

# *Dietary Effects on Air Emissions: Beef Cattle*

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## **Feedyard Emissions of Concern**

**Ammonia,  
Hydrogen Sulfide**

**Methane,  
Odors**

**Particulates,  
Pathogens**



**Nitrogen, Carbon, Sulfur, etc.**

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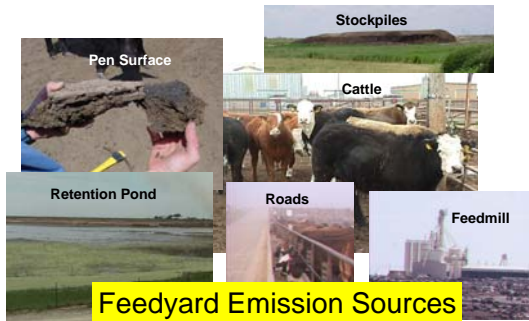
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## **How Does Diet Affect Emissions?**



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## Diet & Particulates



- > To our knowledge – no studies
- > Does supplemental fat in diet decrease?
- > PM emissions - affected by pen surface moisture
  - > As the organic matter content of the pen surface manure increases, the quantity of moisture required to control dust may increase (Miller & Woodbury, 2003)
- > Ammonia – a precursor of PM<sub>2.5</sub>

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## Ammonia Losses

**Most ammonia is produced rapidly from urine spots on the pen surface**

**Possible Exception - “burst” during warm-up after an extended cold (< 45° F) period**

**Emissions increase with days on feed (increased urinary N)**

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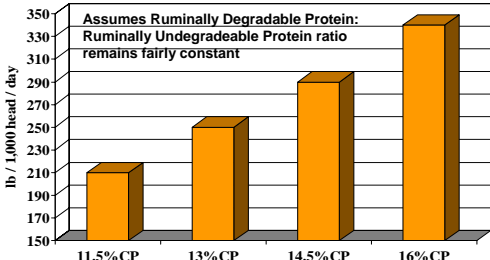
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### Dietary Crude Protein (CP) Effects on NH<sub>3</sub> Emissions (Cole & Todd, preliminary data)

Assumes Ruminally Degradable Protein:  
Ruminally Undegradable Protein ratio  
remains fairly constant



Note: These values should not be used to calculate emission factors

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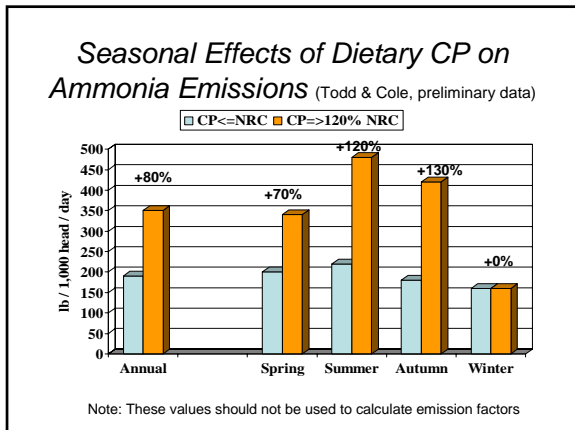
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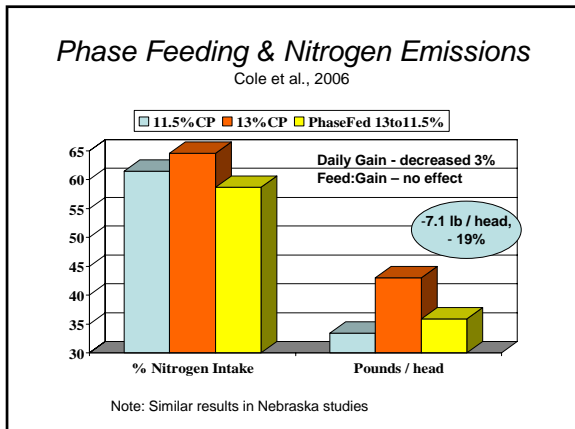
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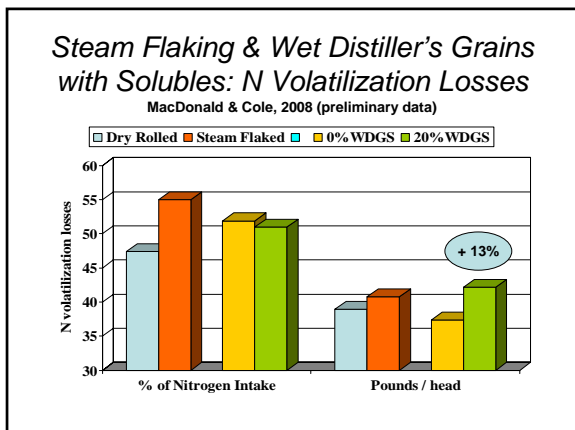
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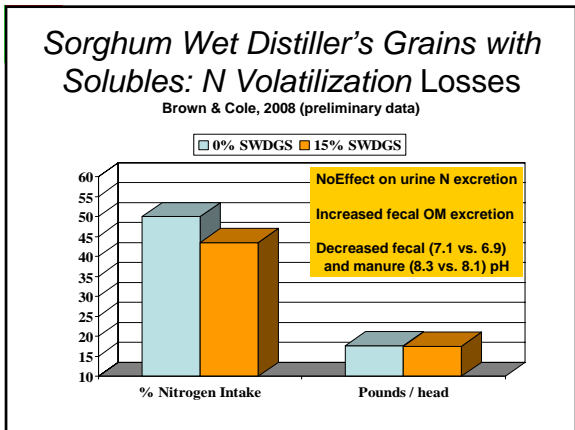
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**NH<sub>3</sub> : Summary**

- **Daily ammonia emissions from beef feedyards may be decreased by**
  - Decreasing dietary crude protein concentration
  - Limiting Ruminally Degradable Protein (i.e. urea) percentage
  - Phase feeding of protein

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**NH<sub>3</sub> : Summary**

- **Effects of feeding Distiller's Grains**
  - In general - NH<sub>3</sub> losses increase with increasing diet crude protein
  - May be affected by
    - Dietary concentration of distiller's grain (DG)
    - DG grain source (corn vs. sorghum)
    - Season
    - Grain processing method
    - Crude protein of forages fed
      - Alfalfa vs. grass hay vs. silage?

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### Hydrogen Sulfide and Odors

Most odorous compounds (Volatile organic compounds – VOC) are produced by anaerobic fermentation of carbohydrates and proteins

Hydrogen sulfide (H<sub>2</sub>S)– from dietary sulfur sources



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### Dietary Sulfur Sources

- Forages and grains (mostly amino acids)
  - Sulfur fertilization effects?
- By-products (amino acids & sulfates)
  - Distiller's grains
  - Gluten feed
- Mineral sources (sulfates)
- Water (sulfates)

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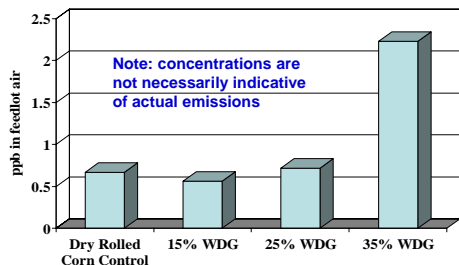
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### Distiller's Grains (WDG) & Feedlot H<sub>2</sub>S Concentrations (Benson et al., 2005)



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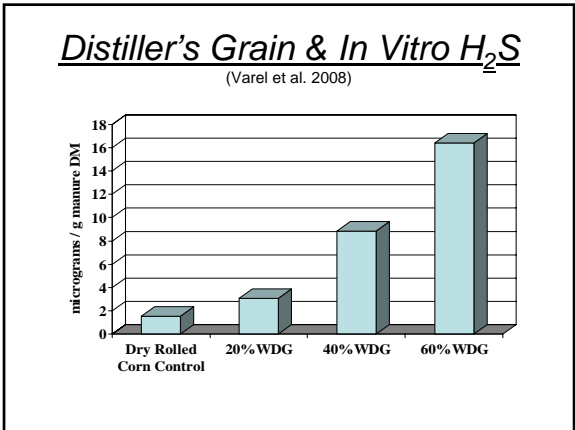
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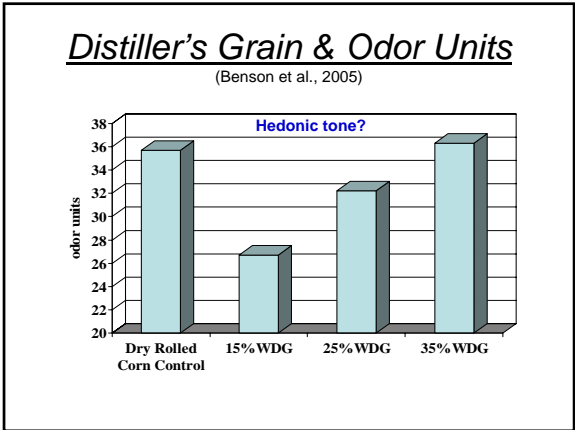
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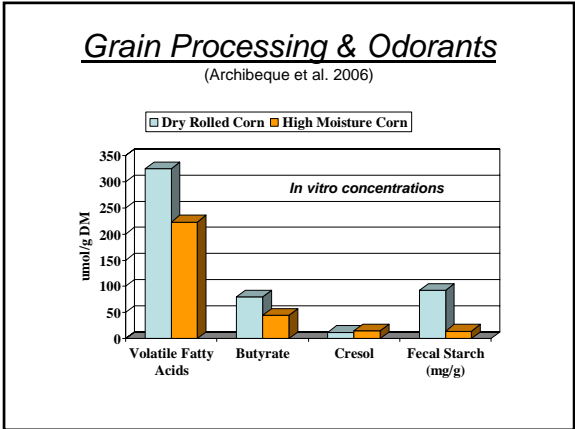
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## Odors: Summary

- Odor Emissions
  - Decreased by decreasing fecal starch
    - Grain processing method
  - Distiller's grains effects are not clear
- Hydrogen Sulfide Emissions
  - Increased by increased dietary S
    - High S byproducts – Distillers grains, gluten feed
    - High sulfur water

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## Greenhouse Gases



**Methane is produced from both enteric fermentation in the animal and fermentation in pen surface and stockpiled manure, etc.**

**Methane production from shallow retention ponds is minimal during the day**

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## Dietary Effects on Methane Production: Rules of Thumb

- **Increasing dietary fiber concentration increases enteric methane production**
  - Greater ruminal acetate:propionate ratio
- **Supplementing with fat decreases enteric methane production**
  - Decreased ruminal fermentation
  - Selective effects on methanogenic bacteria
  - Biohydrogenation of fatty acids

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*Dietary Effects on Methane Production: Rules of Thumb*

- More intensive grain processing tends to decrease enteric methane production
  - Effects on ruminal fermentation
    - Lower pH decreases methanogenesis
    - Decreased acetate:propionate ratio
    - Decreased dry matter intake
- More intensive grain processing may also decrease manure methane production
  - Less fecal starch

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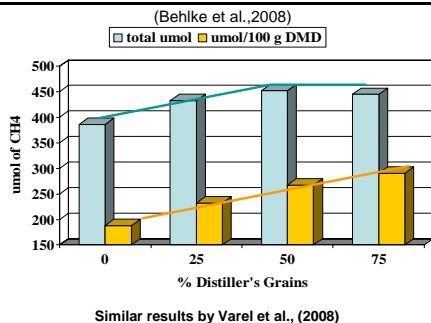
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*In Vitro CH<sub>4</sub> Production: Replacing Corn + Oil With Distiller's Grains*




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*CH<sub>4</sub>: Summary*

- **Enteric emissions**
  - Decreased by more intensive grain processing
  - Effects of Distiller's Grain & Gluten Feed are not clear
    - Basal fat level of diet?
    - Roughage level of diet?
- **Manure emissions**
  - Theoretically – decreased by more intensive grain processing and lower roughage levels

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### Additional Conclusions

- Feeding and management technologies that increase production efficiency
  - Ionophores, beta-agonists, implants, etc.
  - Tend to decrease emissions per unit of production
- Effects on performance need to be considered –
  - g/day vs. g/lb ADG or g/lb beef produced

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### References & Additional Reading

- Archibeque et al. (2006) J. Anim. Sci. 84:1767-1777
- Behlke et al. (2008) U. Neb. Beef Report MP91
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