

**AGRICULTURAL RESEARCH FOUNDATION  
FINAL REPORT  
FUNDING CYCLE 2014 – 2016**

**TITLE:** Metabolic imprinting: impact on growth and reproductive development of beef heifers

**RESEARCH LEADER:** Reinaldo Cooke

**COOPERATORS:** None

**SUMMARY:** Metabolic imprinting is defined as biological responses to a nutritional intervention during early life that permanently alters physiological outcomes later in life. In this experiment, we compared growth, physiological, and reproductive responses of beef heifers with (**MI**) or without (**CON**) access to a creep-feeder, as a manner to stimulate metabolic imprinting while nursing their dams. Sixty Angus × Hereford heifers were assigned to MI (n = 30) or CON (n = 30). From day 1 to 51 of the experiment, MI heifers and their dams were allocated to 15 drylot pens where heifers had ad libitum access to a corn-based supplement through a creep-feeder. The CON heifers and their dams were maintained in an adjacent single drylot pen. From day 52 to 111, treatments were managed as a single group on a semiarid range pasture. On day 111, heifers were weaned and allocated to 2 pastures, receiving hay and a corn-based concentrate until day 326. Average daily gain was greater ( $P < 0.01$ ) for MI than CON from day 1 to 51, tended ( $P = 0.09$ ) to be greater for CON than MI from day 112 to 326, while BW on day 326 was similar between treatments. On day 51, MI had greater ( $P \leq 0.01$ ) plasma IGF-I and glucose concentrations, as well as mRNA expression of hepatic pyruvate carboxylase and adipose fatty acid synthase than CON. On days 261 and 325, plasma insulin concentrations were greater ( $P \leq 0.03$ ) in CON than MI. Mean mRNA expression of hepatic IGF-I and adipose peroxisome proliferator-activated receptor gamma were greater ( $P \leq 0.05$ ) in MI than CON. No treatment effects were detected for puberty attainment rate. In conclusion, supplementing nursing heifers via creep-feeding for 50 days altered physiological and biochemical variables suggestive of a metabolic imprinting effect, but did not hasten their puberty attainment.

**OBJECTIVES:** Compared growth, physiological, and reproductive responses of beef heifers with (**MI**) or without (**CON**) access to a creep-feeder, as a manner to stimulate metabolic imprinting while nursing their dams

**PROCEDURES:** Sixty Angus × Hereford heifers were assigned to MI (n = 30) or CON (n = 30). From day 1 to 51 of the experiment, MI heifers and their dams were allocated to 15 drylot pens where heifers had ad libitum access to a corn-based supplement through a creep-feeder. The CON heifers and their dams were maintained in an adjacent single drylot pen. From day 52 to 111, treatments were managed as a single group on a semiarid range pasture. On day 111, heifers were weaned and allocated to 2 pastures, receiving hay and a corn-based concentrate until day 326. Heifer body weight was recorded prior to and at the end of the creep-feeding period (day 1 to 51), and on days 112 and 326. On days 0, 51, 111, 187, 261, and 325, jugular

blood was collected and real-time ultrasonography for longissimus muscle depth and backfat thickness assessment was performed. Blood was also collected every 10 days from days 113 to 323 for puberty evaluation via plasma progesterone. Liver and subcutaneous fat biopsies were performed on days 51, 111, 261, and 325.

**SIGNIFICANT ACCOMPLISHMENTS:** Feeding a high-concentrate supplement to nursing beef heifers for 50 days did not enhance their post-weaning body development, physiological responses, and puberty attainment. However, supplemented heifers had long-term increases in biochemical variables suggestive of metabolic imprinting (mean mRNA expression of hepatic IGF-I and adipose peroxisome proliferator-activated receptor gamma), which is defined as biological responses to a nutritional intervention during early life that permanently alters physiological outcomes later in life. Perhaps a longer period of creep-feeding may be required to further increase supplement intake in nursing beef heifers, and effectively enhance body and reproductive development via metabolic imprinting effects.

This research was included in the M.Sc. thesis of Maria de Meireles Reis (Animal and Rangeland Sciences – graduated December 2015), and resulted in the following journal article:

Reis, M. M., R. F. Cooke, B. I. Cappelozza, R. S. Marques, T. A. Guarnieri Filho, M. C. Rodrigues, J. S. Bradley, C. J. Mueller, D. H. Keisler, S. E. Johnson, and D. W. Bohnert. 2014. Creep-feeding to stimulate metabolic imprinting in nursing beef heifers: Impacts on heifer growth, reproductive, and physiological parameters. *Animal* 9:1500-1508.

**BENEFITS & IMPACT:** These outcomes are indicative that creep-feeding is a viable alternative to increase weaning weight and permanently modulate heifer metabolism via metabolic imprinting events.

**ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:** None

**FUTURE FUNDING POSSIBILITIES:** These outcomes will serve as preliminary data for a USDA-NIFA AFRI Foundational Program proposal to be submitted next funding cycle.