Peripheral blood mononuclear cell mitochondrial enzyme activity in calves is associated with average daily gain, reproductive outcomes, lactation performance, and survival

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Mitochondria are central to metabolism and are the primary energy producers for all biosynthesis. The objective of this study was to determine if the mitochondrial enzyme activity of peripheral blood mononuclear cells in heifers were associated with ADG, reproductive outcomes, first lactation milk production and survival. Twenty-three Holstein and 23 Jersey heifer calves were enrolled, and blood and body weight data were collected at 1, 2, 8, 36, 52 and 110 wk of age. Respiratory and fecal scores were recorded daily for the first 30 d of life. Milk production data were collected from herd management software through first lactation and health events were tracked to the fourth lactation on surviving animals. Mitochondrial isolation and enzyme activities for citrate synthase, complex I, complex IV, and complex V were determined using kits from Abcam. Data were analyzed using GLM and the Logistic procedure of SAS (Version 9.4). Multivariate regression analyses were conducted to determine if calf mitochondrial enzymatic activity and covariate health indices (fecal and respiratory scores, number of treatments, hematology) were associated with ADG (8, 36, 52 and 110 wk), lactation performance (milk yield, fat yield, solids yield, ECM, 305ME and relative value) and reproduction (age at first service, age at first conception, age at first calving and number of services). For Holsteins and Jerseys, mitochondrial enzyme activities and health indices were correlated to all ADG and milk production outcomes ($R^2 \geq 0.63$, and $R^2 \geq 0.45$, respectively). Reproduction outcomes were correlated with bodyweight gain, mitochondrial function and red

blood cell traits for Holsteins and Jerseys ($R^2 \geq 0.47$, and $R^2 \geq 0.55$, respectively). Logistic regression analyses were performed to determine if early life enzymatic activity impacted survival outcomes in the herd. Calves below the median for complex V enzyme activity at 1 wk were more likely to be removed from the herd compared to calves above the median by lactation 1, 2, 3 and 4 (odds ratio = 4.7, 7.7, 7.0 and 6.9, respectively). Calves below the median for the difference in hematocrit from 2 to 1 wk were more likely to be removed from the herd compared to calves above the median by lactation 1, 2, 3 and 4 (odds ratio = 13, 10, 5.2 and 4.7, respectively). These findings suggest that predictions of cow performance could be improved by considering the impact of early life mitochondrial enzymatic activity and health indices.