Animal Welfare: New Insight through Genomics Research

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The health and production of farm animals is directly related to their welfare. Environmental stress is inevitable, even under ideal production conditions. Accumulated evidence indicates that some animals are less affected by the negative influence of everyday stress. There is tremendous potential for research using endocrine and molecular tools to improve our understanding of how stress influences the welfare of dairy cattle. Goals of the current project are to identify individual cattle with different susceptibility to stress and discover genes with roles in regulating the stress response.

Our research approach combines powerful expression genetics and DNA array technologies with established stress and immunological models for cattle. In Experiment I we determined individual differences between 50 female calves (at 3 and 10 months of age) in blood concentration of cortisol (stress hormone) in response to a single injection of adrenocorticotrophin hormone (ACTH). Blood samples were taken at –20, 0, +20, +40, +60, +120, and +180 min after i.v. injection of 100IU of ACTH. Results showed marked increases in cortisol following ACTH injection, with considerable variation between calves at all points before +180 min. Peak values ranged between 40 and 70ng/ml. We also developed a non-invasive method, using saliva, for measuring changes in cortisol levels. In Experiment II we injected ACTH into 12 Holstein calves (6 months old), followed by euthanization (groups of three calves) at different time points (0, 15, 50, and 100 min) after injection to obtain tissues for gene expression profiling in adrenal gland and brain (pituitary gland and hypothalamus). The tissues have been used to for comprehensive evaluation of global gene expression and to develop a collection of genes that exhibit differential expression between individual animals in response to the acute stress.

Implications of the Research for the Dairy Industry: Development of molecular-based, noninvasive methods to objectively assess stress will create new opportunity to enhance the well being of dairy cattle under current production conditions. Enhanced tolerance to stress will improve health, production, and reproductive performance of dairy cattle, and thereby reduce involuntary culling.

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