Targeted Feeding Strategies to Reduce Nitrogen Losses and Ammonia Emissions from Dairy Cows

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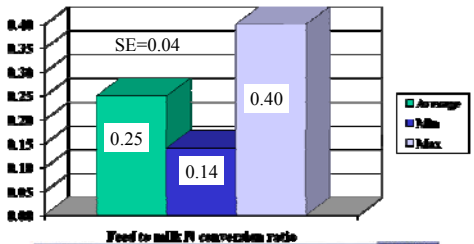
Hristov et al., 2005

Efficiency of utilization of feed N in Holstein dairy cows (846 diets)



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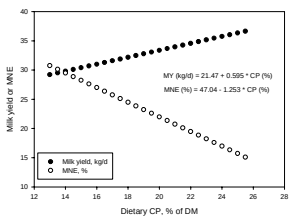
Hristov & Huhtanen, 2008

Effect of dietary crude protein on milk yield and milk N efficiency

(simulation based on 1,700 diets)



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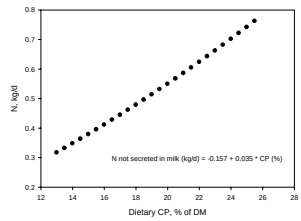
Hristov & Huhtanen, 2008

Effect of dietary crude protein on N losses (simulation based on 1,700 diets)



1%-unit increase in dietary CP will result in 2.8 g/d increase in milk N output and 35.7 g/d N lost with feces and urine

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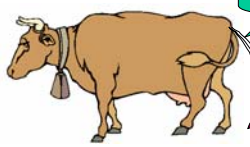
N losses in the ruminant – volatility of excreted N



Losses with **urine** – approx. 63% of all N losses

50-90% is urea N

66-70% may be lost as ammonia

Losses with **feces** – approx. 37% of all N losses

Only 1-13% may be lost as ammonia

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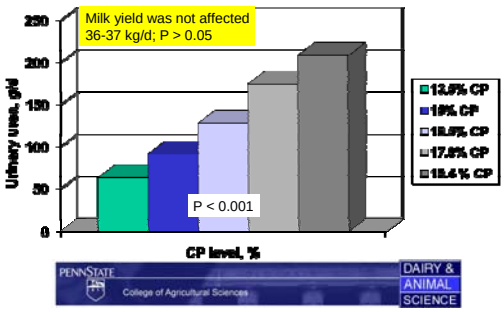
Colmenero and Broderick, 2006

Effect of crude protein on urinary urea excretion



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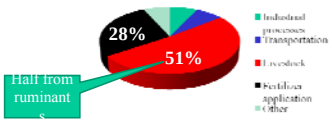
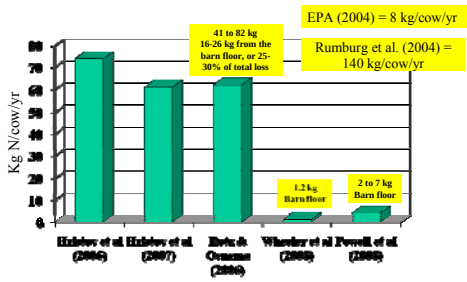
Roy Huntley, EPA, personal communication



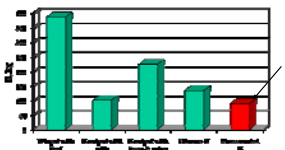
Ammonia emissions:
Crude protein level in the diet

Published ammonia emission rates



Hristov et al., 2007

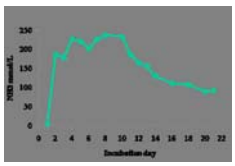
N mass-balance study



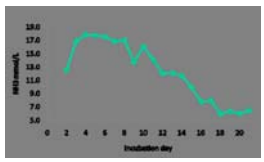
About 50% of the estimated N output with feces and urine was unaccounted for in manure in 24 h

Lee et al., unpublished

Typical ammonia emission pattern in vitro



Ammonia in manure



Ammonia in collection solution

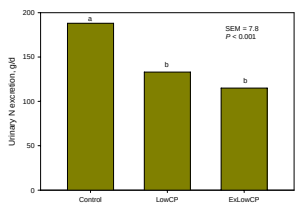
Agle et al., 2008

Crude protein levels study - diets

Composition (DM)	Control	LowCP	ExLowCP
Crude protein, %	17.6	15.2	14.4
NEL, Mcal/kg	1.55	1.51	1.51
NDF, %	30	30	32
Forage NDF	25	24	26
NFC, %	44	46	46
MP balance, g/d	+15	+16	+18
RDP balance, g/d	+570	+1	-369

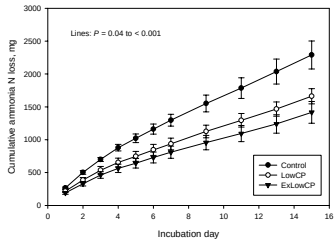
Agle et al., 2008

Urinary N excretion



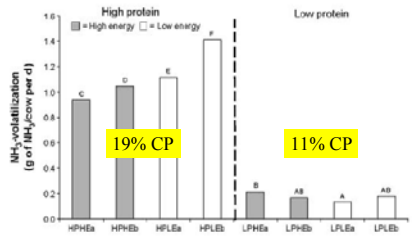
Agle et al., 2008

Cumulative ammonia losses from manure as affected by diet CP



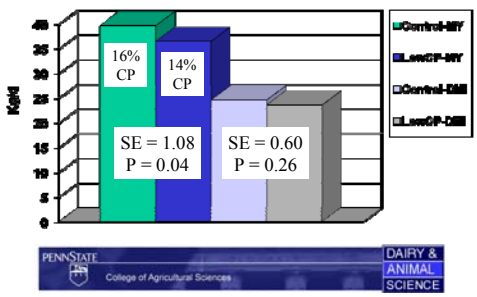
Van der Stelt et al., 2008

Protein and energy interaction



Hristov et al., unpublished

When the requirements of the cow for AA are not met, production suffers



Ammonia emissions: Energy density of the diet

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Agle et al., 2008

Energy density study - diets

Composition (DM)	Control	High-energy diet
Forage, %	**50**	**17**
Crude protein, %	17.9	17.8
RDP, %	12	12
NEL, Mcal/kg	1.65	1.83
NDF, %	32	25
Forage NDF	22	13
NFC, %	39	47

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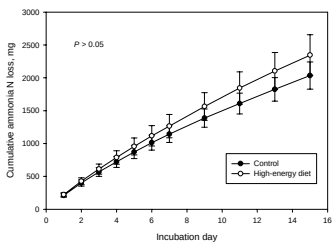
Agle et al., 2008

Cumulative ammonia losses from manure



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Take-home message

- Dietary CP concentration is the most important single factor determining milk N efficiency
  - Rumen N balance should be reduced to improve N efficiency
- Feeding diets with lowered CP & ruminally-degradable protein concentrations will decrease urinary N excretion
  - In one study, cumulative ammonia losses from manure were reduced by 38%
- In one study, increasing energy density of the diet reduced ruminal ammonia concentration and relative urinary N losses, but had no effect on cumulative ammonia losses from manure

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