



CANFARMSAFE™

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All Cooped Up - Part 2

Dust and Bioaerosol Concentrations in Laying Hen Housing

Airborne dust and bioaerosols are indicators often monitored in occupational settings to evaluate air quality and associated health risks for exposed workers. These indicators were evaluated in the *Developing Strategies to Minimize Health Risks in Next Generation Livestock Buildings Integrating Modern Animal Welfare Considerations* project to compare the air quality between conventional and alternative laying hen housing systems. To improve animal welfare, egg producers are progressively moving away from conventional cages (Figure 1) to systems where hens can express more of their natural behavior, such as enriched cages and aviaries (Figures 2 and 3). However, air quality is an issue in these next-generation livestock buildings which puts workers at a higher risk of developing both infections and non-infectious respiratory diseases (asthma and chronic bronchitis for example).



Figures 1 to 3: Conventional cages, enriched cages and aviary production systems

Materials and Methods

Samples were collected in 12 of the 18 total barns planned in the project. Different particle size fractions, such as PM_{2.5} and PM₁₀ (particulate matter with a diameter equal to or lower than 2.5 μm and 10 μm respectively), were measured using a DustTrak DRX Aerosol Monitor (TSI Incorporated). Airborne bacteria, bacterial fecal indicators (*Clostridium perfringens*, *Enterococcus* and *Escherichia coli*) as well as molds were collected with two air samplers: a Coriolis Micro (Bertin Corp.) and a SASS@3100 Dry Air Sampler (Research International). Finally, airborne endotoxins or lipopolysaccharides, structural components of Gram negative bacteria, were sampled by filtration using glass fiber filtering membranes housed in plastic 37 mm cassettes and Gilian® GilAir-5 Air Sampling Pumps (Sensidyne).



SASS@3100 Dry Air Sampler



Gilian Sampling Pump with 37mm Cassette



Coriolis Micro Air Sampler



Preliminary Results

Some interesting observations can be made from the data of the 12 visited farms, but a complete statistical analysis from a total of 18 buildings will be used to confirm any trends or conclusions. The concentrations of all airborne dust particle size fractions observed in aviaries were much higher compared to facilities with cage systems (Figure 4). In fact, the median total dust concentration was 32.6 mg/m³ in aviaries while values below 2 mg/m³ were observed in the battery and enriched cages.

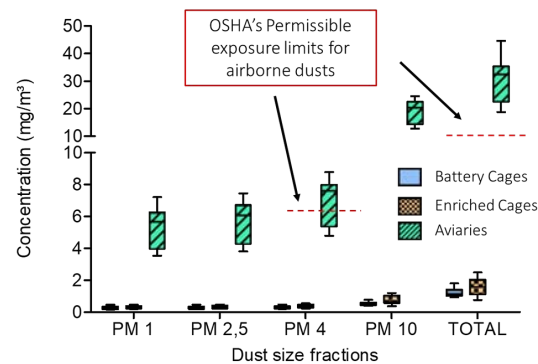


Figure 4: Dust Concentrations

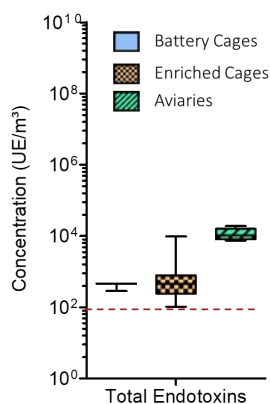
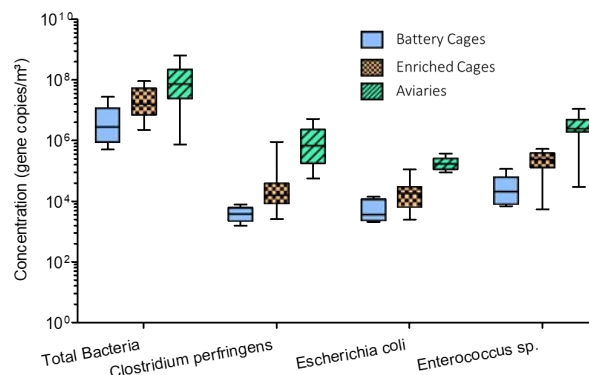
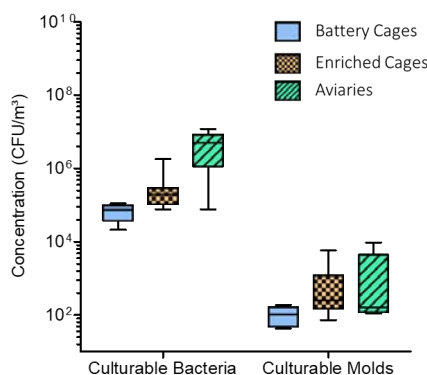


Figure 5: Endotoxins

Except for culturable molds, concentrations of bioaerosols seemed to be more important in aviaries than facilities with cages (Figures 6 and 7).

Airborne concentrations of total endotoxins also appeared higher in aviaries (Figure 5) while values were similar in facilities with battery cages and enriched cages. However, all the measured concentrations exceeded the limit for occupational exposure (90 EU/m³) proposed by the Dutch Committee on Occupational Safety (Health Council of the Netherlands, 2010).



Figures 6 and 7: Bioaerosol Concentrations

Conclusion

Cage-free laying hen housing systems, such as aviaries, are meant to allow hens to display a broader range of natural behaviors such as perching, dust bathing, foraging, scratching, kneeling, ruffling feathers and pecking activities. However, from the preliminary results, air quality in these housing systems is lower compared to systems with enriched or conventional cages. The next steps in this project will therefore focus on finding and testing strategies and technologies to reduce ammonia, dust and bioaerosols that can be implemented in commercial cage-free housing systems for laying hens.

