Critical components to a healthy flock

• Temperature
• Feed
• Water
• Litter
Functions of litter

- Provides comfortable surface for birds
- Dilutes fecal matter
- Absorbs spilled water
- Insulates from cold pad
Traditional litter

• Diverse environment with bacteria, viruses, fungi, gases, insects and nutrients
• Has structure with absorbency characteristics
Production management shifts

- ABF
- Organic
- Veggie based diet
- Bigger bird
- More built-up litter
- Windrowing
- Tilling
Impact on today’s litter

• Higher loads of microorganisms
• Higher amounts of nutrients (N-P-K)
• Higher amounts of ammonia
• Higher amounts of moisture
• Wetter droppings
• Degraded bedding with less absorbency
Importance of litter management

• You’re dealing with a living, breathing organism!
• Proper management directly impacts performance
• Impact starts with 1st flock
• Each flock has direct impact on future flocks
Control variables for pathogens

- Temperature
- Moisture content
- pH
Temperature

- Optimum temp: 98 F
- Target temp for pathogen kill: 131 F
- Causes protein denature and thermal breakdown of cell membrane
In-house windrowing

- Used by some farms
- Can achieve high temps for bacterial control IF properly conducted
- Careful management required
- Longer downtimes required
- May not be recommended in winter months
In-house windrowing challenges

- Windrowing requires moisture
- Conflicts w/ litter mgmt. strategies of achieving dry litter
- Windrowing requires proper C:N ratio (25:1)
- Most litter C:N ratio (15:1)
- Degrades carbon to a fine particle size
- Results in less absorbent litter
- Redistributes and mixes wet litter
- Produces high levels of ammonia
- Temps often go unchecked
Continuous windrowing challenges

Finely textured, overworked litter with less absorbency (600 ppm NH₃ under surface)

Shallow decaked litter with more absorbency (100 NH₃ ppm under surface)
Moisture content

- Bacteria require water
- Wet litter promotes pathogen growth
- Wet litter promotes ammonia release
Hygrometers

• Inexpensive
• Measure at litter surface
• Maintain RH between 50-70%
• Humidity sensors on controllers don’t tend to work well
Start off right: Bedding Depth

- Critical for regulating body temperature
- Insulates bird from cold floor
- Deeper litter base retains heat better
- Wicks more moisture away from the bird

5 inches recommended
Shallow bedding vs deeper bedding

- Shallow litter:
  - quicker contamination
  - less absorbent
  - less insulation
Stratification
(1°F per foot)
Ventilation - considerations
Ventilation - considerations

- Obstructions to airflow
Ventilation - considerations
Ventilation - considerations

• Leaky Inlets
Ventilation - considerations

- Fan efficiencies
Ventilation - considerations

- Fan efficiencies
Moist air that didn’t exit
Condensation or poor ventilation

Ammonia

Pathogens
Cumulative effect: shallow litter, leaks, minimum vent, leaky inlets, high RH, overused litter
High relative humidity
Chicks don’t like cold air
Smoke test for leaks

• Mark with chalk and seal
Waterline Management

Ammonia

Pathogens
Waterline Management
Waterline Management

• Level waterlines and manage pressure
First steps at downtime

• Walk the house
• Locate cake. Note depth of cake.
• Determine if cake is due to ventilation, insulation or water line management
• Now is the time to fix these issues!
Litter moisture

- Understand all moisture sources
- Test litter tackiness
Downtime when de-caking

- De-cake wet litter areas ASAP
- Run de-cake machines as shallow as possible
- House should be closed tightly as soon as possible to retain heat in litter
- This heat will “cook off” ammonia and moisture
- Ventilate based on relative humidity and when working in house
De-cake the sidewalls! This is where ammonia and bacteria reside.
Downtime when windrowing

- Leave houses shut during the windrowing process
- Level windrows out at least 7 days prior to chick placement
- Shut houses up tight immediately after leveling windrows
- Ventilate to exhaust ammonia and moisture
Open vs Closed House

![Graph comparing the temperature over 7 days for open and closed houses.]

- **Open**: The temperature decreases steadily over time, reaching a lower value by the 7th day.
- **Closed**: The temperature decreases at a slower rate compared to the open house, maintaining a higher value by the 7th day.

The graph shows the temperature on the y-axis and the days on the x-axis, with red representing the open house and green representing the closed house.
The granularity of this litter allows for water to be wicked away. This is also evidenced by the minimum thickness of cake. Litter depth should be about 4-5 inches.
Cake - Remove!

Good Litter - Don’t Touch!
Overworked Litter
Pre-placement for performance

• Pre-heating is crucial for bird health
  • Warms the air and litter
  • Purges ammonia
  • Removes moisture from litter
• Minimum of 48-72 hour pre-heat EVERY flock
Dry litter on top.
Wet litter on bottom.
Requires adequate pre-heating.
Pre-Heating

- Keep houses shut tightly to save fuel and retain heat
- Run fans during driest part of day to prevent sweating.
- Ventilate based on relative humidity.
PLT application

- Open vent boxes and turn on 2 tunnel fans to purge ammonia just prior to PLT application
- Loss of ambient heat will be realized but floors will maintain heat
- Apply PLT as close to chick placement as possible
Bacteria prefer environmental pH of 6-8.
Litter usually contains pH of 7.5-8.5.
In acidic environment, bacteria try to maintain neutral intracellular pH.
They eventually deplete energy reserves and die.
In highly acidic environment, cell wall ruptures.
Litter pH and pathogens

- Litter treatments commonly applied pre placement for ammonia control.
- Reduce litter pH during the first week when birds are most susceptible to pathogen invasion.
## Effect of pH on pathogens

<table>
<thead>
<tr>
<th>pH</th>
<th>E. Coli</th>
<th>Clostridium</th>
<th>Salmonella</th>
<th>Pastuerella</th>
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<td>Heavy</td>
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</tr>
<tr>
<td>6.4</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Light +</td>
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<tr>
<td>6.3</td>
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<td>Heavy</td>
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<tr>
<td>6.2</td>
<td>Moderate</td>
<td>Heavy</td>
<td>Moderate</td>
<td>Very light</td>
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<tr>
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<tr>
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<td>Very light</td>
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<tr>
<td>4.3</td>
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<td>Very light</td>
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Source: Effects of pH on selected poultry bacterial pathogens, Boyd E. Hardin and C.S. Roney, Alabama Department of Agriculture and Industries State Diagnostic Lab
## Effect of pH on pathogens

<table>
<thead>
<tr>
<th>Level (lb/1000 ft²)</th>
<th>Salmonella (log₁₀/mL)</th>
<th>pH</th>
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<tbody>
<tr>
<td>Control</td>
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<td>8.3&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Sodium bisulfate</td>
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<td>6.23&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
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<td>1.47&lt;sup&gt;d&lt;/sup&gt;</td>
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<tr>
<td>P-value</td>
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</tbody>
</table>

Salmonella survival in litter as a function of pH and RH

• “Our data suggests that by reducing litter pH to 4, Salmonella populations can be reduced below detectable limits within 20 h or less when litter is previously contaminated with high populations of Salmonella.”

Evaluation of acidification with sodium bisulfate on controlling broiler necrotic enteritis

- Natural challenge, pen study on new litter (7 trts; 10 reps per trt)
- Seeder group of birds inoculated with *Clostridium perfringens*
- Seeder group removed from litter post infection + litter sprayed
- Unseeded group of day-old chicks placed on infected litter
- Birds received coccidiosis vaccine
- PLT and PWT treatments
- Lesion scored for NE at day 21
- Litter surface pH measured
- Litter total aerobic bacteria and *Clostridium perfringens* counts measured
Litter surface pH

- Control
- BMD
- PLT
- PWT

Day -1, Day 0, Day 18, Day 19

Legend:
- Day -1
- Day 0
- Day 18
- Day 19
**Clostridium perfringens populations**

![Graph showing the populations of Clostridium perfringens over different days for different conditions.](image-url)
Lesion scoring (Day 21, 5 birds/pen)

0 = normal: no NE lesions, small intestine has normal elasticity (rolls back to normal position after being opened)

1 = mild: small intestinal wall was thin and flaccid (remains flat when opened and doesn’t roll back into normal position after being opened); excess mucus covering mucus membrane

2 = moderate: noticeable reddening and swelling of the intestinal wall; minor ulceration and necrosis of the intestine membrane; excess mucus

3 = severe: extensive area(s) of necrosis and ulceration of the small intestinal membrane; significant hemorrhage; layer of fibrin and necrotic debris on the mucus membrane (Turkish towel appearance)

4 = dead or moribund: bird that would likely die within 24 hours and has NE lesion score of 2 or more; or birds that died due to necrotic enteritis.
Values within a row with no common letters are significantly different from each other. $P = 0.001$
Evaluate the effectiveness of sodium bisulfate for reducing bacterial and fungal populations within a broiler house

- 3 house broiler farm with history of NE
- Full house clean-out; 3 week downtime
- PWT administered in drinker lines
- PLT applied to pad at 150 lbs/1000 sq ft.
- Fresh shavings applied with no PLT
- PLT applied mid-flock at 100 lbs/1000 sq ft.
- Pad or litter samples collected and analyzed for bacterial counts throughout grow-out
Field demonstration

Anaerobic counts (PEA agar)

Note: Pre mid exceeded level of detection (>13.7)
Field demonstration

Total coliform counts

- Pre pad
- Post pad
- Shavings
- Day 7
- Pre mid
- Post mid
Field demonstration

Salmonella spp.
Evaluation of salt and sodium bisulfate pad treatments on bacterial populations

Susan Watkins, Ph.D. and Josh Payne, Ph.D
University of Arkansas
Jones-Hamilton, Co.
Effect of sodium bisulfate vs salt as pad treatment: Trial 1

- Plots set up in freshly cleaned out broiler house
- Samples taken pre, 24h and 72h post treatment
- Treatments:
  - Farmers Coop Salt 150 lbs/1000 sq. ft
  - PLT 100 lbs/1000 sq. ft.
  - PLT 150 lbs/1000 sq. ft.
- 4 reps per treatment
- Analyzed for bacterial counts
Effect of sodium bisulfate vs salt as pad treatment: Trial 1

• Salt showed no significant effects on APC and pH
• Sodium bisulfate at 100 and 150 lb/1000 sq. ft showed significant effects
• APC increased at 72 hours; however, pH was maintained below 4
• This suggests increase was non pathogenic bacteria

Source: Dr. Susan Watkins, University of Arkansas and Dr. Josh Payne, Jones-Hamilton, Co. 2017.
Effect of sodium bisulfate vs salt as pad treatment: Trial 2

• Plots set up in freshly cleaned out broiler house
• Samples taken pre, 24h and 72h post treatment
• Treatments:
  Farmers Coop Salt 150 lbs/1000 sq. ft
  PLT 150 lbs/1000 sq. ft.
• 5 reps per treatment
• Analyzed for bacterial counts
Effect of sodium bisulfate vs salt as pad treatment: Trial 2

**Surface pH**

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>24 hr</th>
<th>72 hr</th>
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<tbody>
<tr>
<td><strong>pH</strong></td>
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<td>8</td>
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</tbody>
</table>

**Aerobic Plate Count**

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>24 hr</th>
<th>72 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>log₁₀ cfu/ml</strong></td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>
Impact pH 2 sodium bisulfate solution with 30 second exposure on *E. coli* 0157:H7

Control w/ no cell wall rupture

Sodium bisulfate w/ cell wall rupture

Source: Dr. Ravi Jadeja. Oklahoma State University
Josh Payne, Ph.D.
Technical Services Manager
Jones-Hamilton, Co.
jpayne@jones-hamilton.com