Poultry, swine, and equine animal facilities are all considered as Concentrated Animal Feeding Operations (CAFOs). All of these CAFOs are emission sources of gases and other pollutants which have negative impacts on the environment, human health, and animal health as well. One of those gases in Ammonia (NH₃), which is a colorless, highly irritating gas with a pungent, suffocating odor, and if inhaled in high concentrations, it may cause harm to the human body and the function of lungs. Personal exposure to ammonia was assessed for six workers in the three animal facilities: poultry, swine, and equine. Two workers from each facility wore passive badges (Model 584, Assay Technologies, OH) once per day over the sampling days. Eleven microenvironments frequented by the workers (stalls, barns, swine facility’s rooms, broiler houses) were also monitored daily using color dosimeter tubes (Model 810-3DL, Gastec Corp., Japan). The concentrations in the microenvironments were read directly from the dosimeter tubes. An activity log was used to document the workers’ activities and locations during their shifts. A Repeated Measures ANOVA statistical analysis was used to test for the differences among the personal-exposure concentrations.

### Methods

#### Materials and Methods

**Abstract**

This research took place in three animal facilities: poultry, swine, and equine. Two workers from each facility wore passive badges (Model 584, Assay Technologies, OH) once per day over the sampling days. Eleven microenvironments frequented by the workers (stalls, barns, swine facility’s rooms, broiler houses) were also monitored daily using color dosimeter tubes (Model 810-3DL, Gastec Corp., Japan). The concentrations in the microenvironments were read directly from the dosimeter tubes. An activity log was used to document the workers’ activities and locations during their shifts. A Repeated Measures ANOVA statistical analysis was used to test for the differences among the personal-exposure concentrations.

**Analysis and Results**

Mean 8-Hour TWA personal exposure concentrations ranged from 0.04 to 6.99 mg/m³ NH₃. Poultry workers were exposed to 127% and 91% higher concentrations than equine and swine workers, respectively. Exposure of workers within the poultry and the equine facilities varied significantly (P=0.0004 for poultry, P=0.0001 for equine), while workers at the swine facility were exposed to similar concentrations (P=0.0802). Workers’ activities varied during the sampling period. On the average, about 72, 75, and 81 min/day were spent by the poultry, equine, and swine workers, respectively, in the environments where ammonia was generated.

Regarding aerial measurements, NH₃ concentrations in the equine and swine facilities during the sampling days were 98% and 92% respectively lower than in the poultry facility, while the NH₃ concentrations in the equine facility were 83% lower than the swine facility. NH₃ concentrations were not the same for each facility during the 10 sampling days (P = 0.0213). NH₃ concentrations were not the same every day in each facility (P = 0.0004), and there was an interaction between day and facility in mean NH₃ concentrations (P < 0.0066).

### Conclusions and Recommendations

- The highest 8-Hour TWA concentration for personal exposure was 6.99 NH₃ (mg/m³) from the poultry facility.
- Based on the compliance testing that was done referring to NIOSH’s occupational exposure sampling strategy manual, none of the workers were exposed to NH₃ concentrations that exceeded the Permissible Exposure Limit (PEL=50 ppm) that is set by the Occupational Safety and Health Administration (OSHA).
- Only chicken houses recorded high concentrations of NH₃, where the 8-Hour TWA exposures exceeded 50 ppm.
- It is recommended for poultry workers to wear half mask respirators inside broilers to minimize their exposure to NH₃.
- Increased ventilation rate in chicken houses and other animal facilities during winter time is highly recommended.
- Using soybean hulls and wheat middling as feed types instead of starter feed for chickens may reduce the NH₃ concentrations by 50%.

### Acknowledgments

- Dr. Jooy Bray, Assistant Professor and Director of Poultry Science
- Dr. Stacie Appleton, Assistant Professor and Director of Equine Center
- Dr. John McHaffey, Assistant Professor and Director of Swine Center
- Mr. Justin Glasscock, Operations manager of Poultry Center
- All participating students at the animal facilities

### Analysis and Results

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- The personal monitoring badges outfitted by the workers were subjected to analytical analysis in the lab following the National Institute of Occupational Safety and Health (NIOSH) Analytical Method 6805 (Visible Absorption Spectrophotometry). Analysis required the use of TNT vials which contained indophenol blue that reacted with NH₃ when a portion of the resulting solution was added to the vial. TNT vials are an easy way to measure the concentration of a material inside them using a spectrophotometer based on transmittance and absorbance using light. High and Low rate vials were used for accuracy purpose.

#### Chemical Analysis

- Personal Exposure Sampling
  - NH₃ personal passive monitoring badges which required lab analysis.
  - Six workers, two in each facility.
  - Chemical Analysis done in the lab.
  - Duration of Exposure depended on the work shift while the aerial sampling aimed to measure how much NH₃ was suspended in the air.

- Aerial Exposure Sampling
  - NH₃ passive sampler tubes that can show NH₃ concentration based on a change in the color inside the tube.
  - Eleven sampler tubes distributed around the three facilities:
    1. Poultry: four samplers inside each of the four chicken houses and one outside at the center of the stalls area.
    2. Equine: one sampler in the barn area and one in the growing rooms.
    3. Swine: one sampler inside the farrowing, nursery, and the growing rooms, and one sampler outside the building.

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