# Darkling Beetles and Salmonella

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# Life Cycle of Darkling Beetles

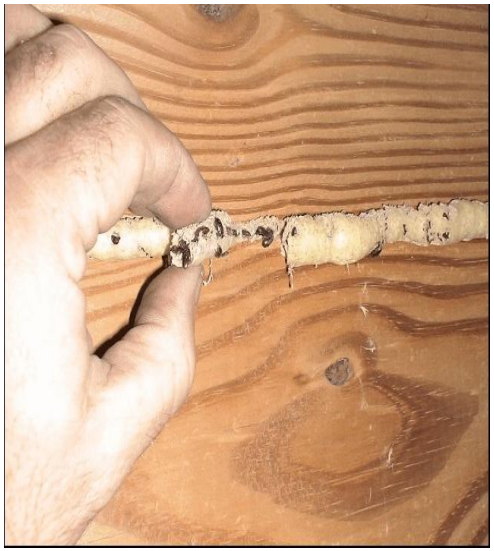
- Female darkling beetles lay on average 200 to 400 eggs.
- Eggs are laid in cracks, in litter, and under feed and water lines in poultry houses.
- Larvae hatch in four to seven days.
- Complete life cycle is around 30-40 days.

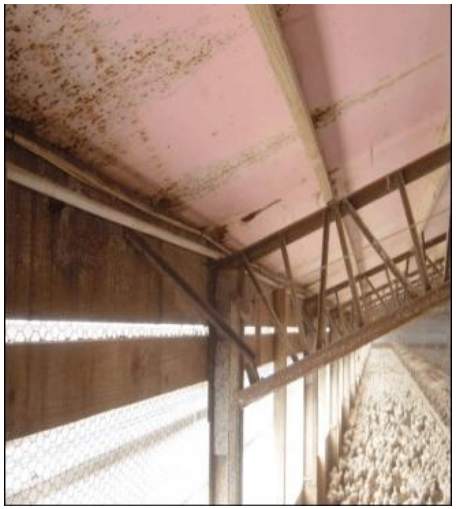
# Problems Associated with Darkling Beetles

- Increase in heating and repair cost
- Increase in production cost
- Nuisance
- Pathogen transmission
- Difficult control

# Damage to Structure and Insulation

- Larvae of the darkling beetle burrow into the insulation when preparing to pupate.
- Not only cause damage to insulation, but to wood structure as well.





# Feed Cost and Other Concerns

- The loss of chicken feed in broiler houses by the pest readily consuming spilt feed increases production costs.
- Birds feeding on lesser mealworms in preference to feed lowers their nutrition.
- In addition, feeding on beetles directly increases the likelihood of ingesting disease organisms or parasites.

# Problems Outside the Poultry House

- There has also been recent concern with these beetles leaving the poultry houses, or surrounding fields and flying into residential areas
- Run the risk of lawsuit, and very unhappy neighbors.

# Pathogen Transmission

- Darkling beetles are known vectors and reservoirs of a number of serious disease causing pathogens and parasites.
- These include: fowl pox, Marek's disease, avian influenza, Newcastle disease, Infectious Bursal disease, and avian leukosis.
- Also transmit food-borne pathogens: *Salmonella, E. coli, and Campylobacter*

# Broiler Production

- Broilers are the birds used for meat production
- Houses are very large (20,000 $ft^2$) and floors are dirt with wood shavings
- Around 22,000 to 26,000 birds per house
  - On the floor
- Grow out period is usually 8 weeks (3.8 lb)
- Time between flocks is 7-21 days
  - Complete clean out once a year
  - Cake out rest of time

# Salmonellae

- Leading cause of foodborne illness
  - Significant public health hazard
- Difficulties in controlling in animal husbandry, production, and processing
  - Implicated as significant routes of foodborne *Salmonella*

# Role of the Darkling Beetle in Transmission

- Adults and larvae are readily fed on by broilers
  - Chicks given a choice between starter feed and larvae average consumption was 389 larval beetles per day
    - Despins and Axtell 1995
- Omnivorous and cannibalistic consuming feed, dead birds, manure, and each other
- Abundance: 1,000 per square meter
  - Out of 1,000 adults collected from turkey brooder houses rate of *Salmonella* contamination was 2.2%
    - Harein et al. 1970

# Case in Point

- Darkling beetles exposed to *Salmonella* Typhimurium via feeding for 24 hrs tested positive 28 days (fecal samples)
- Surface swabs and whole body homogenates were positive for 16 days post-exposure
- Chicks were colonized by *S.* Typhimurium within 24 hrs of ingesting a single adult or larva inoculated via feed
  - McAllister et al. 1994

# *Salmonella* Colonization in Broilers

- Broilers fed beetles inoculated on the same day showed colonization at levels of 50-100%
- Insects inoculated and held for a week were also able to transfer Salmonella, but colonization was much lower
- Naturally contaminated beetles from broiler farms were also able to colonize broilers at low levels
  - Hazeleger et al. 2008

# Persistence *of Salmonella*

- Can persist on non-living darkling beetles for at least 45 days
  - De las Casas et al. 1968
- Salmonella in adults exposed for 24 hrs persisted for 64 days
- Larvae were positive for Salmonella for up to 49 days
- 19% of inoculated larvae allowed to pupate were positive for Salmonella following pupation
  - Roche et al. 2009

# Colonization in Subsequent Flocks

- Grow out is approximately 8 weeks with one week between flocks
  - Salmonella can persist for up to 64 days
  - Insects are in pupal stage and remain in the house
  - Adults will emerge with new flock

# Summary

- *Salmonella* is a one of the primary causes of foodborne bacterial illnesses
- Darkling beetle adults and larvae are capable of acquiring and harboring *Salmonella* spp. for over 30 days
- *Salmonella* can persisted on the darkling beetle throughout its various life stages
- Its persistence is sufficient time to colonize subsequent broiler flocks
- Chicks fed inoculated adults and larvae are colonized