TITLE: Effects of Bovine Somatotropin Treatment on Performance, Reproductive, and Physiological Responses of Replacement Beef Heifers

RESEARCH LEADER: Reinaldo F. Cooke
Assistant Professor
Eastern Oregon Agriculture Research Center
67826-A Hwy 205
Burns, OR 97720

COOPERATOR (S) (if any):

David W. Bohnert **(Co-PI)**
Associate Professor & Assistant Superintendent
Eastern Oregon Agricultural Research Center - Burns Station
Oregon State University
67826-A Hwy 205
Burns, OR 97720

PROPOSAL:

Justification: The Oregon beef industry is mainly constituted by cow-calf operations, and represents the second largest agriculture commodity in the state. The inclusion of replacement heifers into the cowherd is one of the most important factors for the overall efficiency of cow-calf production systems. For optimal economic return and lifetime productivity, replacement heifers should attain puberty by 12 months of age, conceive by 15 months of age, and calve as 2 year-olds (Lesmeister et al., 1973). Still, in this optimal scenario, replacement heifers will only provide economical returns to producers when they wean their first calf, approximately at 3 years of age. Given that $800 is a typical cost to develop a 2 year-old pregnant heifer ready to calve, and in 2008 approximately 100 thousand replacement heifers were introduced into the Oregon cow-calf industry, more than 80 million dollars were invested in 2008, with no immediate return, into heifer development programs by cow-calf producers. These expenses are further increased when replacement heifers fail to conceive during their first breeding season, become pregnant for the first time as 2 year-olds, and wean their first calf at 4 years of age. Therefore, management strategies that maximize the number of replacement heifers pubertal by 12 months of age and pregnant as yearlings are vital to the productivity of the cow-calf industry and overall Oregon beef production system.

To reach these reproductive development goals, heifers should be placed on high planes of nutrition. However, beef heifers in Oregon are typically reared in cow-calf systems based on low-quality forages, where supplementation programs are often based on local industry by-products with lower energy content compared to grain-based supplements, and offered in restricted amounts to maintain reduced costs of production. Because of these nutritional and economical challenges, many research efforts are being conducted to identify the physiological links between nutrition and reproduction in cattle, so beef producers can manipulate the reproductive efficiency of herd without the expenses of pricey feeding programs. To this point, some endogenous hormones have been recognized as potential links between nutrient intake and puberty attainment/fertility in cattle. The most promising one is IGF-I, an endogenous hormone positively associated with nutritional level, growth rates, and reproductive performance of cattle.

Research studies have demonstrated that heifers that reach puberty by 12 months of age typically have greater blood IGF-I concentrations compared to non-pubertal cohorts (Cooke et al., 2007). In these studies, however, IGF-I concentrations were modulated by increased

feeding level, whereas plane of nutrition also affects other blood substances that perhaps influence reproductive development, such as glucose, insulin, and leptin. One viable alternative to increase plasma IGF-I in cattle independently of plane of nutrition is the administration of bovine somatotropin (bST; Schwarz et al., 1993). Consequently, treatment with bST may be an effective method to individually test the effects of IGF-I on reproductive function of cattle. Additionally, several studies reported positive effects of bST on reproduction of mature dairy and beef cows, and also on performance of growing beef cattle. However, the effects of bST treatment on reproductive performance of replacement beef heifers have not been completely clarified. Therefore, we hypothesize that replacement heifers administered with bST will have increased blood concentrations of IGF-I, resulting in hastened onset of puberty and enhanced reproductive performance during their first breeding season compared to non-treated cohorts.

The results from the proposed research will determine if: 1) IGF-I is the key factor for optimal reproductive development of beef heifers, serving as foundation for management strategies to enhance circulating IGF-I and consequent reproductive development in replacement beef heifers; and 2) inclusion of bST into heifer development programs is a viable alternative to hasten puberty attainment, enhance pregnancy rates, and thus increase overall efficiency of cow-calf operations in Oregon.

Literature Cited

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Objectives: The objectives of the proposed study are to evaluate plasma concentrations of IGF-I, glucose, insulin, and leptin, in addition to growth rates, carcass development, puberty attainment, and pregnancy rates of beef replacement heifers administered or not exogenous bST.

Procedures: The proposed experiment will be conducted at the OSU-Eastern Oregon Agricultural Research Center (EOARC), Burns, which has all of the equipment, resources, and personnel necessary to complete this research in a timely fashion.

Forty Angus heifers will be weaned at 7 months of age (September 2010; d -30), and utilized in this experiment. On day 0, heifers will be stratified by body weight and randomly assigned to one of the two treatments: 1) treatment with bST or 2) negative control (no treatment). Heifers assigned to the bST treatment will be administered intramuscular injections containing 250 mg of sometribov zinc (bST) every 14 days. Treatments will be applied from d 0 (October 2010) to day 240 (June 2011). During this period, heifers will be maintained on separate meadow foxtail (*Alopecurus pratensis* L.) pastures according to treatment, and will receive similar amounts of supplemental meadow foxtail hay and concentrate when required to sustain a growth rate of approximately 1 pound per day. On day 181, heifers will be assigned to an estrus synchronization + timed artificial insemination protocol, and then exposed to mature Angus bulls (1:20 bull to heifer ratio) for 40 days, beginning on day 200. Bulls will be rotated weekly between treatment groups to account for potential bull effects.

Body weight gain will be assessed and blood samples will be collected weekly (concurrently with treatment applications every other week) from day 0 to day 240. All blood samples will be harvested for plasma and stored at −80°C until assayed for concentrations of IGF-I, glucose, insulin, leptin, and progesterone. Carcass composition will be evaluated via backfat ultrasounding on d 0, 80, 160, and 240 of the study. Heifers will be considered pubertal once plasma progesterone concentrations are greater than 1.0 ng/mL for 2 consecutive weeks. Heifer pregnancy status will be verified by detecting a fetus with transrectal ultrasonography 70 days after the end of bull exposure, whereas date of conception will be estimated retrospectively by subtracting gestation length (286 days) from the calving date.

The sample size planned for this experiment is adequate to result in statistical significances regarding treatment effects for all measurements proposed, according to the G*power 3 software. Heifer will be considered the experimental unit. Results will be analyzed with the MIXED procedure of SAS (SAS Institute Inc., Cary, NC). The model statement will contain the effects of treatment, time variables, and appropriate interactions. Data will be analyzed using heifer(treatment) as random variable.

Upon the completion of the study, an economical analysis will be performed to evaluate the inclusion of bST into heifer development programs. All results will be immediately analyzed, summarized, integrated into cow/calf extension material, and reported in popular press and scientific publications.

Duration of study: September 2011 to June 2012 (10 months).