Darkling Beetles and Salmonella

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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
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.
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.
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.
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*. 
Broilers are the birds used for meat production.

Houses are very large (20,000 ft²) 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*
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
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
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
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