06-02: Climate effects: changes in the tea metabolome

Nicole Kfoury, Albert Robbat

Tufts University, Sensory and Science Center,
Chemistry Department, Medford, MA, USA
E-mail: albert.robbat@tufts.edu

Well-known are the effects of extreme weather such as droughts, heatwaves, and cold on crop yield [1,2]. Less understood are climate effects on crop quality. To study how abiotic and biotic pressures affect plant metabolism detailed analysis of the metabolome is required to learn how these effects change the sensory quality and health beneficial properties of plant materials. Toward this end, we developed automated-sequential, 2-dimenasional, gas chromatography/mass spectrometry (GC-GC/MS) methods and new data analysis software to detect the hundreds of volatile compounds in tea, coffee, hops, berries and essential oils [3-6].

For example, we found striking differences in the composition of volatile secondary metabolites in tea (*Camellia sinensis* (L.) Kuntze) harvested from Yunnan Province, China, due to differences in rainfall and temperature [7,8]. Of the 400 compounds detected, about one-third increase, with another third decreasing in concentration, with more than half of them by hundreds of percent. Of these metabolites, 150 possess organoleptic and/or nutritional properties. Similarly, we measured a 50% decrease in the concentration of catechins (well-known phenolic antioxidants) [9] and an increase in other phenolics such as proanthocyanidins, phenolic acids, flavones, flavonols and their derivatives as measured by total polyphenol content and anti-oxidant potential between seasons, namely, spring (no rainfall) and summer (monsoon rains).

In this presentation, results illustrate how tea plants respond to rainfall and temperature over a three-year period and how automated database construction and annotation of GC-GC/MS and GC/MS data lead to these findings, see figure below.

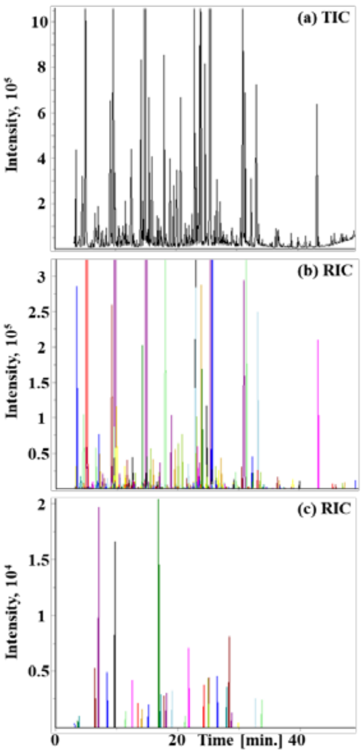

Figure. Total ion current (TIC) chromatogram of spring tea from Yunnan, China (a) and reconstructed ion current (RIC) chromatograms of 360 target compounds (b) and another 39 non-target compounds (c).

References

[1] KANG, Y., KHAN, S. and X. MA, 2009: Progress in Natural Science, **19**, 1665-1674.

[2] KURUKULASURIYA, P., and S. ROSENTHAL, 2013: In: Climate Change Series, **91**, Washington, DC: World Bank.

[3] SCOTT, E. R., LI, X., KFOURY, N., MORIMOTO, J., HAN, W-Y., AHMED, S., CASH, S. B., GRIFFIN, T. S., STEPP, J. R., ROBBAT JR., A., and C. M. ORIANS, 2019: Environmental and Experimental Botany, **157**, 283–292.

[4] KFOURY, N., BAYDAKOV, E., GANKIN, Y., and A. ROBBAT JR., 2018: Food Research International, **113**, 414-423.

[5] ROBBAT JR., A., KFOURY, N., BAYDAKOV, E., and Y. GANKIN, 2017: J. Chrom A., **1505**, 96-105.

[6] ROBBAT JR., A., KOWALSICK, A., and J. HOWELL, 2011: J. Chrom A, **1218**, 5531– 5541.

[7] KFOURY, N., MORIMOTO, J., KERN, A., SCOTT, E., ORIANS, C., AHMED, S., GRIFFIN, T., CASH, S., STEPP, J., XUE, D., LONG, C., and A. ROBBAT Jr., 2018: Food Chemistry, **264**, 334-341.

[8] KOWALSICK, A., KFOURY, N., ROBBAT JR, A., AHMED, S., ORIANS, C., GRIFFIN, T., CASH, S. B., and J. R. STEPP, 2014: J. Chrom A **1370**, 230-239.

[9] AHMED, S., STEPP J.R., ORIANS, C., GRIFFIN, T., MATYAS, C., ROBBAT, A., CASH, S., XUE, D., LONG, C., UNACHUKWU, U., BUCKLEY, S., SMALL, D., and E. KENNELLY, 2014: PlosOne, **9**, 1-13.