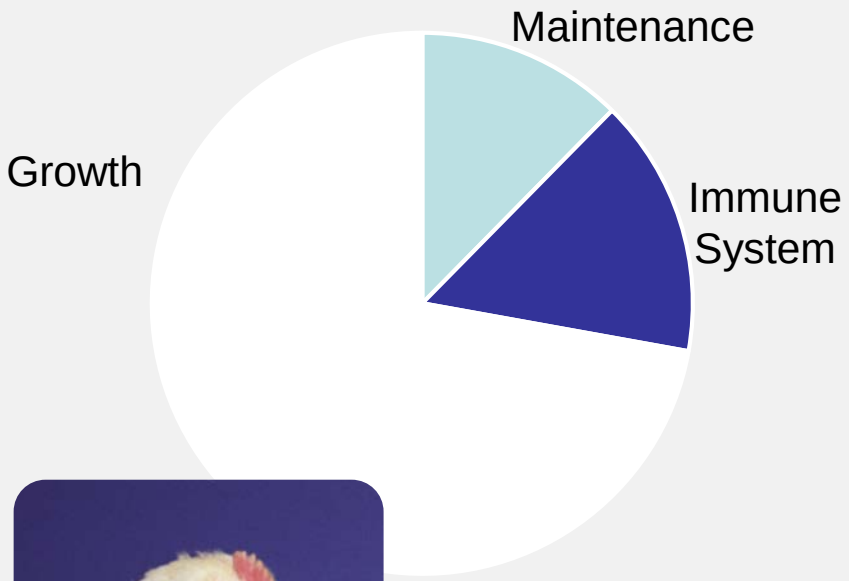
Challenge

- On 8,10 and 12d, birds were inoculated with 2 mL of bacterial suspension (5.9 x 10^8 CFU/ml)
- Unchallenged birds received 2 ml of LB broth

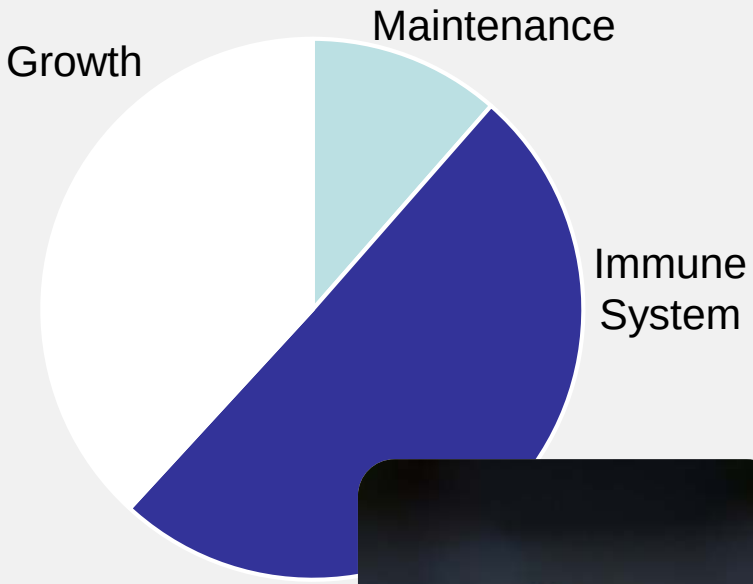
Beski et al., 2015. J. Animal Physiology and animal nutrition.

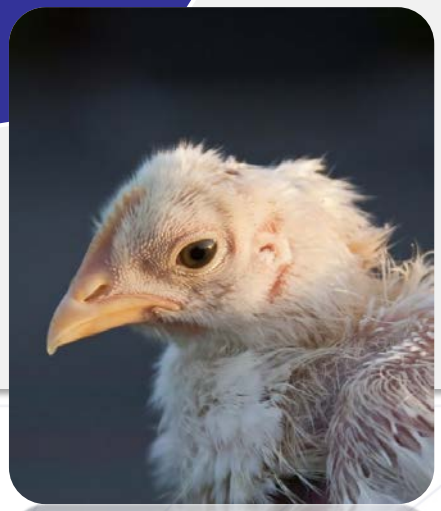
Functional proteins allow energy and nutrients for growth and other productive functions

With Functional Proteins



Without Functional Proteins





Summary

- In livestock production antibiotics are effective in the treatment and prevention of infections.
  - Improves production efficiency
- Options and Considerations
  - Effectiveness
  - Ease of adaption
  - Cost