Penn State **Extension**

Can we feed less protein to dairy cows, save money, and help the environment?

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The Pennsylvania State University Ammonia Mitigation Project

In 2009, the Northeast Sustainable Agriculture Research and Education (NE SARE) program funded a 3-year project targeting reduction of ammonia emissions from dairy farms in Pennsylvania.

Feeding protein to dairy cows in excess of their requirements is no longer an acceptable practice. Of about 9 lbs. protein intake per day, an average cow will use 2 to 3 lbs. for milk protein synthesis. The difference of 1 lb. (which is the difference between a low- and a high-efficient cow), however, would make a huge difference on nitrogen losses and consequently ammonia emission from manure.

Protein (as amino acids) is an important nutrient for maintenance and production and its deficiency would lead to loss of production and poor animal health and reproduction. Protein requirements, however, may be over-predicted by the current dairy protein models, which leads to overfeeding of protein, deliberately through ration formulation, or due to inadequacy of monitoring of feeding management practices. ***Excess dietary protein results in increased nitrogen excretion with urine and consequently, ammonia volatilization losses from manure.*** Ammonia is an environmental and human health hazard, contributing to fine particulate matter formation, eutrophication of surface waters and nitrate contamination of ground waters, and soil acidity.

For this project, the Penn State Extension Dairy Team identified 12 small (50 cows) or larger (550 cows), free-stall and tie-stall dairies in Central, Southeast, and Southwest PA with scrape, gravity-flow, or flush manure management systems. All dairies fed a total mixed ration (TMR). The team performed extensive forage and TMR sampling to verify crude protein (CP) levels at the beginning and throughout the project (Figure 1).

Project main objective:

Reduce whole-farm nitrogen inputs and ammonia emissions from Pennsylvania dairies while maintaining or improving profitability as measured through Income Over Feed Cost (IOFC)

Measuring barn floor ammonia emissions

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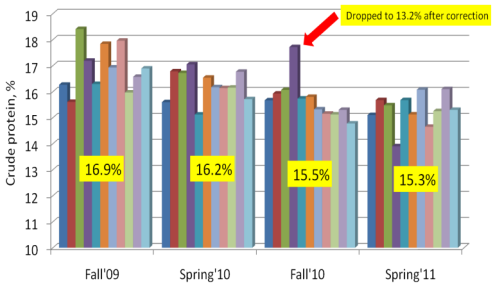
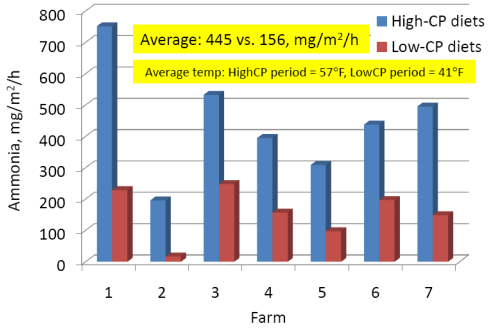
Fig. 1. Average TMR crude protein before (Fall'09 & Spring'10) and after (Fall'10 & Spring'11) protein reduction



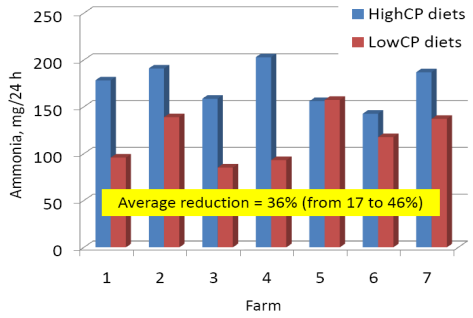
Following consultations with the dairymen and their nutritionists, a 1%-unit drop in TMR CP was achieved in most dairies in the 2nd year of the project (Figure 1). Barn floor and laboratory ammonia emissions were measured before and after the TMR protein reduction. So was milk yield per cow, milk composition (including milk urea nitrogen, MUN), and IOFC.

Fig. 2. Barn floor ammonia emissions



Following TMR protein reduction, barn floor ammonia emissions were reduced on average by about 65% (Figure 2), but a large portion of this difference was likely due to differences in ambient temperature, which was 41°F during the low-CP TMR periods vs. 57°F for the high-CP periods. Our laboratory measurements, conducted at the same temperature to more truly represent the effect of feeding, showed a **36% reduction in ammonia emission due to the reduced protein content of the TMR** (Figure 3). Overall, flush dairies emitted less ammonia off the barn floor than scrape or gravity-flow dairies.

Fig. 3. Laboratory ammonia emissions (Ammonia Emitting Potential of manure)



Average MUN were also reduced (13.2 vs. 15.4 vs. mg/dL, a 14% reduction) and IOFC was increased by $0.90/cow/d (Figure 4) for the low-CP period; there was no difference in milk yield of the cows (Figure 5).

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Laboratory measurement of the ammonia emitting potential of manure

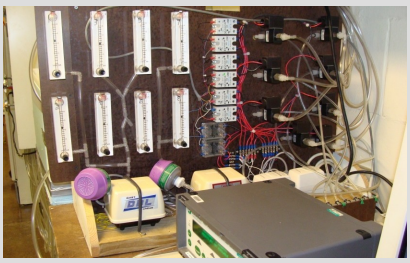


Fig. 4. Income Over Feed Cost for Dairies Participating in the Project

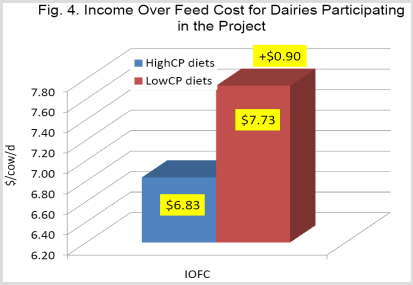
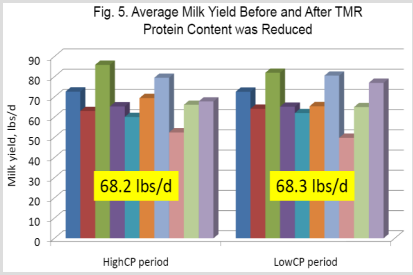


Fig. 5. Average Milk Yield Before and After TMR Protein Content was Reduced



Conclusion: Reduction of dietary crude protein by about 1%-unit resulted in a significant 36% reduction in ammonia emissions from manure, did not affect milk yield, and increased income over feed costs by $0.90/cow/d in commercial Pennsylvania dairies.

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