chemistry proceedings

MDPI

Abstract

Fast Detection of Apple Juice Adulteration by Parallel Chromatography and Chemometric Data Analysis †

Edward Muntean

Department of Food Science, University of Agricultural Sciences and Veterinary Medicine Cluj Napoca, Cluj-Napoca 400372, Romania; edimuntean@yahoo.com

† Presented at the 1st International Electronic Conference on Chemical Sensors and Analytical Chemistry, 01—15 July 2021; Available online: https://csac2021.sciforum.net/.

Abstract: Apple juice is a nutritious beverage commonly consumed for its refreshing attributes, taste, flavor, nutritional properties and health benefits; being rich in carbohydrates, minerals, vitamins and many other phytonutrients, it contributes to a good health status, while playing an important role in a wholesome diet. Unfortunately, the temptation for a fast economic gain, lead to food frauds, such adulterations; for juices, adulteration is accomplished usually by practices such as dilution with water, using cheaper ingredients (mainly different combinations of sugar solutions and syrups), addition of peel and/ or pulp wash. This paper presents a method for fast detection of apple juice adulteration based on parallel chromatography, followed by chemometric data analysis. To prove its usefulness, commercial apple juices were obtained from the local supermarkets; after dilution 1/ 10 (v/v) with ultrapure water and filtration through 0.45 μm Millipore membrane filters, chromatographic analyses were performed on a hybrid Shimadzu system, consisting of two Prominence LC-20AP solvent delivery modules, a Prominence DGU 20As online degasser, an automatic sample injector SIL-10AF, an RID-10A differential refractive index detector, a CDD-10Avp dual channel conductivity detector, a Prominence CTO-20A column oven, an FCV-10AH2 valve unit and a Prominence CBM-20A system controller. Isocratic separations were conducted at 40^0C, using a Universal Cation 7u column for cation analysis, while carbohydrates were separated using an EC 250/4 Nucleodur 100–5 NH_2 RP column; the external standard method was used for quantification. Reference apple juices were obtained from Starkinson and Red-Star apples using a centrifugal juice-extractor; after homogenization, the freshly-made juices were processed as mentioned before. The external standard method was used for quantification, all the samples being analyzed in triplicates; recoveries were established by spiking several samples with known concentrations of analytes. Instrument control, data acquisition and data analysis were accomplished by „LCsolution" software. Multivariate data analysis was completed on autoscaled chromatographic data using Matlab (The Mathworks Inc., USA). The proposed configuration delivered simultaneously the concentrations of sodium, potassium, calcium, magnesium, fructose, glucose and saccharose. Principal component analysis and cluster analysis of the data matrix highlighted four classes of apple juices: juices sweetened with saccharose, juices sweetened with glucose-fructose syrup, genuine apple juices (containing also the laboratory-extracted juices) and adulterated apple juices. Hence, chromatographic analysis in conjunction with multivariate data analysis proved to be appropriate complimentary tools in discriminating between sweetened and non-sweetened apple juices, between genuine and adulterated products - with minimal sample workup, separations being achieved in less than 17 minutes.

Keywords: high performance liquid chromatography; juice; carbohydrates; adulteration

Published: 01 July 2021