ENGINEERING FOODS TOWARDS OPTIMAL CANCER CHEMOPREVENTION

Asst. Prof. Avi Shpigelman

Research aim and objectives

For an identification of optimal targets for utilizing food engineering for optimal chemoprevention an extensive literature review was conducted on two possible sources of compounds, sulfur compounds from the *Allium* genus and compounds from the Mandarins. The extensive and high quality review on those large topics (that was done with extensive collaboration with experts from the world) resulted in two publications that acknowledge the valuable support from the Laura Gurwin Flug Fund (Poojary et al., 2017; Putnik et al., 2017). Due to the very high volatility of the compounds from *Allium* we have started working on flavonoids (part of the polyphenolic group) looking into various effect of processing on them. The project so far aimed at understanding the effects of processing treatments considered more healthy on the content and stability of some flavonoids.

Results and discussion

We have measured the effects of the presence of sugars and high pressure (hydrostatic) on the stability of EGCG as a model flavonoid showing that pressure, unlike his more natural conception, is actually enhancing the degradation rate of this polyphenol (Figure 1). On the other hand the presence of sugars (Figure 2) protects the flavonoids in a structure dependent manner.

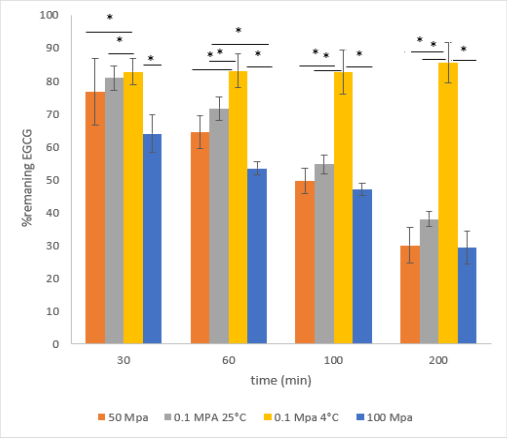

Figure 1: Influence of pressure (0.1, 50, 100 MPa) and temperature (4°C and 25°C) on EGCG stability. EGCG content is presented as percentage of initial peak area (at 270 nm) as a function of storage time

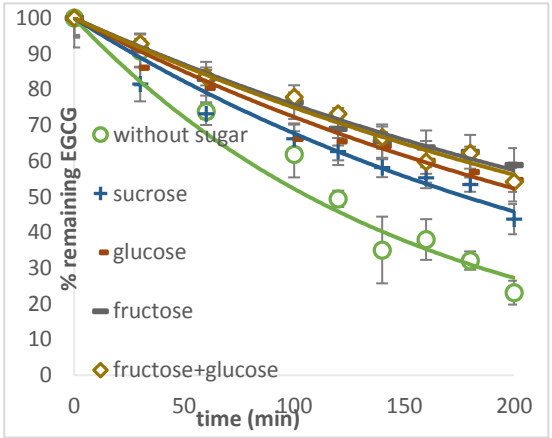

Figure 2: Effect of sugars on stability of EGCG: EGCG percentage of initial peak area (at 270 nm) at different sugar 10% solutions (fructose, sucrose, glucose and fructose + glucose) and phosphate buffer (as control) as a function of time

Those results suggest that we cannot assume that non thermal processing is in all cases better than thermal processing. On the other hand high pressure homogenization with decreasing particle size (Figure 3) increased the content of the total polyphenols in strawberry puree (Figure 4) likely due to an improved extractability from the seeds of the strawberry.

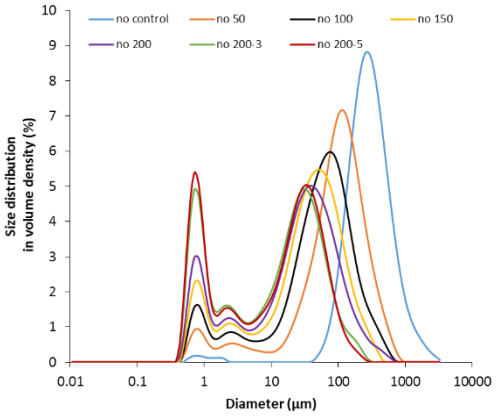

Figure 3: Size distribution (in volume density %) for increasing homogenization pressure

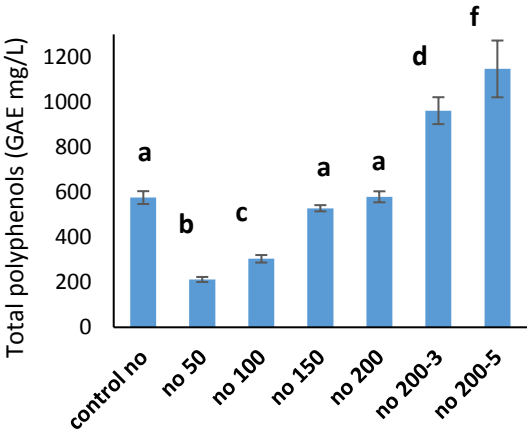

Figure 4: Total polyphenols (in GAE mg/L) for the different treatments ($p<0.05$).

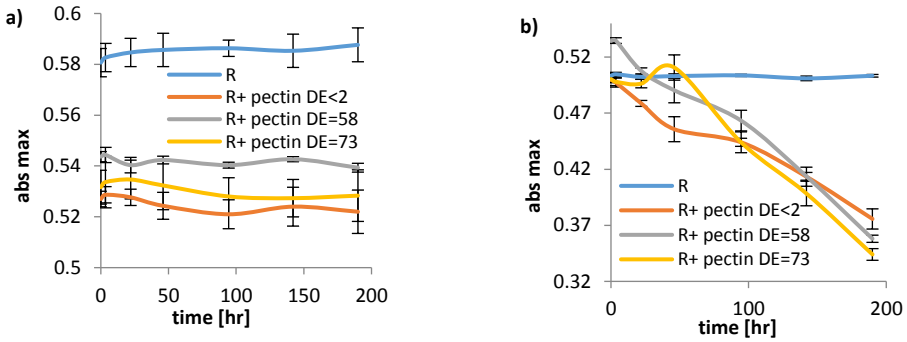

Figure 5: Maximal absorbance of Rutin alone and in the presence of pectins with different degrees of esterification at pH 4.5(a) and 6.5(b) as a function of time.

Figure 5 presents the fact that ruitn (one of the most common flavonoids) interacts with the water soluble pectin (in various pH conditions and various pectin methyl esterification level). Such results will have a great importance on the bioaccessibility and bioavailability of flavonoids that will be further studied.

Cyanidins are a part of the anthocyanins group very common in various berries. Those compounds such as all other polyphenols reported so far have a prospective capacity for cancer prevention. Yet very little is known regarding parameters affecting their stability. Currently we are trying to identify factors related to their stability. Cyanidin (the molecule without a conjugated sugar) shows an extremely low stability and complete degradation is observed in minutes. On the other hand for its glycosides (Fgiures 6) we have identified a higher stability and a pH dependent manner. Surprisingly and not as what was observed for other polyphenols not necessarily acidic pH fully inhibited the degradation.

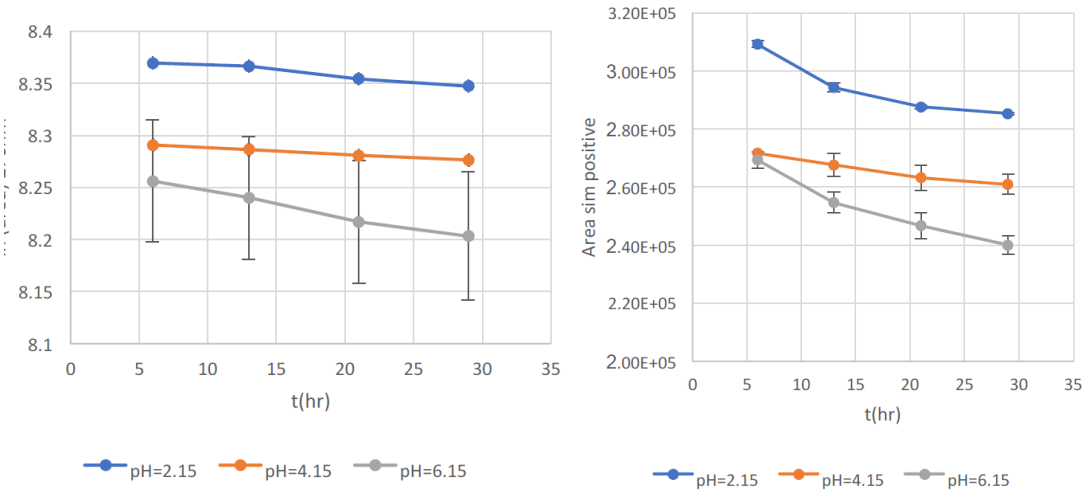

Figure 6: Degradation of cyanidin 3 rutinoside (left) and cyanidin 3 glucoside (right) as a function of time at different pH levels.

Conclusions

Our results clearly show that by engineering the optimal conditions and processing the concentrations of stable polyphenols can be conserved. Yet not necessarily what is commonly conceived as more natural (ie no thermal treatment, hydrostatic high pressure) ensures higher content, leading to better chemoprevention. Therefore we continue to research the current project aimed at more clearly identifying the optimal engineering parameters allowing conservation of structure and activity of the polyphenols.

Published works from this funded project (with acknowledgment of the valuable contribution of the Laura Gurwin Flug Fund)

Poojary, M. M., Putnik, P., Bursać Kovačević, D., Barba, F. J., Lorenzo, J. M., Dias, D. A., & Shpigelman, A. (2017, August 1). Stability and extraction of bioactive sulfur compounds from Allium genus processed by traditional and innovative technologies. *Journal of Food Composition and Analysis*. Academic Press. https://doi.org/10.1016/j.jfca.2017.04.007

Putnik, P., Barba, F. J., Lorenzo, J. M., Gabrić, D., Shpigelman, A., Cravotto, G., & Bursać Kovačević, D. (2017). An Integrated Approach to Mandarin Processing: Food Safety and Nutritional Quality, Consumer Preference, and Nutrient Bioaccessibility. *Comprehensive Reviews in Food Science and Food Safety*, *16*(6), 1345–1358. https://doi.org/10.1111/1541-4337.12310