

Progress Report on Iowa State University Burroughs Endowment Activities

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T.J. Knight, assistant scientist III of animal science;
A.E. Wertz, postdoc of animal science; A. Trenkle, and
D.C. Beitz, distinguished professors of animal science

Summary

Faculty in the Department of Animal Science initiated soliciting of funds in 1987 to establish a permanent endowment to recognize the distinguished career and major contributions of Dr. Wise Burroughs, a distinguished professor in animal science at Iowa State University. The endowment was established in the Iowa State University Foundation in 1991. The purpose of the fund is to support research and graduate education in the areas of fundamental factors regulating growth in food-producing animals, with emphasis on ruminants; to enhance growth of animals with the goal of improving the competitive position of ruminants as food-producing animals; and to develop innovative approaches to ruminant nutrition and/or growth enhancement as a means to improve desirability of meat produced by food animals. Dr. Burroughs' research resulted in important and significant developments in technology for modern production systems for beef cattle. He was widely known for his ability to communicate complex ideas and research results for use by those involved in the animal industry. The current Burroughs Team has established three research projects: 1) Ghrelin--How does ghrelin affect blood and body composition in rats?; 2) Use of 25-hydroxyvitamin D₃ to improve tenderness of beef; 3) Redesigning beef cattle to have a more healthful fatty acid composition.

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A team of animal scientists (Burroughs Team) with a variety of expertise has been assembled to make maximal progress toward development of new knowledge that will assist producers and processors of beef to be more profitable and to provide more desirable and healthy beef. This team has established several objectives to initiate a Burroughs research program. Other scientists may be added to the team as new objectives are added to the ongoing research program. Members of the team that are coordinating the ongoing program described in this report are introduced below.

1. **Dr. Allen Trenkle**, distinguished professor of animal nutrition, has expertise in hormonal and nutritional regulation of efficiency of animal growth and body composition and in effective use of new feed ingredients for the beef feedlot.
2. **Dr. Donald Beitz**, distinguished professor of biochemistry and nutrition, has much experience in studies of basic biochemical mechanisms of animal growth and of nutritional and hormonal controls of composition of animal-derived foods.
3. **Dr. Elisabeth Huff-Lonergan**, assistant professor of muscle biology, has expertise in the regulation of intramuscular processes contributing to tenderization of meat during postmortem aging.
4. **Dr. James Reecy**, assistant professor of molecular genetics, has expertise in identifying genes and in studying the regulation of those genes that contribute to efficiency of animal growth and to regulation of body composition.
5. **Dr. Steven Nissen**, professor of nutrition, has expertise in protein synthesis and degradation in muscles of farm animals and humans.
6. **Dr. John Rathmacker**, adjunct assistant professor of nutrition, specializes in studies of muscle protein degradation.
7. **Dr. Lloyd Anderson**, distinguished professor of reproductive physiology, has expertise in hormonal regulation of reproduction by female cattle and pigs.
8. **Dr. Ronald Horst**, collaborating professor of animal nutrition, has much expertise in the metabolism and biochemical function of vitamin D and its metabolites and the nutritional regulation and etiology of metabolic diseases of ruminants.
9. **Dr. Travis Knight**, assistant scientist, has much experience in nutritional and biochemical regulation of body composition of food-producing animals and the relationship of animal-derived foods to human health.

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10. Dr. Aimee Wertz, postdoctoral research associate, has much experience with nutritional regulation of growth and composition of beef cattle and the impact of nutrition on quality of beef.

11. Ms. Michelle Bohan, Ph.D. degree student, is developing a graduate research program to study the hormonal regulation of animal growth and body composition. Several undergraduate students assist with the ongoing research projects.

The Burroughs Team has been working coordinately on research, teaching, and outreach activities that are related to animal growth, with a focus on beef cattle. Since spring of 2001, when the current Burroughs Team was assembled, three research projects have been initiated:

1. Ghrelin – How does ghrelin affect blood and body composition in rats?

Hypothesis: Ghrelin, a naturally occurring peptide hormone that triggers growth hormone secretion, will modify blood hormone and metabolite concentrations when injected into rats. Therefore, ghrelin status of animals could be correlated positively with more efficient growth.

Design: Ten rats were used in an initial experiment. Half of the rats received a daily injection of 2.4 µg ghrelin/kg body weight, and the other half received a saline injection. Serial blood samples were collected once per week for 5 weeks. Samples were taken every 5 minutes for 20 minutes following the injections. Tissue samples were collected when the rats were killed. Animal growth and feed intake data were collected and will be analyzed as will carcass composition (protein and fat). Blood metabolites to be analyzed include plasma urea nitrogen, nonesterified fatty acids, glucose, and cholesterol. Insulin and IGF-1 in serum also will be quantified.

2. Use of 25-hydroxyvitamin D₃ to improve tenderness of beef

Hypothesis: Oral administration of a single dose of 25-hydroxyvitamin D₃, when given 4-35 days before slaughter, will improve tenderness of beef.

Design: Two doses (62.5 mg or 125 mg) of 25-hydroxyvitamin D₃ were given as an oral bolus to 96 Continental x British breed cross steers 35, 21, 7, or 4 days before slaughter (12 per treatment). There were 12 control steers that did not receive supplemental 25-hydroxyvitamin D₃. Blood samples were taken during the experiment, and skeletal muscle and blood were taken after slaughter. Calcium and vitamin D metabolites will be quantified in blood and muscle samples. Tenderness will be quantified by Warner-Bratzler shear analysis and by 30– kDa protein Western blotting of the muscle tissue.

3. Redesigning beef cattle to have a more healthful fatty acid composition

Hypothesis: Genetic markers can be located that will identify beef cattle that produce muscles containing a healthier fatty acid composition. These markers could be used to screen animals for future genetic selection studies.

Design: Ribeye facings from beef cattle of known genetic origin have been collected for analysis of fat content and fatty acid composition. Over 350 samples have been collected that are represented by about 30 sires. Data from this year's project and a replicate of another 350 animals next year will be pooled and analyzed for fatty acid composition. Statistical analysis will be used to identify sires that produce offspring that are at the extremes of healthfulness. Deoxyribonucleic acid (DNA) samples obtained from the "extreme" sires will be analyzed by using polymerase chain reaction and by sequencing nucleotides in regions of DNA coding for enzymes involved in lipid synthesis or modification (fatty acid synthase, fatty acid elongase, and stearoyl-CoA desaturase). Sequence data will be correlated with compositional data to identify methods to predict composition of offspring of a given sire.

These three research trials will be used as preliminary data for seeking additional funding. Efforts to obtain outside funding to date have focused on five general topics including growth promotants, vitamin D/meat quality, meat composition/heritability, cholesterol-reducing microorganisms, and conjugated linoleic acid. These efforts have manifested in nine proposals, seven preproposals, and three presentations to seek funding from associations or companies. Two of these proposals have been funded (over \$37,000), and the rest are pending at this time.

Presentations at national meetings this past year included an Animal Growth talk about dietary influence on fat composition of early-weaned cattle given at the NCR-97 USDA Technical Committee meeting in Orlando, FL. A Designer Food talk, which focused on modifying foods of animal origin to improve consumer acceptance, was given at the Animal Science annual meetings in Indianapolis, IN. An abstract entitled "Effects of ghrelin injection on blood and body composition in rats" will be presented at the Experimental Biology '02 meeting in New Orleans, LA.