Using Nuclear Magnetic Resonance (NMR) Metabolic Profiling to Distinguish Herds of Bighorn Sheep

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The objective of this study was to determine if nuclear magnetic resonance (NMR) metabolic profiling has the potential to serve as a management tool for evaluating herds of bighorn (*Ovis canadensis*) sheep. Two-hundred and forty bighorn sheep serum samples from 13 herds located in Montana and Wyoming were processed for NMR spectra, profiled for small molecule metabolites using Chenomx®, and then analyzed with MetaboAnalyst (v3.0). Fifty-six small molecule metabolites were identified in ungulate serum. To determine if NMR metabolic profiles can distinguish herds that are geographically distinct with access to different nutritional resources, herds collected in December were compared to herds collected in March. Partial least square discriminant analysis (PLS-DA) indicated a clear, majority separation of metabolic shifts with minor overlaps. Biomarker analysis identified 15 potential biomarkers from the compounds with variables of importance (VIP) scores greater than 1.0. These molecules enabled us to identify 'significantly' important metabolic pathways that discriminate herds sampled in December and herds sampled in March. Key biomarkers resulting from the pathway analysis, included: 2-oxoisocaproate, choline, tyrosine, creatinine, and trimethylamine n-oxide. To determine if metabolic profiling can distinguish individual herds within a month, herds in December, January and March were compared to a domestic, Rambouillet ewes (control) sampled during the sample months. PLS-DA of all herds showed clear metabolic shifts and complete separation between each individual herd and the control ewes for each month. Potential biomarkers for herds within a season that were found to be good discriminants for the December herds included: trimethylamine n-oxide and sarcosine; for January herds included: creatinine and asparagine; and, for March herd included, creatinine. Through identification of small molecule metabolites, it is possible to discriminate herds from each other within and between seasons. These biomarkers represent a potential panel of metabolites that may be used for assessing nutritional status, environmental stress, and herd health through the identification of significantly important metabolic pathways related to energy and protein balance.