MOJOKO, IVANNA[1], NALOVA LISINGE*[1], BILLY G. RAM[2], EWUMBUA MONONO[2], ZHAO JIN[3], XIN SUN[2] and SHYAM L. KANDEL[4], [1]North Dakota State University, School of Natural Resources Sciences, Fargo, ND 58108, [2]North Dakota State University, Department of Agricultural and Biosystems Engineering, Fargo, ND 58108, [3]North Dakota State University, Department of Plant Sciences, Fargo, ND 58102, [4]USDA-ARS, Edward T. Schafer Agricultural Research Center, Fargo, ND, 58102.

Quantitative analysis of sucrose, raffinose, and moisture content in sugar beets utilizing hyperspectral imaging and advanced machine learning techniques.

Sugar beets account for 20-25 percent of the global sugar demand. However, post-harvest losses due to sucrose degradation can significantly impact on the overall yield and quality of sugar. Accurate and timely monitoring of sucrose content is crucial to minimize these losses. Traditional laboratory methods, while precise, are often time-consuming, labor-intensive, and destructive. Hyperspectral imaging emerges as a promising alternative, offering rapid, non-destructive, and accurate analysis of various quality parameters, including sucrose content. To develop robust hyperspectral imaging model for sugar beet quality assessment, sugar beet samples will be randomly collected from three locations: Moorhead and Renville in Minnesota, and Wahpeton, North Dakota. Sugar beet roots will be washed, sliced into 15 mm thickness, and spectral images will be acquired using the Specim SWIR camera in the spectral range of 1,000-2,500 nm. Images will first undergo radiometric correction to remove noise and mitigate any illumination variations. Pre-processing methods, such as Standard Normal Variate for normalization and Savitzky-Golay filtering for derivative-based signal smoothing, will be applied. For feature extraction, discriminant analysis and Principal Component Analysis will be employed. The 10 most significant features, representing sucrose, raffinose, and moisture content, will be selected from the raw 224 spectral signatures. The extracted features and pre-processed signals obtained from standard procedures will be combined into a single dataset. This dataset will then be split into training, validation, and testing sets in a 6:2:2 ratio. Various machine learning and deep learning algorithms will be used for classification. It is anticipated that Linear Discriminant Analysis and Artificial Neural Networks will perform best, with high correlations of 0.90 and 0.95 and standard errors of prediction of 0.51 and 0.56. These results are expected to support the claim that machine learning models trained on spectral signatures cannot destructively predict sucrose, raffinose, and moisture content in sugar beets. *Keywords:* Hyperspectral imaging, Sucrose, Machine learning, Deep learning