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THERMAL PROCESSING OF EITHER FRUITS OR VEGETABLES DIFFERENTLY INFLUENCES POLYPHENOL STABILITY

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Polyphenols are the major microconstituents in fruit and vegetables (F&V) and contribute to their organoleptic and nutritional properties. Epidemiological studies demonstrated that the consumption of fruit and vegetables is inversely associated with the development of cardiovascular diseases [1]. On the other hand, cardioprotection has been correlated to polyphenol consumption [2]. As fruit and vegetables are mainly consumed processed, preservation of polyphenols and vitamins is sought during thermal processing. To this end, a better understanding of their stability during thermal processing is essential to improve the nutritional quality of processed F&V products. The aim of our study is to evaluate the stability of common F&V polyphenols and ascorbic acid during conventional thermal processing. Mechanisms occurring behind the reactivity will also be discussed.

We designed two aqueous model systems containing soluble pectins, an apple polyphenol extract [3], cyanidin-3-glucoside, rutin and ascorbic acid either at pH 4 or pH 6 to study polyphenol stability for fruit or vegetable, respectively, in both hot break (95 °C) and cold break (65 °C) processings. Concentrations in polyphenols and ascorbic acid were as in fruit and vegetables. Kinetics for polyphenols were followed by HPLC-DAD-MS. Degree of polymerization and composition of proanthocyanidins were assessed after acidic depolymerization in the presence of menthofuran.

In the vegetable model at pH 6 and 95 °C, the polyphenol stability over 8 h was: rutin > 5-caffeoylquinic acid > catechin ~ epicatechin > cyanidin-3-glucoside > ascorbic acid. In the fruit model at pH 4 and 95 °C, polyphenols proved to be largely more stable although with a similar order: rutin ~ 5-caffeoylquinic acid > epicatechin ~ catechin > cyanidin-3-glucoside > ascorbic acid. At 65 °C, all compounds were mainly stable at both pH except cyanidin-3-glucoside and ascorbic acid.

This study highlighted a larger evolution of 5-caffeoylquinic acid at pH 6 than at pH 4 for both temperatures tested. Indeed, 5-caffeoylquinic acid led to an equilibrium with 3-caffeoylquinic and 4-caffeoylquinic acids through intramolecular trans acylation without any further degradation. At 65 °C, this equilibrium was slower and not achieved after 8 h. Additionally, (+)-catechin concentration peaked after 3 h at 95 °C and pH 6 with a two-fold higher content whereas (-)-epicatechin decreased by a larger amount at the same time suggesting both epimerization and degradation of monomeric flavanols.

These results suggest a greater stability for polyphenols in fruit processing than in vegetable processing for both temperatures. In the vegetable model, the major reactions are regioisomerization of caffeoyl- and coumaroylquinic acids, epimerization of monomeric flavan-3-ols and depolymerization of proanthocyanidins.

[1] Aune D. et al., *Int. J. Epidemiol.*, 46, 1029-1056, 2017

[2] Medina-Remon A. et al., *Br. J. Clin. Pharmacol.*, 83, 114–128, 2017

[3] Le Bourvellec C. et al., *Nutrients*, 11, 664, 2019