

**North Central Region Canola Research Program
Application Cover Page**

Project Title: Evaluation of Glycerol as an Energy Source in Feedlot Diets

Lead Principal Investigator and Institution: Dr. Vern Anderson, North Dakota State University

Co-Principal Investigator(s): Dr. Greg Lardy, North Dakota State University
Breanne Ilse, North Dakota State University

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Funds Requested for 2007: \$30,000.00

Project Status: New ☒ Renewal _____

Does this project involve recombinant DNA, human subjects or vertebrate animals?

☒ Yes ☐ No

If yes, please complete a CSREES Assurance Statement Form 2008 or a Research & Related Other Project Information Form that is available as part of the new application kit through Grants.gov.

Does this project involve the sale of goods or services? _____ Yes ☒ No

If yes, please indicate the nature of the sale in this space:

By signing this proposal, the applicant certifies that the information contained herein is true and complete to the best of their knowledge and accepts as to any award the obligation to comply with the terms and conditions of the Cooperative State Research, Education and Extension Service in effect at the time of the award.

PI Signature

Dept. Chair/REC Director signature
(applies only to NDSU applicants)

Authorized Organizational Representative
(applies only to non-NDSU applicants)

Project Title: Evaluation of Glycerol as an Energy Source in Feedlot Diets

Objectives:

- 1. Determine the effect of adding stepped levels of glycerol in feedlot finishing rations on feed intake, gain, and feed efficiency.
- 2. Measure the effects of glycerol in feedlot finishing diets on carcass traits and value.
- 3. Determine the relative economic value of glycerol as a feed in grain based diets.
- 4. Evaluate the effects of glycerol on digestion and metabolism of steers fed finishing diets.

Procedures:

Feedlot Finishing Study

Weaned steers (n=128, wt 850 lb) will be allotted to four treatments with four replicates (8 head per pen) per treatment. The treatments will be 1) negative control, no glycerol fed in the ration; 2) glycerol fed at 5% of the diet dry matter; 3) glycerol fed at 10% of the diet dry matter, and 4) glycerol fed at 15% of the diet dry matter in corn based diets during the ~120-day finishing period. Glycerol is a slightly viscous liquid feed that will be added to the rations which are fed as totally mixed diets. Calves will be weighed individually at the start of the study and every 28 days. The corn-based finishing rations will contain 85% concentrate and be fed until calves are marketed. Feed intake will be adjusted and recorded daily. Gains and feed efficiency will be determined for each 28-day weigh period. Feeds will be tested for nutrients and ration formulation changes made as required. Calf health challenges will be recorded and morbidity and mortality reported. A standard antibiotic treatment regime will be used when calves are pulled and diagnosed with respiratory disease. Other health problems will be treated according to veterinary advice. Calves will be marketed at a commercial abattoir when 60% or more are estimated to grade USDA Choice. All animals in this study will be treated according to guidelines established by the NDSU Institutional Animal Care and Use Committee.

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Carcass Traits

Carcasses will be evaluated by qualified graders after a 24-hour chill. Specific traits of interest are carcass weight, dressing percent, yield grade (a measure of fat to lean ratio), USDA Quality Grade, which is determined from marbling scores, fat thickness over the 12th rib, internal fat (KPH%), and rib eye area (sq. in.).

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Digestion and Metabolism Study

A digestion and metabolism study will be conducted on campus at NDSU with the support of technicians and graduate students. This component will evaluate the effects of glycerol on ruminal fermentation, digestion, and microbial protein synthesis when fed in growing and/or finishing diets. A 4x4 Latin square design will be utilized to compare treatment diets. Steers will be adapted to diets for nine days followed by a 5-day collection period. Steers will be fitted with ruminal and duodenal cannulae according to NDSU IACUC approved protocols. The same dietary treatments used in the feedlot finishing trial will be used for the metabolism study. This study will determine the relative digestibility of respective diets with increasing levels of

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glycerol, provide information on the site, rate, and extent of digestibility as well as the effects of the treatment diets on volatile fatty acids, pH and microbial synthesis in the rumen.

Economics

Glycerol has been an expensive product compared to other grains but the glut on the market may drive the price lower. Animal performance and carcass value will be used to determine value of the feed for each respective treatment level. Equivalent value of glycerol to other feeds will be calculated and reported based on other ingredient costs, amount of feed consumed, yardage costs, feed efficiency, carcass value, and other costs.

Outreach

Manuscripts, research reports, and popular press summaries will be prepared as appropriate and the information will be featured at field day events and livestock meetings throughout the region.

Justification:

There is very little research on feeding glycerol to bovines. However, interest is high considering that there will be a significant supply of this product when biodiesel production ramps up. Since North Dakota has the potential to produce significant amounts of oilseeds and subsequently process these crops into biodiesel, there may be a significant amount of glycerol produced. Approximately 10% of the original amount of vegetable oil is in the form of glycerol after methylation. Industrial uses cannot absorb this huge increase and the product is expected to be devalued to the point where it is useful as a feed.

Literature Review:

Schroeder and Sudekum fed glycerol to cattle using three different purities of the product in both high-starch and high-forage diets. The conclusion from this in vivo study was that glycerol can be used in diets for cattle at up to 10%. Glycerol provided more energy in the high-forage diets compared to the high-concentrate diets. There was no difference due to purity up to 10% of the diet dry matter with the lowest purity product containing 27% methanol. It was also noted that the addition of glycerol increased the pellet quality of the prepared feeds. Additionally, a South Dakota group fed glycerol to dairy cows post-partum as a drench or top dressed on the feed. A decrease in pre-partum dry matter intake was noted for each treatment with glycerol in the feed, however, no differences were noted post-partum. Some minor effects on milk yield and fat content were noted. Cows fed glycerol tended to stay in better body condition.

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DeFrain, J. M. A. R. Hippen, K.F. Kalscheur, and P. W. Jardon. 2004. Feeding glycerol to transition dairy cows: Effects on blood metabolites and lactation performance. J. Dairy. Sci. 87:4195-4206.

Schroeder, A. and K-H. Sudekum. 2001. Glycerol as a by-product of bio-diesel production in diets for ruminants. Inst. Of Animal Nutrition, Physiology, and Metabolism, University of Kiel, Germany.

Current Work:

A feedlot finishing study is herein proposed. There has been no research with glycerol reported for beef cattle. Two other studies are being planned with growing beef calves on a high-forage ration and with gestating beef cows. Glycerol may be useful as an energy source to supplement

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low quality forage, such as crop residues or CRP hay, in gestating beef cow diets during the winter.

Facilities and Equipment:

Carrington Research Extension Center Livestock unit for the feedlot production trial and Animal and Range Sciences Dept, Animal Nutrition and Physiology Center for the metabolism study.

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Project Timetable:

Summer 2007	Procure sample of glycerol and conduct feed mixing tests and pilot scale feeding trial
Winter/spring 2007-8	Conduct feedlot experiment and metabolism study
Fall 2008	Final report

Personnel Support:

Carrington	Dale Burr, Livestock Technician, 31 years experience in livestock research
	Tim Schroeder, Livestock Technician, 12 years experience in livestock research
	Seasonal workers to be determined
Animal Science Dept	Trent Gilberry, Research Specialist, 5 years experience in livestock research
	Graduate student(s) to be named

VERN ANDERSON

Animal Scientist; Adjunct Professor, Animal and Range Sciences Dept.
Carrington Research Extension Center, North Dakota State University
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Telephone-Office (701) 652-2951, FAX (701) 652-2055
Home (701) 652-3405; e-mail Vern.Anderson@ndsu.edu

EDUCATION

Ph.D. Ruminant Nutrition, North Dakota State University, 1999
M. S. Animal Science, South Dakota State University, 1980
U.S. Army Reserve Command and General Staff College (Commandants List), 1979
B. S. Agricultural Education, South Dakota State University, 1970

PROFESSIONAL EXPERIENCE

1999 - present	Adjunct Professor, Animal and Range Sciences Dept. NDSU
1987 - present	Animal Scientist, Carrington Research Extension Center, NDSU
1992 - 1995	Graduate Research Fellow, Animal and Range Sciences Dept. NDSU
1983 - 1987	Assoc. Animal Scientist, Carrington Research Extension Center
1979 - 1983	Assistant Animal Husbandman, Carrington Irrigation Station, NDSU
1976 - 1979	Graduate Research Assistant, Animal and Range Sciences Dept. SDSU
1970 - 1998	U. S. Army Active Duty and Reserve (retired in 1998, as a Lieutenant Colonel)

PROFESSIONAL ORGANIZATIONS

- American Society of Animal Science
- American Registry of Professional Animal Scientists
- National Bison Association
- North Dakota Buffalo Association
- North Dakota Stockmen's Association
- Sigma Xi

RESEARCH INTERESTS

- Nutrition and management of beef cattle and bison
- Alternative and co-product feeds for ruminants
- Integrated crop-livestock production systems
- Outreach of research activities for economic development

PROFESSIONAL ACTIVITIES

- Outreach of research activities throughout North Dakota, the US, and internationally.
- Extensive collaboration with ND Dry Pea Assoc to develop feed research and publication series.
- Faculty for North Dakota Feedlot School
- Developed ND Barley Council feed barley education and promotion program
- Chairman, Western Coordinating Committee WCC201-Feed Barley, 2002-3
- Great Plains Agricultural Council, Task Force on Sustainable Agriculture
- Consultant for beef feedlots, cow-calf production, and bison nutrition and management
- Community economic development work in livestock enterprises
- Numerous NDSU committees

SELECTED GRANT AWARDS

Diverse diets with barley, peas and distillers grains. USDA Cool Season Food Legumes, \$23294, 2006
New large kernel barley variety "Rawson" for feedlot rations. ND Barley Council, \$20,000. 2005
Maximize the use of distillers grains in barley based rations. ND Corn Utilization Council, \$25,580. 2005
Timing of flax feeding for feedlot cattle. ND Oilseeds Council, \$28,025. 2005
Processing requirements for peas fed to beef cows and in creep feed, USDA Cool Season Legume, \$22,000. 2004.
Mineral supplementation strategies for beef cows. ND SBARE \$18,000. 2003
Field pea in receiving diets for weaned calves, USDA Alternative Crops, \$36,020, 2001
Starch vs digestible fiber in diets for ruminants, ND SBARE \$14,160, 2001

SELECTED PUBLICATIONS

Anderson, V. L., G. P. Lardy, and B. R. Ilse. 2006. Review: Field pea grain for beef cattle. Prof. Anim. Sci. (accepted)

Anderson, V.L., J. P. Schoonmaker, and B. Ilse. 2006. Field pea processing for feedlot, creep feed, and gestating beef cows. J. Anim. Sci. 84(Suppl. 2.):65 Abstract.

Carlin. K.R. Maddock, G.P. Lardy, R.J. Maddock, B. Isle, **V.L. Anderson**. 2006. Field pea inclusion in high grain diets for beef heifers improves beef tenderness without altering performance. J. Anim. Sci. 84(Suppl. 1.):36. Abstract.

Gilbery, T. C., G. P. Lardy, S. A. Navarro, M. L. Bauer, and **V. L. Anderson**. 2006. Effects of pulse grains on rumen fermentation, digestion, and microbial protein synthesis in receiving diets for beef cattle. J. Anim. Sci. 84(Suppl. 1.) Abstract.

Maddock, T. D., B. Kreft, R.J. Maddock, **V. L. Anderson**, and G. P. Lardy. 2006. Effect of including flax in beef creep feed on performance and subsequent carcass characteristics. J. Am. Vet. Adv. 5 (2):156-160.

Anderson, V.L., E. Aberle, and L. Swenson. 2005. Effects of bedding on winter performance of feedlot cattle and nutrient conservation in composted manure. J. Anim. Sci. 83(Supple 1.) Abstract (2).

Anderson, V. L., and G.P. Lardy. Field pea grain for beef cattle. North Dakota State University Extension Service. AS-1301. 8 pages. 2005.

Anderson, V. L., and J. P. Schoonmaker. 2005. Effects of bedding on winter performance of feedlot cattle and nutrient conservation in composted manure. J. Anim. Sci. 83(Supple 1.) Abstract (in press).

Anderson, V. L., and J. P. Schoonmaker. 2005. Natural feeding systems for feedlot cattle in North Dakota. J. Anim. Sci. 83(Supple 1.) Abstract (accepted).

Anderson, V. L. and C. L. Stoltenow. 2004. Field peas in receiving diets for beef calves. J. Anim. Sci. 82 (Suppl 1): Abstract (65).

Anderson, V.L., E. Aberle, and L. Swenson. 2004. Effects of bedding on winter performance of feedlot cattle and nutrient conservation in composted manure. Circum-Polar Agricultural Association, Umea, Sweden. Abstract (In press).

Anderson, V. L. and G. P. Lardy. Feeding peas to livestock. Circum-Polar Agricultural Association, Umea, Sweden. Abstract (In press).

Anderson, V. L. 2003. Protein requirements of bison fed for meat. J. Anim Sci 81 (Suppl 2):78 (Abstract).

Lardy, G.P and **V. L. Anderson**, 2002. Canola and sunflower meal in beef cattle diets. Vet. Clin. Food Anim. 18:327-338.

Anderson, V. L., J. S. Caton, J. D. Kirsch, and D. A. Redmer. 2000 Effect of crambe meal on performance, reproduction, and thyroid hormone levels of mature gestating and lactating beef cows. J. Anim. Sci 78:2269-2274.

Anderson, V. L. 1998. Performance, metabolic, and physiological effects of crambe meal as a protein source for beef cattle. Ph.D. Dissertation. North Dakota State University.

Anderson, V.L., E. W. Boland, and H.H. Casper. 1996. Effects of vomitoxin (deoxynivalenol) from scab infested barley on performance of feedlot and breeding cattle. J. Anim. Sci 74(Suppl. 1):208 (Abstract).

Numerous articles in Beef Reports, Field Day Proceedings, and Extension publications.

Gregory P. Lardy

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Animal and Range Science Dept.
North Dakota State University
Fargo, ND 58105
Telephone (701) 231-7660
Fax (701) 231-7590
e-mail glardy@ndsuent.nodak.edu

Professional Experience

2003-Present Associate Professor and Beef Cattle Specialist, North Dakota State University (60% Extension, 40% Research Appointment).
Responsible for statewide beef cattle extension programming and applied beef cattle nutrition and management research program. Authored or co-authored over 15 extension bulletins and circulars and spoke to over 5800 livestock producers, allied industry personnel, and county extension staff at over 140 local meetings. Research duties include applied nutrition and management research in the following areas: beef cattle and sheep nutrition, beef cattle management, utilization of forages, utilization of byproducts. Advised or co-advised 14 graduate students.

1997-2003 Assistant Professor and Beef Cattle Specialist, North Dakota State University (60% Extension, 40% Research Appointment).

1994-1996 Laboratory Manager, University of Nebraska

1993-1997 Graduate Research Assistant, University of Nebraska

1991-1993 Graduate Research, University of Missouri

Education

Ph.D. Ruminant Nutrition. University of Nebraska, Lincoln. 1997.
M.S. Animal Sciences. University of Missouri, Columbia. 1993.
B.S. Animal and Range Science. North Dakota State University. 1991.

Awards

Excellence in Extension, Early Career; NDSU Extension Service, 2000.
Communicator of the Year, Association for Communication Excellence, NDSU Extension Service, 2003

Professional Organizations

American Society of Animal Science
Society for Range Management
North Dakota Stockmen's Association

Professional Activities

Editor, Ranch Hand Newsletter
Chairman, North Dakota Beef Quality Assurance Committee
Editorial Board, Journal of Animal Science, 2005-2007

Selected Grant Awards

Inclusion of whole oilseeds in cooked molasses blocks. USDA Alternative Crops Grant Program. \$43,200.

Dectomax Pour-On Application in Spring Calving Cow/Calf Herds in the Northern Great Plains. Pfizer Corporation, Inc. \$45,000.

Pressed blocks or salt-limited pellets as creep feeds for beef calves. Cooperative Research Farms. \$14,000.

Livestock production as a method of disposing of potato processing by-products in North Dakota. USDA Alternative Crops Research. \$45,782.

North Dakota Beef Quality Assurance Program. North Dakota Agricultural Products Utilization Commission. \$25,500.

Feeding barley to beef, dairy, sheep, and non-ruminants (swine and poultry). \$8,000. North Dakota Barley Council.

North Dakota Beef Quality Assurance Program, ND Beef Commission, \$20,000.

Education and Outreach Programs for Backgrounding beef calves in the four-state region. USDA-CSREES Special Research Grant. \$196,950.

Beef 101: From Calves to Carcasses. National Cattleman's Beef Association. \$11,857.

Food Safety Education in the 21st Century: Improving the Process. USDA IREECGP. \$233,915.

Processing feed barley in backgrounding diets. USDA Feed Barley for Rangeland Beef Cattle. Montana State University. \$40,000.

Suitability of intake restricted field pea/wheat midd creep diets and nutrient digestibility among nursing calves grazing native range in western North Dakota. USDA Alternative Crops Grant Program. \$54,368.

Selected Publications

- Gelvin, A.A., G.P. Lardy, S.A. Soto-Navarro, D.G. Landblom, and J.S. Caton. 2004. Effect of field pea-based creep feed on intake, digestibility, ruminal fermentation, and performance by nursing calves grazing native range in western North Dakota. *J. Anim. Sci.* 82:3589-3599.
- Baumann, T.A., G.P. Lardy, J. S. Caton, and V. L. Anderson. 2004. Effect of energy source and rumen degradable protein addition on performance of lactating beef cows and digestion characteristics of steers. *J. Anim. Sci.* 82:2667-2678
- J. J. Reed, G. P. Lardy, M. L. Bauer, T. C. Gilbery and J. S. Caton. 2004. Effect of field pea level on intake, digestion, microbial efficiency, ruminal fermentation, and in situ disappearance in beef steers fed forage-based diets. *J. Anim. Sci.* 82:2185-2192.
- H. B. Encinias, G. P. Lardy, A. M. Encinias, and M. L. Bauer. 2004. High linoleic acid safflower seed supplementation for gestating ewes: Effects on ewe performance, lamb survival, and brown fat stores. Accepted with Revisions. *J. Anim. Sci.*
- J. J. Reed, G. P. Lardy, M. L. Bauer, T. C. Gilbery and J. S. Caton. 2004. Effect of field pea level on intake, digestion, microbial efficiency, ruminal fermentation, and in situ disappearance in beef steers fed growing diets. *J. Anim. Sci.* 82:2123-2130.
- T.A. Baumann, A.E. Radunz, M.L. Bauer, V.A. Anderson, and G.P. Lardy. 2004. Effect of barley processing method and yeast/enzyme addition on growth and performance of beef cattle. *IProf. Anim. Sci.* 20:178-184.
- S. A. Soto-Navarro, G. J. Williams, M. L. Bauer, G. P. Lardy, D. G. Landblom, and J. S. Caton. 2004. Effect of field pea replacement level on intake and digestion in beef steers fed byproduct-based medium concentrate diets. *J. Anim. Sci.* 82:1855-1862.
- Loe, E. R., M. L. Bauer, G. P. Lardy, J. S. Caton, and P. T. Berg. 2004. Field pea (*Pisum sativum*) inclusion in corn-based lamb finishing diets. *Small Rumin. Res.* Vol 53:39-45.

Budget Justification:

B. Salaries and Wages: Salaries for Research Technicians covers research technicians to assist in facility preparation, feeding, animal care, collecting data, and lab analysis for the metabolism study. Fringe Benefits are calculated at the rate of 35% for research technicians.

D.1. Travel: Funds will be used to present data at scientific meetings.

Travel to state meetings – 1000 miles @ \$.28 = \$280.00

Airfare/per diem/lodging for out-of-state meetings - \$1020.00

F.1. Materials and Supplies: Consist of feed, veterinary supplies, fuel for feed delivery, ear tags, implants, and lab supplies.

Feed - \$4300.00

Veterinary supplies, tags, implants - \$500

Fuel - \$1000.00

Lab supplies - \$5000.00

F.2. Publication Costs: Publication of study results in scientific journals.

3.3 pages @ \$300.00/page = \$1000.00

F.8. Feed Analysis and Carcass Evaluation

Feed analysis – 11 samples @ \$24.50/sample = \$260.00

Carcass evaluation – 128 head @ \$5.00 = \$640.00