Competing with antibiotic growth promoters – the issues...

Aoife Corrigan, Ph.D.
Alltech Bioscience Centre
Ireland

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Are we ready for 9 billion ???

The World needs to double the meat production in the next 50 years.
What are the challenges?

• Changes in the world economy
• Impact of the transportation of foods
• Food security: Food chain safety and traceability
• Food sufficiency: Efficiency of food production
• Effective nutrient utilization
• EU ban on AGPs
Who has the responsibility?

• a farm-to-fork approach.
• the responsibility for the production of safe food lies with the primary animal producer up through the food chain to the consumer.
In the past we used antibiotics to mask the underlying problems related to optimum gut health and function..... and food safety!
Why do we worry?

- Antibiotic Resistance
- Food safety
- Gut health
**Antibiotics**

- AGPs have a long history of prophylactic use in animal feed to improve animal performance and health status by targeting and destroying the intestinal microflora.
  - interfering with the bacteria's ability to reproduce
  - damaging cell membranes
  - disrupting essential cellular activities

- Most AGPs target gram-positive organisms that are commonly associated with poor health and reduced animal performance.

- Economic benefit of feeding prophylactic AGPs
  - improvement of growth, health and uniformity
  - The size of response to AGPs is dependent on:
    - farm management
    - exposure to pathogens
    - environmental stresses
    - diet.
Alternatives to AGPs must meet the same expectations and also meet regulatory requirements

- Safe
- Cost effective
- Non toxic
- Cannot become resistant???
- Efficacious
Where do we start?

- Education and information
- Slaughter house hygienic measures
- Breeders
- Pathogen free feed
- Biosecurity
  - Internal and External
- Holistic approach
- Focus on gut health and immunity
  - More research needed
What’s happening?

What are our options with out AGP’s
Healthy gut

Balanced intestinal microflora

Gut wall morphology, integrity and inflammation

Optimal gut health

Nutrition and management

Optimal animal performance
What feed intervention strategies are available?

- Heat treatment
- Organic acids
- Physical characteristics
- Probiotics
  - Competitive Exclusion
- Glycans
- Medium chain fatty acids
- Essential oils
- Prebiotics
Alternatives, How do they work?

- Altering gut pH
- Maintaining protective gut Mucin
- Selection for beneficial intestinal organisms or against pathogens
- Enhancing fermentation acids,
- Enhancing nutrient uptake
- Increasing the humoral immune response.
Mannan-oligosaccharides

- *Salmonella* contain mannose-specific lectins (Type 1 fimbriae) on the bacterial surface that binds to glycoproteins (rich in mannose) on the intestinal surface.

- Mannose sugars can thereby compete with the intestinal glycoproteins for attachment sites and prevent colonization.

- *Salmonella* binding has been demonstrated with mannan-oligosaccharide (Bio-Mos) at significantly lower concentrations than that required for purified mannose. (Spring 2000)
Does it address the specific issues when looking for an AGP alternative?

- Safe - ✓
- Cost effective - ✓
- Non toxic - ✓
- Unlikely to become resistant - ✓
- Efficacious - Does it achieve the same aims of an AGP?
**Disease control**

**Reduction Salmonella**

- MOS reduced the average mortality by 27%
- Bio-Mos used 62 g less feed to produce 1 kg of body weight, corresponding to an improvement of 3.24%
- With MOS, the infection rate decreased to 1/8 of the previous rate in the previous cycles
• Works as an alternative in terms of performance

• But also has added effects on
  • Intestinal structure
  • Mucin production
  • Digestion
  • Immune modulation
Goblet cells and Mucin

- Mucin is a mucous gel secreted by epithelial goblet cells that acts as a protective barrier against harmful intraluminal components such as:
  - Abrasive action of feedstuffs
  - Bacteria colonization
  - Toxins
How do MOS affect intestinal structure?

- Reduction in pathogenic bacteria
- Leads to a reduction in cell sloughing on the villi
- Less energy expended maintaining GI tract
- Mannan may aid in tissue repair
Focusing on specific genomic effects: Individual gene markers
Regulation of mucin associated genes in intestinal tissue of broilers by MOS
Effects of MOS on gene expression:
Decreased expression of stress protein and indicators of tissue damage in the small intestine

Both supplements decreased expression of stress related genes

Both supplements decreased expression genes associated with tissue damage

Biomarkers: Less tissue stress and damage
Effects of MOS on gene expression: Increased expression of genes for digestive enzymes in the small intestines

Increased digestive capacity
MOS also has an effect on immunity

- Innate immunity
  - attenuated mucus secretion
- Acute Phase response
  - suppression of the fever response
- Humoral immunity
  - enhanced antigen presentation to immune cells
  - modulated antibody production
Effects of MOS on genes related to immune related genes

### LYZ

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<td>Average signal intensity</td>
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* Indicates statistical significance

### B2M

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Benefits to the consumer and the animal.
Bio-Mos reduced the number of *Salmonella* positive samples from 28 to zero % in 5 months.
Reduction in the levels of AB resistance genes being carried in the intestine

- Significant reduction in levels of tet A gene ($p \leq 0.05$) and tet B gene ($p \leq 0.037$) seen following 42 days supplementation with MOS
Conclusions

• There will always be a need for antibiotic use
• Need to try and minimise and conserve their use
• No silver bullet approach
• Combined approach
Three key strategies for limiting the use of Antibiotics on farm

• **Infection control**
  – Operate an all-in all-out policy
  – Minimise mixing of animals

• **Good hygiene**
  – Good hygiene practices, especially production phases
  – Ensure all pens & feeders are disinfected between batches

• **Nutritional support**
  – Mos inclusion to reduce colonization and alleviate disease pressure
Can we switch to AGP alternatives - yes

- Safe - ✓
- Cost effective - ✓
- Non toxic - ✓
- Unlikely to become resistant - ????
- Efficacious - ✓