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MONITORING OF THE GROWING PROCESS OF SPROUTING PLANTS UNDER TEMPERATURE AND HUMIDITY FACTORS BY NEAR-INFRARED SPECTROSCOPY

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Agriculture, as the backbone of food systems, is under constant pressure to innovate and adapt to meet the rising demand marked by the increasing global population and numerous environmental challenges. Adequate crop management plays a crucial role in safeguarding global food security. Sunflower sprouts, which are young living vegetables, are nutritionally dense and of high economic importance. Environmental stress conditions have a significant impact on the growth, development, and yield of sunflower sprouts, as well as on their nutritional value. Temperature and humidity are important factors that affect the growth of sunflower sprouts, as they are generally sensitive to excessive temperature and humidity conditions. Environmentally-controlled chambers that simulate different atmospheric conditions and control the environmental variables can provide the optimal growth conditions for sunflower sprouts. The study aimed to evaluate the suitability of Near Infrared Spectroscopy (NIRS) to monitor the growing process of commercially valuable sprouting plants under different temperature and humidity levels.

In this study, environmentally controlled chambers were used to monitor the growing conditions of sunflower sprouts under temperature and humidity factors by NIRS. The temperature conditions tested were 15ºC, 19ºC, and 23ºC while the humidity conditions were 70%, 80%, and 90%, resulting in 9 temperature-humidity combinations. In total, nine growth chambers (grouped in 3 sets) were used for the different environmental conditions. The NIRS

spectral was pretreated with Savitzky-Golay-second derivative and Multiplicative Scatter Correction (MSC) in the 1100-1800nm range. Multivariate analysis techniques, such as Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) were used for pattern recognition and discrimination of sprout samples under stress conditions, respectively. The Partial Least Square Regression (PLSR) was utilized to test the capacity for the prediction of brix, height, and dry matter by NIRS.

The results of the PCA showed some trend of separation based on temperature and humidity conditions and indicated that high temperature and humidity levels may induce environmental stress and affect plants' overall growth and development. Specifically, the temperature factor showed greater observable impact compared to humidity, showing that samples from lower temperatures (15ºC and 19ºC) have more dispersion compared to samples from a higher temperature (23ºC). The LDA results had high prediction and recognition accuracies, with the results from the analysis of specific conditions of different temperature and humidity levels showing 100% recognition and prediction accuracies for every single temperature and humidity combination tested. However, analysis on samples from all temperature and humidity levels were misclassified by almost 40%, as it had the lowest prediction and recognition values at 60.595% and 60.295% respectively. The general PLSR regression models for all the sunflower sprout samples showed modest prediction capacities for brix, dry matter, and height, where the highest R^2 was for height with values 0.78 and 0.71 for the R^2C and R^2CV respectively.

Overall, temperature and humidity conditions influence the growth and status of sunflower sprouts, with different growing conditions resulting in varying compositions of the plant, which may be useful knowledge for fulfilling the dietary needs of people. Based on the result, NIRS can be a promising technique for assessing sprouts under temperature and humidity factors, especially for classification. However, as it is not conclusive research, the potential for improvements exists, including developing rapid and nondestructive techniques to monitor these changes to help in precision food production and precision diet.