**BACKGROUND**

- Coccidiosis is a major gastrointestinal disease that causes significant economic losses in the broiler industry.
- Pathogenicity often determined via visual scoring of lesions during necropsy.
  - This has been the standard since it was first validated by Johnson and Reid in 1970.
  - For species *E. tenella*, it is performed on a categorical scale of 0-4.
  - It is a reliable but relatively subjective assessment.
- Visual scoring has its challenges.
  - It can be very time intensive to sufficiently score and diagnose a flock.
  - Similarly infected individual birds can vary drastically in lesion severity.
  - Subjective assessment leaves much room for inter and intra observer variation.
- There is need for a more objective method of assessment.
  - Imaging technology could satisfy that need while reducing labor and time inputs.
  - Advancements in technologies have paved the road for increasing the functionality and diversity of imaging utility for other subjects.

**OBJECTIVE**

Evaluate the use of a digital image analysis method to quantify coccidial lesion severity in the ceca of broilers challenged with *Eimeria tenella*.

**MATERIALS & METHODS**

- 288 male Ross 708 broilers were raised in 24 battery cages.

<table>
<thead>
<tr>
<th>Age</th>
<th># Birds</th>
<th>Vent</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 Challenge</td>
<td>144 + 144</td>
<td></td>
<td>Treatments administered via oral gavage</td>
</tr>
<tr>
<td>24 3 Days PC</td>
<td>24</td>
<td>2/cage</td>
<td>Digital images taken</td>
</tr>
<tr>
<td>26 5 Days PC</td>
<td>24</td>
<td>2/cage</td>
<td>Digital images taken</td>
</tr>
<tr>
<td>28 7 Days PC</td>
<td>24</td>
<td>2/cage</td>
<td>Digital images taken</td>
</tr>
</tbody>
</table>

- Both ceca were then gently washed, dried, and photographed using a remote-controlled, mounted digital camera set-up.

- The collected digital images were analyzed using the ImageJ software.

- In ImageJ, the following measures were taken for each individual cecum and averaged between the left and right ceca:
  - Ceca length and width (cm)
  - Ceca total surface area (cm²)
  - Total lesion surface area (TLA, cm²)
  - Lesion area percent (TLA%) as a percentage of total surface area

- Lesions were quantified using a red color threshold analysis on a standardized hue-saturation-brightness (HSB) scale.

- Lesions were also visually scored for comparison with the digital data.

**RESULTS**

- Result graphs are pictured with days post challenge on the X axis and recorded measure on the Y axis. Control is shown in red, while challenge is shown in yellow.

**CORRELATIONS (r)**

- As lesion score increased, ceca length decreased, ceca width increased, and lesion area decreased

<table>
<thead>
<tr>
<th>Lesion Score</th>
<th>Length, cm</th>
<th>Width, cm</th>
<th>Total Lesion Area, cm²</th>
<th>Total Lesion Area, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>0.35</td>
<td>0.38</td>
<td>0.62</td>
<td>0.60</td>
</tr>
<tr>
<td>Length, cm</td>
<td>1.00</td>
<td>-0.36</td>
<td>-0.25</td>
<td>-0.28</td>
</tr>
<tr>
<td>Width, cm</td>
<td>1.00</td>
<td>0.30</td>
<td>0.30</td>
<td>0.27</td>
</tr>
<tr>
<td>TLA, cm²</td>
<td>1.00</td>
<td>0.99</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>TLA, %</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONCLUSION & IMPLICATIONS**

- Ceca lesions were the most severe for challenge birds 5 days post challenge.
  - Highest lesion scores, lesion area, and percent lesion area
  - Wider but shorter ceca, possibly due to coccidial damage to the cecal wall
  - Positive correlation between lesion score and ceca width
  - Negative correlation between lesion score and ceca length

- The use of an imaging software provided digital values for lesion severity which reflected those of the visual lesion scoring method.
  - A moderate positive relationship between lesion score and total lesion area was found.
  - Digital image technology has the potential to serve as a practical diagnostic-active tool to determine the pathogenicity of coccidia.
  - The use of imaging software to assess infection could be applied to the creation of practical diagnostic devices or apps.

**ACKNOWLEDGEMENTS**

- This project was completed at the USDA Beltsville agricultural research center. Special thanks to Dr. Kate Miska for providing the opportunity to collaborate on this project, and to Heidi Rinehart and Ashanti Mangrum for their assistance in its completion.