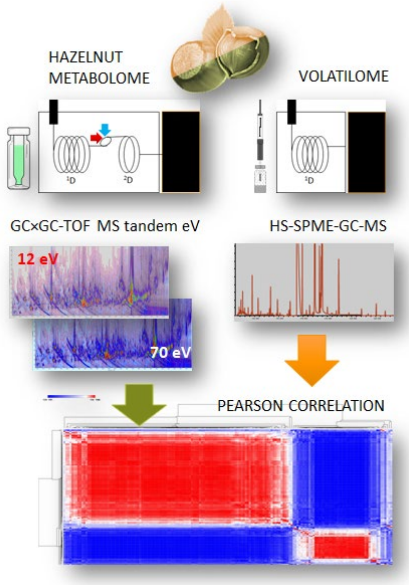
Advanced analytical approaches for "omic" investigations of high quality food matrices of vegetable origin

Marta Cialiè Rosso
Department of Scienza e Tecnologia del Farmaco, University of Torino, Turin
marta.cialierosso@unito.it
Tutor: Chiara Emilia Irma Cordero (UniTO)

In recent years, consumer preferences have been directed at healthier and more flavorsome food with, above all, higher nutritional value and hedonic quality. Modern "omics" disciplines (foodomics, metabolomics, sensomics, flavoromics, etc.) aim at investigating all food constituents (primary and secondary metabolites, compounds generated by thermal treatments and/or enzymatic activity) in a comprehensive way while correlating biological properties with specific chemical signatures. Sensory properties, for example, can be correlated to quali-quantitative distribution of known (or unknown) taste and odor active chemicals.



The goal of this project is the development of analytical strategies, based on multidimensional chromatography and on mass spectrometry, capable of comprehensively characterizing the food metabolome with particular emphasis on those components directly correlated to sensory properties and hedonic quality[1]. The entire analytical process is considered as an integrated work-flow that includes: (a) dedicated sample preparation; (b) analyte separation and detection in a multidimensional information space; (c) dedicated data processing, and (d) chemometrics for results interpretation and rationalization.

Hazelnuts (Corylus avellana L.) are taken as reference food matrix because of their chemical complexity in terms of primary and secondary metabolites, their relevance in Piedmont economy and for the peculiar sensory profile of particular interest for confectionery industry.

These fruits are characterized by a complex array of primary metabolites strictly correlated to key-volatile components[2] produced during storage and after thermal processing, i.e., roasting. It is indeed well known that some primary metabolites are precursors of (key)-aroma compounds and potent odorants (lysine and proline/1-pyrroline; lysine and arginine/2-acetylpyrroline; leucine/3-methylbutanal; alanine/pyrazines) developed by Strecker degradation and Maillard reaction.

The information potential of comprehensive two-dimensional gas chromatography combined with time of flight mass spectrometry (GC×GC-TOFMS), featuring hard and soft ionization in tandem, is integrated in a work-flow based on pattern recognition algorithms (template matching) developed for the 3D-array of data to achieve a comprehensive untargeted/targeted (UT) chemical fingerprinting[3]. Chemical characterization of key-metabolites is then completed by enantiomeric recognition of key-odorants by dedicated ES-GC-MS and by an accurate profiling of esterified and free fatty acids. The temporal evolution of hazelnuts chemical signature is studied over two harvest years and 12 months of shelf-life. The sampling design includes also reference cultivars of economic relevance and different production areas.

Results pose solid foundation for a rational evaluation of hazelnuts quality "potential" based on advanced analytical work-flows capable of exploring Nature's complexity with high effectiveness.

References

1) C. Cordero et al. *TrAC - Trends Anal. Chem.,* 2019, 113, 364-378
2) Kiefl J.et al. *J. Agric. Food Chem*., 2013 61, 22, 5226-5235
3) F. Magagna et al. Anal. Chim. Acta, 2016, 936, 245–258.