Measurement and Analysis of Drinking Behaviour Traits in Broilers

Julija Rusakovică\textsuperscript{1}, Thomas Ploetz\textsuperscript{1}, Valentin Kremer\textsuperscript{2}, Santiago Avendano\textsuperscript{2}, Ilias Kyriazakis\textsuperscript{1}

\textsuperscript{1}Newcastle University, UK
\textsuperscript{2} Aviagen, UK
INTRODUCTION

General overview
- Lack of research related to water use and drinking behaviour in poultry
- Water is a scarce resource having implications for resource utilisation and environmental impact
- At a bird level water impacts gut health and foot pad dermatitis through litter quality

Current study approach
- Availability of RFID-based automated systems
- Record individual drinking events in a social, group-housed environment
- Allows to focus on bird behaviour, not only on water intake
**BACKGROUND: RESOURCE UTILISATION**

**Broiler water intake:**
- To reach 2.1kg BW * 1.62 FCR = 3.4 kg Feed

- 3.4kg Feed * 1.75 Water/Feed =

~ 6litres water/chicken (1.75 litres water at 21C)

- 100,000 broilers * 6 litres water/chicken =

600,000 litres in the grow cycle

Volume of water through Niagara falls = 567, 811 litres per second

http://www.planetware.com
DRINKING BEHAVIOUR & WATER USE

- Use of automated water stations

- Individual water intake recording

- Monitors drinking behaviour

- Records time of each visit, visit duration and drinker ID for each bird
OBJECTIVE

_Identify novel drinking behaviour traits in broilers that could be incorporated into genetic selection programme_

Specific Objectives

- How do we measure drinking behaviour traits?
- What are the biologically relevant traits for drinking behaviour?
- Which drinking behaviour traits can be used in genetic selection programmes?
- Are there differences in drinking behaviour between different genetic lines?
MATERIALS & METHODS: DATA

Data from two purebred commercial broiler lines:

- **Line 1**: 1878 birds from 15-35 days of age (1,577,530 events)

- **Line 2**: 2048 birds from 13-32 days of age (2,641,233 events)
DRINKING BEHAVIOUR & DRINKING BEHAVIOUR TRAITS

Hypothesis
- Visits occur generally at random and are affected by social interaction
- Visits to the water station can be clustered into bouts

Genetic basis of water drinking behaviour (next step)
- Heritability and genetic correlations with feed efficiency
- Genetic basis of drinking behaviour strategies
RESULTS: ORIGINAL DATA

Intervals between drinking events

- Intervals between drinking events were log-transformed
- High proportion of very short intervals between drinking events
RESULTS: MERGING CRITERION FOR BROILERS

- System validation step revealed system oversensitivity to bird movements, fragmenting some visits with short intervals between drinking events.

- To merge such visits, a merging criterion was calculated using a correlation coefficient between the duration of visits (black) and water intake (blue) per visit from 0 to 10 seconds.
GROUP MATERIALS & METHODS: MODELLING

Grouping drinking behaviour into bouts using Mixture Models

- Comes from previous studies on feeding behaviour
- Each bout is defined as time interval spent in proximity to the drinker
- Requires identification of a **bout criterion** – the shortest interval between visits to the drinker that is considered to be part of a bout
- Truncated log-normal distribution was used for within-bout intervals, log-normal for between bout intervals
- Bout criterion \( t \) was estimated at the intersection point between two distributions
RESULTS: MODELLING

- The bout criterion was estimated at the intersection point between the two distributions and resulted in **846 seconds** for line 1 and **566 seconds** for line 2.
<table>
<thead>
<tr>
<th>Level</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visit Level</td>
<td>• Number of visits per bout</td>
</tr>
<tr>
<td></td>
<td>• Drinking rate</td>
</tr>
<tr>
<td>Bout Level</td>
<td>• Daily bout frequency</td>
</tr>
<tr>
<td></td>
<td>• Water intake per bout</td>
</tr>
<tr>
<td></td>
<td>• Drinking time per bout</td>
</tr>
<tr>
<td>Day Level</td>
<td>• Daily bout duration</td>
</tr>
<tr>
<td></td>
<td>• Daily drinking time</td>
</tr>
<tr>
<td></td>
<td>• Daily water intake</td>
</tr>
</tbody>
</table>
RESULTS: DRINKING BEHAVIOUR TRAITS

<table>
<thead>
<tr>
<th>Traits</th>
<th>Line 1</th>
<th>Line 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of visits per bout</td>
<td>2.12±0.03*</td>
<td>1.99±0.03*</td>
</tr>
<tr>
<td>Drinking rate (ml/min)</td>
<td>7.78±0.04*</td>
<td>5.51±0.03*</td>
</tr>
<tr>
<td>Daily bout frequency</td>
<td>12.42±0.07*</td>
<td>18.78±0.10*</td>
</tr>
<tr>
<td>Water usage per bout (ml)</td>
<td>22.64±0.14*</td>
<td>11.91±0.07*</td>
</tr>
<tr>
<td>Drinking time per bout (s)</td>
<td>175.30±1.34*</td>
<td>132.55±1.04*</td>
</tr>
<tr>
<td>Daily bout duration (min)</td>
<td>62.90±0.56*</td>
<td>66.91±0.44*</td>
</tr>
<tr>
<td>Daily drinking time (min)</td>
<td>36.17±0.23*</td>
<td>40.84±0.22*</td>
</tr>
<tr>
<td>Daily water usage (ml)</td>
<td>282.48±0.86*</td>
<td>221.15±0.56*</td>
</tr>
</tbody>
</table>

All traits were significantly different between the lines (p < 0.01) based on Kruskal-Wallis test.
CONCLUSIONS

• Drinking behaviour in broilers follows the satiety principles; this enables biologically significant traits to be defined.

• Novel drinking behaviour traits have been derived; they include 2 traits at a visit level, and 3 traits each for bout and day levels.

• Lines showed differences in the organisation of drinking behaviour.

• The novel traits may be used in genetic selection by identifying birds that utilise water more efficiently or spent less time in drinking associated activities.
ACKNOWLEDGEMENT

- Colleagues at Newcastle University
- Aviagen for data and support on farm
- BBSRC for funding the project
Thank you!