

Expression of beta-adrenergic receptors during lactation in Holstein dairy cattle

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There is great variation among dairy cattle in body condition loss during early lactation, which affects all aspects of production, health and longevity. As a result of over 20 years of research on body condition score, metabolism of fat and regulation of lipolysis in dairy cattle at WSU, we are now able to examine the control of lipolysis and thus body fat use at a genetic level.

The objective was to determine the expression of beta-adrenergic receptors in adipose tissue of Holstein dairy cattle. Activity of hormone sensitive lipase and responsiveness to beta-adrenergic stimulation increases during the transition period; and the adaptation varies among cattle with different milk production ability. However, expression of beta-adrenergic receptor subtypes and their potential role in control of lipolysis is unknown for dairy cattle. Therefore, twenty Holstein dairy cattle were grouped by lactation number (1, 2, and 3 or more) and subcutaneous adipose tissue was sampled to measure lipolytic rates and gene expression. Production of 305ME for 1st, 2nd and higher parity cows were 14936, 12791, and 11326 (SE 931). Fat averaged 3.55 and protein 3.3 %. Day 30 postpartum production was 39.3 kg/d (SE 3.4) with 3.6% fat and 2.7% protein and d 90 postpartum production was 48.8 kg/d (SE 1.5) with 3.4% fat and 2.9% protein. Body weight and BCS, measured at -30, 30, 90 and 270 days around calving averaged 682, 598, 634 and 638 kg and 3.3, 2.3, 2.5, and 2.7 BCS units. Duplicate samples were extracted for RNA and tissue was also incubated to measure basal and stimulated lipolysis. We determined that the beta-2-adrenergic receptor is expressed in Holstein adipose tissue at all time points measured during late pregnancy and lactation, by PCR and agarose gel analysis as well as real time RT-PCR. The expression of beta 2-adrenergic receptor increased 80% following parturition and remains elevated throughout pregnancy with an increase of 75% and 33% at day 90 and 270 relative to day -30. Beta-3 receptors were also measured and these were also expressed at all time points. The expression of beta-3 adrenergic receptor increased 3.5 fold from day -30 to day 30. The expression was elevated throughout pregnancy with expression 2.45 fold higher at day 90 and 3.26 fold higher at day 270 relative to day -30.

This work demonstrates that an increase in the expression of beta-adrenergic receptors is part of the regulation of lipolysis in dairy cattle. Further work can now be directed to identify potential genetic differences among dairy cattle.