Retaining manure nitrogen in confinement housing

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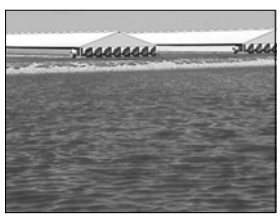
Reasons to conserve nutrients

- Nutrients have value
- Lost nutrients can incur costs
- Nutrients contribute to odor and gaseous emissions
- Regulatory thresholds

Confinement options

Decrease the volatilization potential

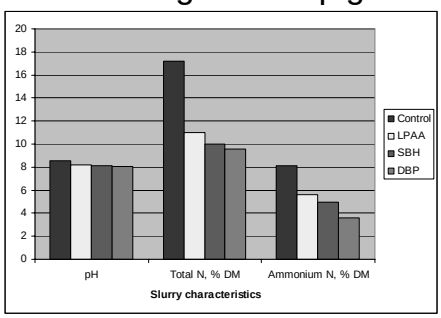
- Minimize the formation of ammonia
  - From excreta
  - From storage



Decrease the volatilization potential

- Minimize the formation of ammonia
  - From excreta
    - Fiber
    - Acidulants

Feeding fiber to pigs



Shriver et al., 2003. JAS

Shriver et al. (2003) conclusions

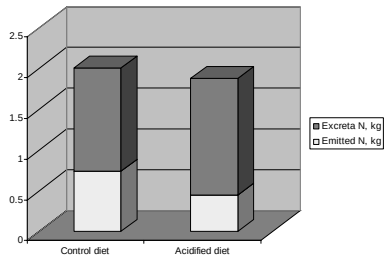
- Fiber addition to the LPAA diet tended to result in a greater proportion of N excreted in the feces than in the urine.
- Slurry pH, ammonium N content, and urinary urea N excretion were reduced ($P < 0.10$) in pigs fed LPAA, and
- A further reduction ($P < 0.06$) in slurry ammonium N content and urinary urea N was observed with fiber addition

Diet acidification

- Reduces pH and causes N to remain in ammonium form rather than volatilize in ammonia form
- $CaSO_4$ in the diet reduced ammonia emissions from laying hen excreta by 40%

Wu-Haan et al., 2007 (Poult. Sci.)

Acidification of hen diets



Wu-Haan et al., 2007 (Poult. Sci.)

Reducing nitrogen substrate available

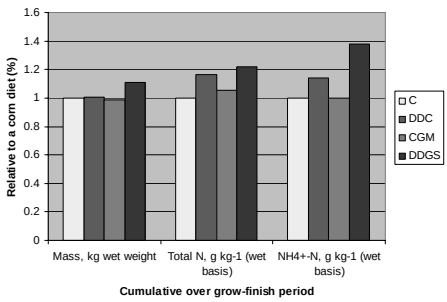
- Excreted nitrogen can be lost as ammonia
  - Reduce nitrogen excretion
  - 10% reduction in ammonia emissions for every 1 percentage unit decrease in dietary crude protein

Feeding corn co-products to pigs

- 6 feeding phases (40 to 270 lbs)
- Co-products included at 5, 10, 15, 20, 25, 30% as phases progressed

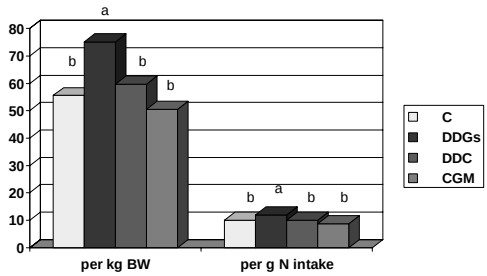
Powers et al., unpublished

Swine manure characteristics following feeding of 4 diets



Powers et al., unpublished

Ammonia emissions Daily emissions, mg



Powers et al., unpublished

In the dairy herd…

- Diet acidification may not be effective
  - Rumen buffering capacity
- Overfeeding N increases urinary N which is more subject to volatilization
- Tomlinson et al. (1996, Trans of ASAE) demonstrated greater urine N and less fecal N following feeding of Ca salts of LCFA.

Decrease the volatilization potential

- Minimize the formation of ammonia
  - From housing and storage
    - Design options
    - Management

Estimated losses

System	Nitrogen lost, %
Solid	
Daily scrape and haul	20 to 35
Manure pack	20 to 40
Open lot	40 to 55
Deep pit (poultry)	25 to 50
Litter	25 to 50
Liquid	
Anaerobic pit	15 to 30
Above-ground storage	10 to 30
Earth storage	20 to 40
Lagoon	70 to 85

From MWPS-18 'Livestock Waste Facilities Handbook' 2nd edition, Midwest Plan Service, Ames, IA 50011.

Urine-feces segregation

- In principle, urine and feces do not come in contact with each other
  - Prevents the release of ammonia from manure
  - >80% reduction in ammonia levels; corresponds to increased manure N

Photo courtesy of North Carolina State University

Management options

- Flushing frequency
  - Flushing increases N losses; increased scraping frequency decreases losses
  - Find compromise between cleanliness and N volatilization

Management options

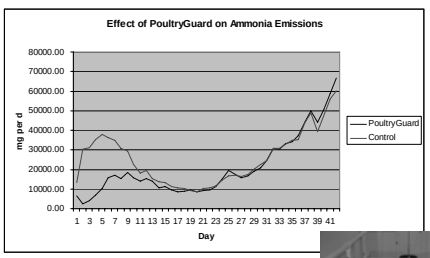
- Oil spraying – surfactant properties
- Misting – unknown effect
- Belt houses versus high-rise houses
  - Do the total system emissions change?

Litter amendments

- In a study of 194 broiler houses in Delaware, Maryland, and Virginia (Sims and Luka-McCafferty, 2002), alum treatment increased total N by 5.4 pounds per ton,
  - Alum increased the litter's fertilizer value and reduced the potential of P and heavy metal pollution.

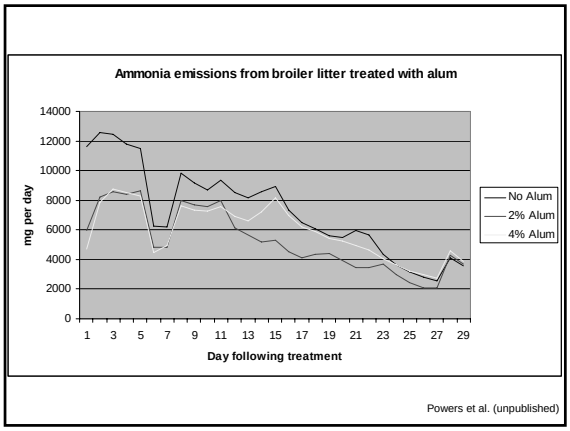
Litter amendments

- Poultry Guard – reduced house ammonia concentration (Shah et al., 2007 NCSU)
- PLT – reduced house ammonia concentration (Shah et al., 2007 NCSU)
- Absorbents – mixed results (Shah et al., 2007 NCSU)
- Expected that reduced ammonia concentrations were accompanied by increased litter N content



- Turkey litter with and without PoultryGuard amendment
- 42-d broiler chicken grow-out on the litter

Powers et al. (unpublished)



Powers et al. (unpublished)

Summary

- Nitrogen is too valuable to lose
  - As a crop nutrient
  - As an air pollutant
- Overfeeding nutrients is not a profitable means of increasing manure nutrients
- It is worth the time to calculate the savings that can be realized by making a management and/or feeding change to conserve N and prevent volatilization