1993

Beef Research Program

Progress Report No. 4

Roman L. Hruska
U.S. Meat Animal Research Center

In cooperation with
University of Nebraska College of Agriculture
The Agricultural Experiment Station

United States
Department of Agriculture

ARS-71 (1993)
May 1993
This report represents a cross section of our cattle research program at the present time. The report includes research results in genetics, meat quality, meat safety assurance, animal health, reproduction, nutrition, and production systems. Since some of the projects from which results are reported are still in progress, the preliminary nature of some of the results must be recognized. However, it is our opinion that information useful to the industry should be provided at the earliest possible time. Progress reports of this nature will be released periodically to make current results available to the beef cattle industry.

**Keywords:** Beef cattle, breeds, meat safety, genetics, meat quality, production, meat safety, nutrition, stress.

Mention of company names, trade names, or commercial products does not constitute a guarantee or warranty by the U.S. Department of Agriculture or imply a recommendation or endorsement over other products not mentioned.

The papers in this report are printed essentially as supplied by the authors.

While supplies last, single copies of this publication may be obtained free of charge from:

U.S. Meat Animal Research Center
Agricultural Research Service
United States Department of Agriculture
P.O. Box 166
Clay Center, Nebraska 68933
## CONTENTS

ROMAN L. HRUSKA  U.S. MEAT ANIMAL RESEARCH CENTER, D. B. Laster ........................................... v

### GENERAL INTEREST

Beef facilities and management at MARC: W. Gordon Hays and Gary S. Ross .................................. 1

### GENETICS AND BREEDING

Cycle V of the germplasm evaluation (GPE) program in beef cattle: Larry V. Cundiff, Keith E. Gregory, and Robert M. Koch ............................................................. 3

Contributions of ovum cytoplasm and uterine environment and postnatal environment to maternal effects in beef cattle: Keith E. Gregory, and Ralph R. Maurer ............................................. 6

Germplasm utilization in beef cattle: Keith E. Gregory, Larry V. Cundiff, Robert M. Koch, and Donald D. Lunstra .......................................................... 7

Use of crossbreeding and breed differences to meet specific targets for production and carcass traits of beef cattle: Keith E. Gregory, Larry V. Cundiff, and Robert M. Koch .................................................. 20

Differences among parental breeds in germplasm utilization project: Keith E. Gregory, Larry V. Cundiff, Robert M. Koch, and Donald D. Lunstra ........................................ 22

Estimates of genetic and phenotype parameters of pelvic measures, weight, height, calf birth weight and dystocia in beef cattle: Keith E. Gregory, Larry V. Cundiff, and Robert M. Koch .................................................. 43

Twinning in cattle: Keith E. Gregory, Sherrill E. Echternkamp, L. Dale Van Vleck, and Larry V. Cundiff .............................................................. 48

Mortality and cold tolerance of calves with different ratios of *Bos indicus* to *Bos taurus* inheritance: Maurie J. Josey, Larry V. Cundiff, Robert M. Koch, Keith E. Gregory, and G. LeRoy Hahn .................................................. 52

Biological efficiency differences among *Bos taurus* x *Bos taurus* and *Bos indicus* x *Bos taurus* F1-Cross Cows: Ronnie D. Green, Larry V. Cundiff, Gordon E. Dickerson, and Thomas G. Jenkins ........................................ 55

Characteristics of diverse breeds in cycle IV of the cattle germplasm evaluation program: Larry V. Cundiff, Robert M. Koch, Keith E. Gregory, John D. Crouse, and Michael E. Dikeman .................................................. 57

Genes of the major histocompatibility complex in cattle: Roger T. Stone and Noelle E. Muggli-Cockett .............................................................. 61

Effect of marbling on variation and change in beef tenderness in *Bos taurus* and *Bos indicus* crosses: Robert M. Koch, John D. Crouse, Michael E. Dikeman, Larry V. Cundiff, and Keith E. Gregory .................................................. 63

Genotype-environment interactions for reproduction and maternal performance of *Bos indicus* and *Bos taurus* crosses in Nebraska and Florida: Larry V. Cundiff, Timothy A. Olson, K. Euclides Filho, M. Koger, W. T. Butts, and Keith E. Gregory .................................................. 65

Gene mapping in cattle: Craig W. Beattle, Roger T. Stone, Michael D. Bishop, Sara L. F. Sunden, John W. Keele, and Steven M. Kappes .................................................. 67

### REPRODUCTION

Identification of twin pregnancies in cattle by ultrasonography: Sherrill E. Echternkamp and Keith E. Gregory .............................................................. 68
Hormone profiles in cattle selected for twin ovulations and births: Sherrill E. Echternkamp, Leon J. Spicer, and Keith E. Gregory ................................................................. 71
Can cattle be litter bearing? Uterine capacity in cattle: Sherrill E. Echternkamp ....................... 74
Bovine embryos from Bluetongue infected donors did not transmit virus to susceptible recipients: John A. Acree, Sherrill E. Echternkamp, Steve M. Kappes, Gary S. Ross, Albert J. Luedke, and James E. Pearson ........................................... 78
Superovulation of cows by initiating FSH treatments during the first few days after estrus: Andrew J. Roberts and Sherrill E. Echternkamp ......................................................... 80
Factors involved in regulating the development of ovarian follicles in cattle:
Andrew J. Roberts, Sherrill E. Echternkamp, Judith M. Grizzle, and Thomas Wise ............. 83
The relationship of metabolic hormones, nutrition, and postpartum anestrus in different biological types of cattle: Andrew J. Roberts, Russell A. Nugent III, Thomas G. Jenkins, and John M. Klinadt .......................................................... 85
Scrotal thermography as a tool for predicting semen quality and natural-mating fertility in young beef bulls: Donald D. Lunstra, and Glenn H. Coulter .................................. 86
Puberty occurs at the same testis size in both *Bos taurus* and *Bos indicus* crossbred beef bulls: Donald D. Lunstra, John D. Crouse, and Larry V. Cundiff .................................................. 90
Immunization against inhibin increases sperm production in young beef bulls:
Donald D. Lunstra, Terry L. Martin, Gary L. Williams, and James J. Ireland ..................... 93
Effect of method of estrous synchronization on oocyte quality and follicular insulin-like growth factor (IGF-I): Thomas H. Wise and Ralph R. Maurer ................................................... 96
Follicular hormonal changes and oocyte quality in heifers that exhibited an LH surge, no LH surge, or in which the LH surge was suppressed with progestin:
Thomas H. Wise and Ralph R. Maurer ........................................................................... 99
Relationships of thymic peptides thymosin α1 and β2 with reproductive status: puberty and estrus: Thomas H. Wise, Michael L. Day, James E. Kinder, and Ralph R. Maurer ............. 102

**NUTRITION**

Factors influencing fetal growth and birth weight in cattle: Calvin L. Ferrell .......................... 104
Feedlot and carcass characteristics of heifers: Effect of ovariotomy and ovariotomy with ovarian autograft: John M. Klindt and John D. Crouse ......................................... 108
Is fiber digestion in the rumen reduced by catabolite repression?: Kevin L. Anderson and Vincent H. Varel .......................................................... 112
Omasal and duodenal nutrient flow in steers: Kelly K. Kreikemeier, Gary P. Rupp, and Louis J. Perino .................................................................................. 114
Fiber degrading microorganisms from bison, cattle-bison hybrids and cattle:
Vincent H. Varel and Burk A. Dehority ........................................................................... 116
Energy expenditures of mature cows during the production cycle: Calvin L. Ferrell and Thomas G. Jenkins .......................................................... 118

**MEATS**

Improving the microbiological quality of meat: James S. Dickson and Gregory R. Siragusa. 119
Predicting the growth of salmonellae on beef: James S. Dickson, Gregory R. Siragusa, and James E. Wray, Jr ........................................................................... 121
Use of calcium alginate to immobilize antimicrobial agents on beef tissue:
Gregory R. Siragusa and James S. Dickson .................................................................... 123
Comparisons of *Bos indicus* and *Bos taurus* inheritance for carcass beef characteristics and meat palatability: John D. Crouse, Larry V. Cundiff, Robert M. Koch, Mohammad Koohmaraie, and Steve C. Seideman ......................................................... 125

Effects of a β-agonist on muscle protein degradation, enzyme activity, and meat tenderness in steers: Tommy L. Wheeler and Mohammad Koohmaraie ......................................................... 128

Meat tenderness and the calpain enzyme system in young bulls and steers: Tommy L. Wheeler, J. Brad Morgan, Mohammad Koohmaraie, Jeff W. Savell, and John D. Crouse ................................................................. 131

Effect of marbling degree on palatability and caloric content of beef: Tommy L. Wheeler, Larry V. Cundiff, and Robert M. Koch ......................................................... 133

Effect of castration on skeletal muscle protein turnover and muscle enzyme activities in cattle: Tommy L. Wheeler, J. Brad Morgan, Mohammad Koohmaraie, John D. Crouse, and Jeff W. Savell ................................................................. 135

*Bos indicus* breeding effects on muscle characteristics and their relationship with meat tenderness: Georgianna Whipple, Mohammad Koohmaraie, Michael E. Dikeman, John D. Crouse, and Melvin C. Hunt ................................................................. 137

Acceleration of postmortem tenderization in Brahman-cross beef carcasses by calcium chloride: Mohammad Koohmaraie, Georgianna Whipple, and John D. Crouse ................................................................. 139

A calcium chloride injection process to produce guaranteed tender and calcium fortified meat: Tommy L. Wheeler, Mohammad Koohmaraie, and John D. Crouse ................................................................. 141

Improving beef tenderness with calcium marination: Georgianna Whipple, and Mohammad Koohmaraie ................................................................. 143

The effectiveness of subjecting *Bos indicus* crossbred beef carcasses to higher temperatures to improve tenderness: Georgianna Whipple, Mohammad Koohmaraie, Michael E. Dikeman, and John D. Crouse ................................................................. 144

**BIOLOGICAL ENGINEERING**

Characterizing stress in feeder cattle: G. LeRoy Hahn and John A. Nienaber ................................................................. 146

Heat and moisture production and dissipation in beef cattle: John A. Nienaber, G. LeRoy Hahn, and Anders Ehrlemark ................................................................. 149

**PRODUCTION SYSTEMS**

Influence of controlled energy intake on body composition of beef steers: John W. Keele, Calvin L. Ferrell, Ralph N. Arnold, Mike E. Dikeman, and Melvin C. Hunt ................................................................. 151

Management factors influencing the feeding of young bulls for market-ready beef: Michael D. MacNeil, Keith E. Gregory, and J. Joe Ford ................................................................. 154

Evaluation of four computer models for prediction of growth and body composition: Gary L. Bennett and Ralph N. Arnold ................................................................. 155

Conversion efficiency through weaning of nine breeds of cattle: Thomas G. Jenkins and Calvin L. Ferrell ................................................................. 156

Characterization of lactation curves for nine breeds of cattle fed differing rations: Thomas G. Jenkins and Calvin L. Ferrell ................................................................. 158

Estimates of mature weights and maturing rates for breed crosses: Thomas G. Jenkins, Miroslav Kaps, Larry V. Cundiff, and Calvin L. Ferrell ................................................................. 160

Simulated effects of herd-level management strategies on efficiency of beef production: Michael D. MacNeil, Don D. Kress, and Gordon E. Dickerson ................................................................. 162

Using crossbreeding systems to produce beef: Michael D. MacNeil, Larry V. Cundiff, Keith E. Gregory, and Robert M. Koch ................................................................. 164
Effects of inbreeding and heterosis in Hereford lines on reproduction and maternal performance: Michael D. MacNeil, Delwyn D. Dearborn, Larry V. Cundiff, Chris A. Dinkel, and Keith E. Gregory ........................................ 167
Postpartum interval is influenced by nutritional environment and biological type: Russell A. Nugent III, Thomas G. Jenkins, Andrew J. Roberts, and John M. Klindt .... 168
Computer simulation of body composition in growing and finishing beef cattle: Charles B. Williams, John W. Keele, and Gary L. Bennett ........................................ 170
A new approach to estimating empty-body weight in growing and finishing beef cattle: Charles B. Williams, John W. Keele, and Dale R. Waldo ........................................ 172

ANIMAL HEALTH SYSTEMS
Determination of passive immunity in calves: Louis J. Perino, R. James Sutherland, and Neal E. Woollen ........................................ 176
Development of a method for the serological differentiation between animals either vaccinated with killed virus vaccine or infected by bovine viral diarrhea virus (BVDV): Jimmy Kwang and E. Travis Littledike ........................................ 178
Development of a sensitive antibody detection method to bovine viral diarrhea virus (BVDV) infection: Jimmy Kwang and E. Travis Littledike ........................................ 179
Consequences of antigenic diversity of bovine viral diarrhea virus: E. Travis Littledike, Steven R. Bolin, and Julia F. Ridpath ........................................ 180
Brachygnathia in Simmental cattle: Neal E. Woollen ........................................ 183
Transmission of bovine leukosis virus: Louis J. Perino, E. Travis Littledike, Larry V. Cundiff, and Catherine E. Dewey ........................................ 184
Isolation of Pasteurella spp. from sick and healthy feedlot calves using four different sampling techniques: Keith A. Gilmore, D. Dee Griffin, and Louis J. Perino ........................................ 186