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MONALISA - A collaborative multi-sensor approach for non-destructive prediction of apple fruit quality

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Since the apple fruit industry faces significant post-harvest losses due to inferior quality of only a small fraction of it, current research efforts aim to develop effective ways for the assessment and the prediction of apple fruit quality and storage potential. In the present collaboration, solutions were sought in a multidisciplinary approach. To this end apple cultivars Nicoter/Kanzi(r), Braeburn and Gala from different altitudes, European production regions, and agronomic conditions, were analyzed with various non-destructive optical and acoustic techniques. Fruit were measured with non-destructive sensors based on VIS interactance, chlorophyll fluorescence and acoustic firmness. Using statistical procedures, such as probelation and indexed non-linear- and quantile regression, kinetic models for describing post-harvest colour and texture evolution were calibrated on the basis of the data with promising results. Moreover, spatially- and time-resolved NIR spectroscopy used for developing empirical models describing and predicting flesh firmness, revealed clear differences between cultivars, and the production regions. For evaluating the potential of computer tomography (CT) for non-destructive assessment of internal defects, different settings for 2D and 3D X-ray CT were tested. While the simple radiography did not perform satisfactorily, the CT enabled spatio-temporal monitoring of the development of internal defects and microstructure, and allowed the calculation of algorithms for detecting defects in CT scans of whole fruit. Apples were also measured with NIR spectroscopy and the standard methods of HPLC-DAD and UV/VIS. PLS models were developed for alpha farnesene, conjugated trienols (scald), and antioxidants. The results of this research could lead to further improvement of pre- and post-harvest management of apple fruit quality.

Keywords: fruit quality, non-destructive techniques, spectroscopy, X-ray, kinetic modelling

Berries aroma phenomics by PTR-ToF-MS

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Aroma is one of main factors impacting fruit and vegetables quality and consumer appreciation. Since aroma involves the perception of a pletora of volatile organic compounds (VOCs), their assessment is crucial to guarantee the selection and marketability of high quality fruits. High priority should thus be given to replacing poor flavor cultivars with favorable ones, exploiting the variability already available in nature. However, the analysis of the aroma trait in a large number of samples, necessary to overcome the usually massive biological and genetic variability among samples, may be laborious and time consuming. The application of Proton Transfer Reaction -Time of Flight-Mass Spectrometry (PTR-ToF-MS) has been recently described and demonstrates that it is a powerful high-throughput phenotyping tool for both genetic and quality related studies. This contribute describes the application of PTR-ToF-MS for the study of the aroma variability present in the germplasm collection of the main berries species available at the Foundation E. Mach, with particular regard to strawberry (Fragaria x ananassa), raspberry (Rubus), and blueberry (Vaccinium). The rapidity and the moderate cost of PTR-ToF-MS analysis allowed us to perform a detailed aroma characterization of each species with a peculiar attention to the VOC fold changes caused by ad hoc storage experiments tailored to simulate the “from farm to fork” chain. The results obtained in these investigations gave important explanatory information to be implemented in the breeding programs.

Keywords: VOCs, blueberry, raspberry, strawberry, breeding