

Marshall D. Stern

Professor

Appointment 20% Research, 65% Teaching, 15% Service

Research Area Protein Nutrition of Ruminants

Appointment History

1989-present	Professor
1985-1989	Associate Professor
1981-1985	Assistant Professor

Graduate Program Affiliations

Animal Sciences – Senior Member

Professional and Honorary Societies

Member, American Society of Animal Science

Member, American Dairy Science Association

Member, North American College and Teachers of Agriculture (NACTA)

Five Most Significant Publications

Bach, A., G.B. Huntington, S. Calsamiglia, and M.D. Stern. 2000. Nitrogen metabolism of early lactation cows fed diets with two different levels of protein and different amino acid profiles. *J. Dairy Sci.* 83:2585-2595.

Holstein cows surgically prepared with indwelling catheters in the mesenteric, portal, and hepatic veins and carotid artery were used to determine the effects of dietary crude protein level and amino acid profile on N metabolism during early lactation (from 25 to 65 d in milk). It was concluded that milk protein production during early lactation is less susceptible to variations in dietary CP contents than variations in the amino acid profile of the dietary protein.

Ziemer, C.J., R. Sharp, M.D. Stern, and D.A. Stahl. 2000. Comparison of microbial populations in model and natural rumens using 16S ribosomal RNA-target probes. *Environ. Microbiol.* 2:632-643.

This was a collaborative effort with scientists at the USDA in Peoria, IL and Northwestern University to evaluate the microbial ecology of the rumen using the continuous culture model and 16S ribosomal RNA-target probes. Fermenters were able to maintain a core prokaryotic community structure similar to the native microbial community in the rumen. Although protozoa populations were lost, maintenance of *Fibrobacter* and archaeal populations indicated that the model system supported a functional community structure remarkably similar to the rumen. Conclusions were that this model rumen system may serve as a suitable model for studies of ruminal microbial ecology providing for control of experimental conditions and resolution of some of the relationships between microbial community structure and function.

Calsamiglia, S. and M.D. Stern. 1995. A three-step in vitro procedure for estimating intestinal digestion of protein in ruminants. *J. Anim. Sci.* 73:1459-1465.

A three-step in situ/in vitro procedure was developed as an alternative to using duodenal and ileal cannulated animals for estimating intestinal digestion of dietary protein. This technique closely simulates physiological conditions of the ruminants; is rapid, reliable, and inexpensive; is applicable to a wide variety of protein sources; and accurately reflects differences in protein digestion. Many university and industry colleagues have adopted this technique to investigate factors affecting feed protein availability. This research has provided invaluable data to the 2001

Nutrient Requirements of Dairy Cattle that were previously lacking (author or co-author of 22 publications that were cited and utilized in the chapter on protein and amino acids).

Mansfield, H.R., M.I. Endres, and M.D. Stern. 1995. Comparison of microbial fermentation in the rumen of dairy cows and dual flow continuous culture. *Anim. Feed Sci. Technol.* 55:47-66.

This experiment compared directly the use of ruminal and duodenal lactating dairy cows with a dual flow continuous culture fermentation. Results substantiated the use of the continuous culture system as an excellent model for simulating ruminal microbial fermentation.

Stern, M.D., G.A. Varga, J.H. Clark, J.L. Firkins, J.T. Huber, and D.L. Palmquist. 1994. Evaluation of chemical and physical properties of feeds that affect protein metabolism in the rumen. *J. Dairy Sci.* 77:2762-2786.

This manuscript summarized the important contributions of the NC-185 committee studying "Metabolic Relationships in Supply of Nutrients for Lactating Cows" and highlighted the many significant contributions my laboratory has made in understanding and improving the efficiency of nitrogen utilization in the rumen.

Refereed Journal Publications and Book Chapters (Last Five Years)

Authored or co-authored the following 12 papers in peer-reviewed journals and 1 book chapter.

- Mesgaran, M. D. and **M. D. Stern.** 2004. Ruminal and post-ruminal protein disappearance of various tropical feeds determined by the mobile nylon bag, in vitro and three-step procedures. *Anim. Feed Sci. Technol.* (In Press).
- Crawford, G.I., **M.D. Stern**, R.L.K. Hulbert, K.A. Caperoon, and P.G. Summer. 2004. Effects of a liquid byproduct nitrogen source on nitrogen utilization by ruminal microbes in continuous culture fermenters. *J. Anim. Vet. Adv.* 3(12):872-880.
- Schwab, C. G., T. P. Tylutki, R. S. Ordway, C. Sheaffer and **M. D. Stern.** 2003. Characterization of proteins in feeds. *J. Dairy Sci.* 86:(E. Suppl.):E88-E103.
- Ziemer, C. J., R. Sharp, **M. D. Stern**, M. A. Cotta, T. R. Whitehead and D. A. Stahl. 2002. Persistence and functional impact of a microbial inoculant on native microbial community structure, nutrient digestion and fermentation characteristics in a rumen model. *Systemic and Appl. Microbiol.* 25:416-422.
- Tapia, M.O., **M. D. Stern**, R. L. Koski, A. Bach, and M. J. Murphy. 2002. Effects of patulin on microbial fermentation in continuous culture Fermenters. *Anim. Feed Sci. Technol.* 97:239-246.
- Ariza, P., A. Bach, **M. D. Stern**, and M. B. Hall. 2001. Effects of carbohydrates from citrus pulp and hominy feed on microbial fermentation in continuous culture. *J. Anim. Sci.* 79:2713-2718.
- Ziemer, C. J., R. Sharp, **M. D. Stern**, and D. A. Stahl. 2000. Comparison of microbial populations in model and natural rumens using 16S ribosomal RNA-target probes. *Environ. Microbiol.* 2:632-643.
- Bach, A., G. B. Huntington, S. Calsamiglia and **M.D. Stern.** 2000. Nitrogen metabolism of early lactation cows fed diets with two different levels of protein and different amino acid profiles. *J. Dairy Sci.* 83:2585-2595.
- Bach, A., G. B. Huntington and **M. D. Stern.** 2000. Response of nitrogen metabolism in preparturient dairy cows to methionine supplementation. *J. Anim. Sci.* 78:742-749.
- Bach, A. and **M. D. Stern.** 2000. Measuring resistance to ruminal degradation and bioavailability of ruminally protected methionine. *Anim. Feed. Sci. Technol.* 84:23-32.
- Bach, A. and **M. D. Stern.** 1999. Effects of different levels of methionine and ruminally undegraded protein on the amino acid profile of effluent from continuous culture fermenters. *J. Anim. Sci.* 77:3377-3384.
- Bach, A., I. K. Yoon, **M. D. Stern**, H. G. Jung and H. Chester-Jones. 1999. Effects of type of carbohydrate supplementation to lush pasture on microbial fermentation in continuous culture. *J. Dairy Sci.* 82:153-160.

Book chapter:

Calsamiglia, S., **M.D. Stern**, and A. Bach. 2000. Enzymatic and Microbial Cell Preparation Techniques for Predicting Rumen Degradation and Postruminal Availability of Protein. *In: D.I. Givens, E. Owen, R.F.E. Axford and H.M. Omed. (Eds) Forage Evaluation in Ruminants (pp. 259-280).* CAB International, Wallingford, United Kingdom.

Awards

North American Colleges and Teachers of Agriculture (NACTA) Teaching Award of Merit 2003

COAFES Distinguished Teaching Award 2002

Nominee, American Feed Ingredients Assoc., Ruminant Nutrition research award, 2003, 2002

Nominee, Purina Undergraduate Teaching Award 2004, 2003

Science In Agriculture Undergraduate Theses (Last Five Years)

Reagan Koski	Evaluation of alfalfa forage protein utilization by ruminant animals.
Erika Nordgren	Evaluation of ruminal in vitro procedure as a modification in the three-step procedure for estimating intestinal protein digestion.
Tom Moody	Ruminal and intestinal protein digestion of energy sources.
Kathy Jo Schmuhl	Ruminal and intestinal protein digestion of kura and red clover forages.
Lisa Aga	Evaluation of variation in protein sources for ruminants.
Lynnette Truen	Protein utilization of red clover and kura clover by the ruminant animal.
Kara Kuha	Chemical composition and small intestinal protein digestibility of various rumen microbial fractions.
Heidi Doering	In vitro and in situ evaluation of ruminal and intestinal nitrogen metabolism of various soybean products.
Cara Kupcho	Evaluation of a ruminal in situ procedure vs an enzymatic in vitro procedure for estimating ruminal and intestinal protein digestion of various soybean products.
Benjamin Seebart	Evaluation of a ruminal in situ procedure vs an enzymatic in vitro procedure for estimating ruminal and intestinal protein digestion of forages with various tannin concentrations.
Melissa Thrune	Evaluation of a ruminal in situ procedure vs an enzymatic in vitro procedure for estimating ruminal and intestinal protein digestion of animal by-products.
Sarah Wickham	Evaluation of a ruminal in situ procedure vs an enzymatic in vitro procedure for estimating ruminal and intestinal protein digestion of plant by-products.

Proceedings and Invited Lectures (3) (Last Five Years)

Stern, M.D., A. Bach and S. Calsamiglia. 2004. Nitrogen metabolism in the rumen. ADSA 2004 Symposium: Science of ruminant nitrogen and its application to feeding cows.

Schwab, C.G., T.P. Tylutki, R.S. Ordway, C. Sheaffer, and **M.D. Stern**. 2003. Characterization of proteins in feeds. *J. Dairy Sci.*

Stern, M., L. Aga, and A. Bach. 2000. Improving soybean meal use by ruminants. Proc. 61st Annual Minnesota Nutr. Conf. pp. 18-32.

Funding (Last Five Years) – \$118,500

Ajinomoto USA	Gift	2002	\$10,000
Land O'Lakes	Gift	2001-02	\$16,000
Cargill	Gift	2001	\$800
Westway Trading Corp.	Gift	2001	\$12,000
Zinpro	Gift	2000-01	\$50,000
Monsanto	Gift	2000	\$4,800
Simplot	Gift	2000	\$900
Celtic Sea Minerals	Gift	1999-00	\$12,000
Westway	Gift	1999	\$12,000

Dissertations and Theses (Last Five Years)

Name	Program	Degree	Thesis Title
Lisa M. Aga	Animal Sciences	M.S.	Effects of dietary supplements on fermentation and digestion by ruminal microbes.
Grant I. Crawford	Animal Sciences	M.S.	Effect of various fat and protein sources on microbial fermentation in continuous culture of rumen contents.

Graduate Student and Post-doctoral Supervision - Current Advisees

Katie A. Caperoon	M.S.	Animal Sciences
Reagan L. Koski-Hulbert	M.S.	Animal Sciences
Martin Ruiz Moreno	M.S.	Animal Sciences

Courses Taught (Last Five Years)

Designator	Name	Cr	% Effort	Term	Years
AnSc 2401	Animal Nutrition	3	90%	Fall	1999-2003
AnSc 1403	Companion Animal Nutrition & Care	2	90%	Spring	2000-2004
AnSc 4403	Ruminant Nutrition	3	25%	Spring	2000-2004
AnSc 8330	Concepts & Dev in Ruminant Nutr	2	100%	Fall	2000, 2003
AnSc 8312	Protein Metabolism	4	15%	Fall	2002
CVM 6815	Ruminant Nutrition Elective	3	10%	Sum	2003
CVM 5400	Freshman Veterinary Nutrition	2	9%	Spring	2000, 2003

Service

Director of DAS Graduate Studies 2002-2004

Member, Cognitive Discovery Laboratory Committee, Agriculture and Food Sciences Academy.

Hueg-Harrison Fellowship Award Selection Committee.

UMN Faculty Chair, MN FFA Convention Career Dev Ed., Small Animal Competition.

Biological Sciences Policy and Review Council.

Biological Sciences Committee for Academic Program Proposal Review.

Reviewer, National Initiative Proposals (NRI), ARS Research Project

Reviewer: *Animal Feed Science and Technology*, *Journal of Dairy Science*, *Journal of Animal Science*,
Journal of Agricultural and Food Chemistry, *Bioresource Technology*.

Reviewer, book, James B. Russell, "Rumen Microbiology and Its Role in Ruminant Nutrition."

Editorial Board: *Animal Feed Science and Technology*

Service to National and Regional Research Committees

Representative, NC-1009 (formerly NC-185) Committee on Metabolic Relationships in Supply of Nutrients for Lactating Cows, 2003, 2002, 2001, 2000.

Cooperator with Dr. Craig Sheaffer as representatives of the University of Minnesota on the NC-189 Committee Meeting on Forage Protein Characteristics, 2002, 2001, 2000.