Efficacy of dried egg product administered to male broiler chickens during experimental necrotic enteritis

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1. Elanco Animal Health,
2. Southern Poultry Research
3. Ab E Discovery

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Necrotic enteritis (NE)

• “NE is the most common and financially devastating bacterial disease in modern broiler flocks” (poultryhub.org)

• Wet litter, diarrhea, increase in mortality

• Depression of growth rate and feed efficiency

• Multifactorial disease
  – Coccidiosis: the trigger!
  – Clostridium perfringens

• Current efforts:
  – Vaccination, medication, and management

Source: poultryhub.org
Interleukin-10

IL-10 is a potent anti-inflammatory cytokine that decreases:

- **Innate immune response**
  - MHC Class II proteins, costimulatory molecules, and reactive oxygen intermediates
- **Adaptive immune response**
  - Antigen specific T-cell generation
- **Inflammation**
  - Inhibits production of IFN-γ, TNF-α, IL-1, IL-2, IL-6 and GMCSF

**IL-10 main function**

- “Resolve” inflammatory processes
IL-10 reduces IFN-$\gamma$ production and release in ConA-stimulated chicken splenocytes \textit{in vitro}.

\textbf{Source: Arendt et al., 2016. Poult Sci 95:430}
Role of IL-10 in pathogenesis

- Epstein Barr Virus encodes for IL-10 and inhibits anti-viral response
- *Yersinia pestis* upregulates IL-10 production and favors its survival
- *Leishmania donovani* upregulates IL-10 and IL-10 KO mice are resistant
- *Eimeria* resistant chickens express low IL-10
- *Eimeria infection* increases IL-10 levels

Certain pathogens appear to use high expression of IL-10 to thwart and fool an immune response

Source: hindustantimes.com
Hypothesis

Neutralization of intestinal secreted IL-10 with an IgY may contribute to increase IFN-γ production to elicit an appropriate immune response resulting in better growth performance of broilers with necrotic enteritis.
Dried Egg Product (DEP)

- **Patents:** 8652457; US20150037277; 9505836; US20160280778; US20160008436
- Laying hens are hyper-immunized with a patented peptide against chicken IL-10 (Arendt et al., 2016 Poult. Sci. 95:430)
- Eggs containing anti-chicken IL-10 IgY antibodies
- Eggs are dried in a manner to preserve IgY binding activity
Experimental design and analyses

- Randomized complete block design
- Six DEP doses (0, 143, 287, 358, 430, and 573 U/MT)
  - Starter and Grower; no Finisher
- Cobb 500 males
- 50 birds/pen
- 70 floor pens (10 pens/treatment)
- Study length: 42 d
  - Starter (d 0 to 14), Grower (d 14 to 28), and Finisher (d 28 to 42)
- Southern Poultry Research
Experimental design and analyses, continued

• Experimental necrotic enteritis
  – Coccivac® B52 (Merck Animal Health, Kenilworth, NJ) spray vaccination on day of hatch according to label
  – Clostridium perfringens
    • $10^8$ cfu/bird/d in feed
    • Day 18, 19 and 20 of study
• 4 bird/pen randomly selected for NE lesion scoring on d 20
• Growth performance
  – Each feeding phase and overall
• Pen was the experimental unit with treatment as a fixed effect and block as a random effect (JMP v.14.1)
Results

Source: wikipedia.org
Necrotic enteritis lesion scores (d 20)

NE lesion score (d 20)

Non-infected

Infected

-100%

-19%

-28%

-38%

-44%

-47%

0%
Overall average daily feed intake (d 0-42)

Linear $P<0.79$

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<thead>
<tr>
<th>Dried egg product IgY, U/MT</th>
<th>Overall ADFI (d 0-42), g/d</th>
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<tr>
<td>Non-infected</td>
<td>0%</td>
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<td>a,b</td>
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$P<0.05$
Overall average daily gain (d 0-42)

Overall ADG (d 0-42), g/d

Non-infected: +8%
Infected: -2%
-2%
+4%
+3%
+5%
+5%

Dried egg product IgY, U/MT

0 143 287 358 430 573

0% -2% +4% +3% +5% +5%

a,b,c,d P<0.05
Overall feed conversion ratio (d 0-42)

Overall FCR (d 0-42)

Non-infected

Infected

0 pts a

-9 pts b

-8 pts b

-10 pts b,c

-13 pts c,d

a,b,c,d P<0.05

Linear P<0.0001

DEP IgY, U/MT

0 143 287 358 430 573

14
Overall production efficiency index (d 0-42)

PEI = ADG*Survival
FCR*10
Summary

• Inclusion of dried egg product containing anti-chicken-IL-10:
  – Reduced necrotic enteritis lesions
  – Improved growth performance

Conclusion

• Use of dried egg product containing anti-chicken-IL-10 may be a viable alternative to reduce the negative effects of coccidiosis and thus ameliorating necrotic enteritis in broilers
References


• Ping Ouyang et al. 2014. IL-10 encoded by viruses: a remarkable example of independent acquisition of a cellular gene by viruses and its subsequent evolution in the viral genome. J. Gen. Virology 95:245–262


Thank you, questions?

**International Poultry Scientific Forum at IPPE 2020**

- Efficacy of dried egg product administered to chickens during an enteritis infection caused by *Eimeria spp.* and *Clostridium perfringens*
- Binding kinetics of IgY contained in a dried egg product to recombinant chicken IL-10