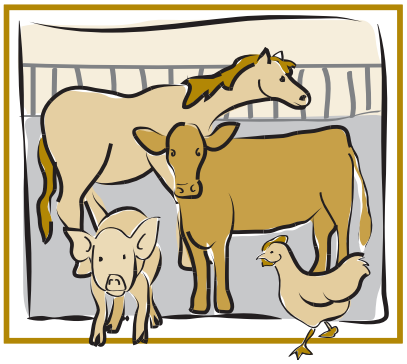
Colorado State University

Extension

Best Management Practices for Reducing Ammonia Emissions: Beef Cattle Nutrition

Fact Sheet No. **1.631C** Livestock Series | **Management**

by S.G. Lupis, K.J. Galles, J.M. Ham, E. Westover, J.J. Stratton, J. Wagner, T. Engle, and J.G. Davis*



Cattle feeding operations have been identified as a potential source of ammonia emissions into the atmosphere. Urea nitrogen in fresh urine and feces is deposited on the pen surface where it is quickly broken down and volatilized into the air as ammonia. Ammonia is especially of concern along Colorado's Front Range, where upslope conditions occasionally occur with easterly winds transporting ammonia from the Eastern Plains to the alpine areas of the Rocky Mountains, including Rocky Mountain National Park (RMNP). Ammonia can then be scavenged from the air by precipitation and deposited on the soil surface in pristine high-elevation environments where excess nitrogen (N) can negatively impact fragile ecosystems. While studies have shown there are many sources contributing to nitrogen deposition in RMNP (e.g., urban settings, transport from other states), every effort should be made to minimize the impact of livestock. One of the most promising strategies for reducing ammonia emissions from feedlots is reducing the amount of excreted nitrogen on the pen surface by modifying livestock diets.

What Goes in Must Come Out

Of the nitrogen fed to beef cattle (often as protein), only about 12 to 15% is retained by the animal. The rest is excreted onto the pen surface. It is less efficient—and costs more—when beef cattle are fed more nitrogen than they need for optimal performance. Feeding nitrogen in excess of what an animal needs doesn't increase performance, so it ends up increasing feed costs without increasing profits. Therefore, by feeding beef cattle to meet, but not exceed, requirements for crude protein, nitrogen excretion and subsequent emissions will be reduced.

Reducing crude protein in the diet can reduce nitrogen lost through beef cattle urine and feces. In one study, feeding 11.5% crude protein reduced nitrogen loss by 60-200% compared to a diet of 13% crude protein. In another study, dietary nitrogen inputs were reduced by 10-20% and resulted in a 15-33% reduction in nitrogen loss. The notion that 'what goes in must come out' works both ways. For example, a Texas study increased feed nitrogen 15-26% and saw an increase in ammonia lost to the atmosphere of 10-64%.

Reducing nitrogen excreted by adjusting diet ultimately can reduce the amount of ammonia lost to the atmosphere. In Texas, beef cattle fed a diet with less crude protein (11.5%) had 25% less nitrogen lost to volatilization with no impact on animal performance. A recent study by Colorado State University scientists compared emissions between beef cattle finished on diets with 13.5% and 11.62% crude protein. A 21-40% reduction in emissions was observed in the low-nitrogen diet group. However, more research is needed to validate these results at commercial scales in different environments to determine if reductions in ammonia can be sustained with lower protein diets without affecting rate of gain, feed efficiency, and health.

Overall, these studies suggest that reducing the crude protein in beef cattle diets can reduce emissions. In addition, it reduces the cost of feeding more crude protein than necessary to maintain animal performance. On Colorado's Front Range—where nitrogen transport to sensitive alpine environments primarily happens in the spring and

*S.G. Lupis, Institute for Livestock and the Environment, coordinator; K.J. Galles, Colorado State University, graduate student, soil and crop sciences; J.M. Ham, professor, soil and crop sciences; E. Westover, graduate student, animal sciences; J.J. Stratton, graduate student, chemistry; J. Wagner, professor, animal sciences; T. Engle, professor, animal sciences; J.G. Davis, professor, soil and crop sciences. 12/12

Quick Facts

- Only 12-15% of the nitrogen fed to beef cattle as crude protein is retained; the rest is excreted onto the pen surface.
- Reducing crude protein in the diet can reduce nitrogen lost through beef cattle urine and feces.
- Reducing nitrogen lost by adjusting diet ultimately can reduced the amount of nitrogen/ammonia lost to the atmosphere.
- On Colorado's Front Range, finishing beef cattle on a reduced-nitrogen diet during the spring and summer would likely reduce environmental impacts as well as producer costs.
- More research needs to be conducted to assess affects on cattle performance and health in a commercial feedlot setting.

www.ext.colostate.edu

summer—finishing beef cattle on a reduced-nitrogen diet during these periods could both reduce environmental impacts and producer costs; however, impacts on cattle performance and health need to be investigated further. Some studies have shown that lower protein diets (11 to 12%) can decrease rate of gain.

References

Cole, N.A., R. N. Clark, R. W. Todd, C. R. Richardson, A. Gueye, L. W. Greene, and K. McBride. 2005. Influence of dietary crude protein concentration and source on potential ammonia emissions from beef cattle manure. Journal of Animal Science 83:722-731.

Cole, N. A., P. J. Defoor, M. L. Galyean, G. C. Duff, and J. F. Gleghorn. 2006. Effects of phase-feeding of crude protein on performance, carcass characteristics, serum urea nitrogen concentrations, and manure nitrogen of finishing beef steers. Journal of Animal Science 84:3421-3432.

Erickson. G. E., T. J. Klopfenstein, and C. T. Milton. 2000. Dietary protein effects on nitrogen excretion and volatilization from open-dirt feedlots, in J. A. Moore (Ed.), 8th International Symposium on Animal Agricultural and Food Processing Wastes, ASAE Publications, Des Moines, IA. pp. 297-304.

Galles, K., J. Ham, E. Westover, J. Stratton, J. Wagner, T. Engle, and T.C. Bryant. 2011. Influence of reduced N diets on ammonia emissions from cattle feedlot pens. Atmosphere. 2: 655-670. Open Access: www.mdpi.com/journal/atmosphere.

Kissinger, W. F., R. K. Koelsch, G. E. Erickson, and T. J. Klopfenstein. 2007. Characteristics of manure harvested from beef cattle feedlots. Applied Engineering in Agriculture 23:357-365.

Malm et al. 2009. Romans: Rocky Mountain Atmospheric Nitrogen and Sulfur Study. National Park Service. ISSN 0737-5352-84. www.nature.nps.gov/air/Studies/romans.cfm.

Reynolds, C. K. and N. B. Kristen. 2008. Nitrogen recycling through the gut and the nitrogen economy of ruminants: An asynchronous symbiosis. Journal of Animal Sciences 86:E293-305.

Further Reading

Colorado State University Extension fact sheet: 1.631 *Best Management Practices for Reducing Ammonia Emissions*