A feed additive containing mixed enzymes and direct fed microbial combination in comparison with AGPs in broiler chickens

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DFM’s and Antibiotics

• Over-use of antibiotics in commercial poultry:
  – Drug-resistant bacteria (Sorum and Sunde, 2001)
  – Drug residues in the body of the birds (Burgat, 1999)
  – Imbalance of normal microflora (Andremont, 2000)

• Growing use of direct fed microbials (probiotics) worldwide throughout the industry
Direct Fed Microbials (DFMs)

• **What are DFMs?**

• **Modes of action include:**
  – Maintaining a beneficial microbial population by competitive exclusion and antagonism
    • (Fuller, 1989)
  – Improving feed intake and digestion
    • (Nahanshon et al., 1992, 1993)
  – Altering bacterial metabolism
    • (Cole et al., 1987; Jin et al., 1997)
Direct Fed Microbials (DFMs)

- **Probiotic effect**
  - *Lactobacillus, Bifidobacterium, Bacillus, Enterococcus, Lactococcus, Streptococcus, Saccharomyces cerevisae*

- **Influence the intestinal microbiota as well as host health and welfare**
  - Competitive exclusion of pathogenic bacteria
  - Lowering the pH through acid fermentation
  - Competing for mucosal attachment and nutrients
  - Stimulating the immune system associated with the gut
  - Increasing epithelial integrity
  - Stimulating the intra-epithelial lymphocytes
    - (Salim et al, 2013)

- **Alternative to AGP’s**
DFM’s on Broiler Performance

• Compared with control, supplementation of DFM did not affect FI and BW gain of the birds
  – (Waititu et al., 2014)

• DFM inclusion improves performance
  – (Yeo and Kim, 1997; Santoso et al., 2001; Salim et al, 2013;)

• Proper DFM supplementation may provide a favorable condition in the intestines for the colonization of beneficial microflora
  – (Mohnl, 2011)
Antibiotic Growth Promoters (AGP’s)

- Bacitracin Methylene Disalicylate
  - Branched, cyclic deca-peptide that interferes with cell membrane function
  - Suppresses cell wall formation by preventing the formation of peptidoglycan strands
  - Inhibits protein synthesis
    - (Kahn et al., 2005)
Antibiotic Growth Promoters (AGP’s)

- Virginiamycin
  - Effective antibiotic against gram-positive microorganisms
    - (De Sommer and Van Dijck, 1955)
  - Two major components: factor m1 and s1
    - (Cocito, 1979)
  - Shown to improve broiler growth rate and feed efficiency
    - (March et al., 1978; Miles et al., 1984; Harms et al., 1986; Woodward et al., 1988)
  - Efficacy more pronounced in broilers fed low calorie diets
    - (Buresh et al., 1984)
AGP’s on Broiler Performance

• Broilers given AGP’s were significantly heavier than those fed control diets
  – (Miles et al., 2006)

• Broilers fed AGP’s showed no significant differences in FCR and BW when compared to the control
  – (Baurhoo et al., 2009)
Xylanase, Amylase, Protease

• What is a mixed enzyme?

• Mixed enzymes have proven to increase starch digestibility and improve broiler growth performance and feed conversion ratio
  – (Meng et al., 2005; Olukosi et al. 2007; Cowieson and Ravindran, 2008)
Objective and Hypothesis

• The objective of the current experiment was to evaluate the effect of a feed additive containing mixed enzymes and a DFM on broiler growth performance as compared to antibiotic growth promoters.

• The working hypothesis is that the inclusion of mixed enzymes and DFM will improve broiler growth performance similar to that observed with AGP inclusion.
Experimental Design

- Experimental design consisted of 4 experimental treatments:
  - 8 replicates per treatment
  - 40 chicks per replicate
  - 1280 straight-run (50:50 ratio) Ross 708 chicks were placed in floor pens for a 42 day-assay period

*Care was provided in accordance with IACUC Texas A&M approved protocol*
Materials and Methods

• 4 dietary treatments:
  • Negative Control – US standard w/ 10% wheat inclusion and 5% DDGs inclusion containing 500 FTU/kg phytase
  • Negative Control + XAP & DFM (XAP: xylanase, amylase and protease, DFM: three *Bacillus* strains)
  • Negative Control + BMD (50g/ton)
  • Negative Control + Virginiamycin (20g/ton)

• Measurements were taken on days 10, 21, 42
  • Body Weight
  • Feed Conversion Ratio (FCR)
Feed Phases

• Starter Phase
  – Days 0-10

• Grower Phase
  – Days 11-21

• Finisher Phase
  – Days 22-42

• All birds were fed a mash diet *ad libitum* throughout the duration of the trial
## Dietary Formulation

<table>
<thead>
<tr>
<th></th>
<th>Starter</th>
<th>Grower</th>
<th>Finisher</th>
</tr>
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<tbody>
<tr>
<td>Corn</td>
<td>47.852</td>
<td>52.033</td>
<td>60.026</td>
</tr>
<tr>
<td>SBM</td>
<td>31.001</td>
<td>24.886</td>
<td>17.989</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>0.314</td>
<td>0.270</td>
<td>0.202</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.285</td>
<td>0.249</td>
<td>0.213</td>
</tr>
<tr>
<td>Threonine</td>
<td>0.098</td>
<td>0.078</td>
<td>0.045</td>
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<tr>
<td>Fat</td>
<td>0.607</td>
<td>2.101</td>
<td>1.486</td>
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<tr>
<td>Wheat</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.352</td>
<td>0.909</td>
<td>0.682</td>
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<tr>
<td>Monocalcium Phosphate</td>
<td>0.654</td>
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<td>Vitamins</td>
<td>0.250</td>
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<tr>
<td>Choline Chloride</td>
<td>0.100</td>
<td>0.100</td>
<td>0.100</td>
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<tr>
<td>Coban 90</td>
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<td>0.050</td>
<td>0.050</td>
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<tr>
<td>LO-DDGS</td>
<td>5.00</td>
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</tr>
<tr>
<td>Pork MBM</td>
<td>2.038</td>
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<tbody>
<tr>
<td>Protein</td>
<td>23.34</td>
<td>21.15</td>
<td>18.66</td>
</tr>
<tr>
<td>Crude Fat</td>
<td>3.62</td>
<td>5.31</td>
<td>4.99</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.05</td>
<td>0.90</td>
<td>0.80</td>
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<tr>
<td>AV Phosphorous</td>
<td>0.50</td>
<td>0.45</td>
<td>0.40</td>
</tr>
<tr>
<td>AME (kcal/kg)</td>
<td>2905</td>
<td>3030</td>
<td>3080</td>
</tr>
<tr>
<td>AV Methionine</td>
<td>0.63</td>
<td>0.56</td>
<td>0.47</td>
</tr>
<tr>
<td>AV TSAA</td>
<td>0.94</td>
<td>0.84</td>
<td>0.72</td>
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<tr>
<td>AV Lysine</td>
<td>1.27</td>
<td>1.10</td>
<td>0.91</td>
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<td>AV Tryptophan</td>
<td>0.23</td>
<td>0.20</td>
<td>0.17</td>
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<td>AV Threonine</td>
<td>0.83</td>
<td>0.73</td>
<td>0.61</td>
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<td>AV Arginine</td>
<td>1.35</td>
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<td>1.02</td>
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Statistical Analysis

• All data was analyzed via one-way ANOVA and means were deemed significantly different at $P \leq 0.05$. Means were separated using Duncan’s Multiple Range Test.

• Parameters Evaluated:
  – Body Weight Gain
  – Feed Conversion Ratio (FCR)
  – Foot Pad Lesion Score
Avg. Body Weight (kg) – Day 10

- Avg. BW (kg)
- Neg. Control
- XAP + DFM
- BMD
- Virginiamycin

-indicates significant difference at p < 0.05

\[ a, b \] Indicates significant difference at p < 0.05
Average Body Weight (kg)

- Starter: Indicates significant difference at p < 0.05
- Grower: Indicates significant difference at p < 0.05
- Finisher: Indicates significant difference at p < 0.05

Legend:
- Neg. Control
- XAP + DFM
- BMD
- Virginiamycin

Note: Variables with different subscripts (a, b) indicate statistically significant differences at p < 0.05.
Mortality Corrected FCR - Grower

Feed:Gain

- Neg. Control
- XAP + DFM
- BMD
- Virgniamycin
Mortality Corrected FCR - Finisher

Feed:Gain

Neg. Control
XAP + DFM
BMD
Virginiamycin

\[\text{a, b Indicates significant difference at } p < 0.05\]
Mortality Corrected FCR

**Indicates significant difference at p < 0.05**
Cumulative Mortality Corrected FCR

- D1-21:
  - Neg. Control: 1.35
  - XAP + DFM: 1.40
  - BMD: 1.45
  - Virginiamycin: 1.50

- D1-42:
  - Neg. Control: 1.70
  - XAP + DFM: 1.75
  - BMD: 1.80
  - Virginiamycin: 1.85

*a,b* Indicates significant difference at *p < 0.05*
Cumulative Body Weight Gain

- **D0-21**
  - Neg. Control
  - XAP + DFM
  - BMD
  - Virginiamycin

- **D0-42**
  - Neg. Control
  - XAP + DFM
  - BMD
  - Virginiamycin
Feed Consumed

- Starter
- Grower
- Finisher

- Neg. Control
- XAP + DFM
- BMD
- Virginiamycin
Foot Pad Lesion Scores

Indicates significant difference at $p < 0.05$
Calorie Conversion

- kcal/kg body weight gain

Neg. Control: a
XAP + DFM: b
BMD: ab
Virginiamycin: ab

a,b Indicates significant difference at p < 0.05
Summary

- Supplementation of a feed additive with mixed enzymes and DFM did not significantly affect body weight, body weight gain, or feed consumed.

- Significant decreases in finisher FCR as well as cumulative FCR with inclusion of feed additive with mixed enzymes and DFM compared to control.

- Foot pad lesion scores were significantly lower than the control with inclusion of feed additive containing mixed enzymes and DFM.

- A significant reduction in kcal/kg body weight gain was observed with supplementation of mixed enzymes and DFM when compared to the control.
Discussion

- Body weight gain was not influenced by the addition of dietary DFM
  - (Lee et. al., 2010; Dersjant-Li et. al., 2014)

- Body weight gain was significantly increased during the first 3 wk of growth but not in the later stage with DFM supplementation.
  - (Salim et. al., 2013)

- An improvement in growth performance was observed when DFM was added to the finisher diet
  - (Mohan et. al., 1996)

- Supplementation with carbohydrates can decrease FCR by increasing feed efficiency
  - (de Toledo et al., 2007; West et al., 2007; Coppedge et al., 2012; Masey O’Neill et al., 2012)

- Combination of XAP + DFM can decrease caloric conversion ratio and improve performance
  - (Dersjant-Li et. al., 2014; Murugesan et. al., 2014)
Conclusion

• Administration of a feed additive with mixed enzymes and DFM improved broiler performance and caloric conversion yielding similar results to that of AGP’s.