Title Non-invasive spectrophotometric sensing of carrot quality from harvest to consumption

Author Manuela Zude, Ines Birlouez-Aragon, Peter-Jürgen Paschold and Douglas N. Rutledge

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Abstract

The impact of different storage conditions and minimal processing on quality changes of freshly harvested carrots were recorded by means of non-invasive spectrophotometric techniques. Methods were adapted and evaluated with conventional chromatographic methods to test their feasibility for non-invasive monitoring of compounds determining the product quality. Sugar contents, which are a major component of carrot taste, were non-invasively monitored by means of diffuse reflectance readings (800–1700 nm) applying partial-least squares regression with a percentage standard error of cross validation (SECV) of 15.4, 4.6, and 2.3% for sucrose, glucose, and fructose, respectively. Using spectrophotometry in the visible wavelength range, non-invasive analyses of α- and β-carotenes, as important contributors to the nutritional value of carrots, were obtained with an SECV <1%. An inter-cultivar validation highlighted the need for re-calibration in sugar analysis, while carotenes were measured with an SEP <18% and a coefficient of determination in the validation of R_P^2>0.9. Application of non-invasive product monitoring shows that storage at high temperature (16 °C) as well as a break in the cooling chain can cause decreases in carotene contents. Under these conditions, in comparison with cool storage (3 °C), reducing sugars contents remained stable or were slightly enhanced, while sucrose contents decreased. After minimal processing all nutrients decreased. A loss was inhibited when the oxygen partial pressure was reduced. Monitoring such quality changes with rapid spectrophotometric methods can provide a quality control tool in modern supply chain management.