Alternatives to Antibiotics in Poultry Diets

Gita Cherian, Ph.D.

Department of Animal and Rangeland Sciences
Oregon State University, Corvallis, Oregon
Presented at Poultry Institute, WSU, Nov 5, 2013
Gita.Cherian@oregonstate.edu

Poultry Production System

• Goals
  – To Optimize Performance
    • Feed Cost over 65% of Production
  – Minimize Nutrient Excretion
  – Promote Bird Health
    • Gastro-intestinal tract
      – Barrier
      – Microbiota
      – Immune organ
Healthy Gut = Healthy Bird

Nutrition: Jungle Fowl vs. Modern Poultry

- Diets
  - Varied diets vs. Corn-soy
    - Omnivore vs. Granivore
- Gut Structure
  - Less processed feeds
- Selective Breeding
  - Fast growth
  - Increase in nutrient requirements
  - Dampened Immunity

Managing Gut Health

- Current Situation
  - 1. Vaccines
    - Protection against a particular pathogen
    - Response to vaccination
      - Feed withdrawal
    - Vaccination not an option for the many less virulent pathogens

Source: Canadian Poultry Magazine
Managing Gut Health

• Current Situation
  – 2. Antimicrobials
    • Broad spectrum protection
    • Growth promotion
    • Continual usage
    • Species-specific

Alternatives Measures Needed—Why?

• Global Problem
• Trend for Eliminating Antibiotics
  • Ban in EU
• Niche Markets
• Demand from Consumers, Scientific Community
Alternatives Measures Needed—Why?

- Transfer of Antibiotic-Resistance Genes
  - (supergerm)
- Residues in Food Products
- Resistance Development
- Antibiotic Shuttling

Alternatives Measures?

- Big Question
  - Not enough options or answers
- Using Feed Additives
  - Pro/Pre-biotics, Plant Extracts, Acidifiers, Enzymes, Neutraceuticals
- Enhancing Bird’s Own Immune Health
Alternatives Measures

• Use of Feed Additives
  – Diverse Functions
    • Influence Gut Health, Enzyme action, Antioxidant roles
    • Alteration in VFA production
      – pH shift in the gut
      – Reduce pathogens

• Probiotics or “Direct-Fed Microbials”
  – Mixed cultures of live protective microbes
    • Gut sterile, establish strong populations of beneficial ‘good’ gut microflora
      – e.g. Lactobacillus
    • Prevent colonization by ‘bad’ pathogens
      – e.g. E. coli
    • Administered at hatching
      – ‘CenBiot’, ‘Biomate’
Alternatives Measures

• Pre-biotics
  – Non-digestible feed ingredients
    • “Food for the good microflora”
      – Improving the intestinal balance
      – Selectively stimulating the growth of one or a limited number of bacteria
      – e.g. Mannan Oligosaccharides (MOS)
  – Pro + Pre-biotics = Synbiotics

Alternatives Measures

• Fiber Degrading Enzymes
  – Non-starch polysaccharides (NSP)
  – Increase the rate of digestion
  – Limit the amounts of substrates available to the microflora
    • Volatile fatty acid production
    • Digesta viscosity
Alternatives Measures

• Essential Oils, Herbs, Botanicals
  • Volatile oils, plant-derived, drugs from plants, roots, leaves
    – e.g. thymol, carvacol, eugenol, cinnamaldehyde
  • Phenolic compounds
    – Appetite, saliva, digestive enzymes, antioxidant action
    – Variability in the product/studies
    – Can be potent, odor, feed intake reduction, volatile, stability aspects

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Studies with Broilers on Phytogenic Compounds in my lab

Feeding *Artemisia annua* alters digesta pH and muscle lipid oxidation products in broiler chickens

G. Cherian,* A. Or,* L. C. Burke,† and W. Past†

*Department of Animal and Rangeland Sciences, Oregon State University, Corvallis OR; and Department of Crop and Soil Sciences, Washington State University, Pullman WA.

2013 Poultry Science 92:588–598

http://dx.doi.org/10.3944/2013-0772

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Use of Organic Acid, Herbs and Their Combination to Improve the Utilization of Commercial Low Protein Broiler Diets

A.S. Abd El-Hakim*, G. Cherian* and M.M. Al†

*Department of Poultry Nutrition, Animal Production Research Institute, Dokki, Giza, Egypt
†Department of Animal Sciences, Oregon State University, Corvallis, OR, USA

ISSN 1885-8195
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Artemisia *annua* as Feed Additive in Poultry

- **What is Known**
- **Anticoccidial Properties**
  - Artesimin
  - Reduce Cecal Lesion

Dried leaves of *Artemisia annua* protect chickens against cecal lesions due to *E. tenella* infection (Allen et al. 1997)
Artemisia Meal: Nutritional Characterization

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Testing Artemisia as Phytogenic Feed Additive

Broiler Diets prepared with 0, 2, 4% Artemisia annua
Testing Artemisia *annua* as Phytogenic Additive in Poultry

- **Broiler Study**
  - One Day Old Broiler Chicks (n=96)
    - 32 birds per treatment
  - Control, 2% (ART2), 4% Artemisia (ART4) diets for 42 days
    - Corn-Soy-based
  - All other nutrients balanced
    - 22% Crude Protein
    - 3,200 kcal/Kg ME
  - Bird Growth and Carcass Characteristics
    - Feed consumption, Body weight
    - Organ weight, Abdominal fat pads

Artemisia *annua* as Feed Additive?

- **Digesta Collection**
  - Ileal, Ceca Digesta
  - Gut pH
- **Fecal oocyst count**
- **Meat Quality**
  - White and Dark Meat
Feeding Artemisia to Broiler Birds: Performance and Ceca PH

Day 42: Body Weight

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Carcass Weight

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Feed: Gain

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Cecal Digesta pH

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**Different letters for each bar indicate a significant difference (P < 0.05), n = 8.**

Alternatives Measures: Use of Herbs

- Thyme, Curcumin, Citric acids in Broiler Feeding
  - Birds
    - n = 210
  - Low protein diets
    - 18% CP
    - 2900 ME
    - 0.2% of alternatives
    - Fed for 42 days

Oregon State University
Summary

- Nutrition becomes even more critical as antibiotics are (or will) eliminated
- Gastrointestinal tract is continuously exposed to foreign materials and challenges
- Gastric acidity is protective against intestinal colonization and translocation of pathogenic bacteria.
Summary

- Products that can replace
  - Economically affordable
  - Efficacious
  - Easy to use/process
  - Safe to the users, feeds, animals
  - Gut enzyme/pH resistant

Products that can Replace Antibiotics?
The Answer is

No Logical Substance

Take-Home Message

We Need a Combination of Nutrition, Management, Housing, Biosecurity, Hygiene, Education
Take Home Message

Diets are not Just Calories
Diet Affects Bird Health, Welfare, Disease Resistance
Ultimate Attainment of Full Genetic Potential

Acknowledgments

- Funding:
  - OSU Agriculture Research Foundation (Cherian)
  - Artemisia sample: Dr. I. Burke (WSU)
    - Life Sciences Discovery Fund (WSU)
Cheap feed

The conditions are bad — and this low cost feed is no better!

Maybe we should go on hunger strike!?