Covalent interactions between dietary fiber and condensed tannins: fiber structure defines the binding

Carine Le Bourvellec, Dimitra Chormova, Catherine M.G.C. Renard

COVALENT INTERACTIONS BETWEEN DIETARY FIBER AND CONDENSED TANNINS : FIBER STRUCTURE DEFINES THE BINDING

Carine Le Bourvellec, Dimitra Chromova, Catherine M.G.C. Renard

UMR408 Sécurité et Qualité des Produits d'Origine Végétale, INRA, Avignon University, 84000 Avignon France

Dietary fiber has been traditionally considered as a good health promoting agent and its anticancer properties have been extensively reported, though there is still no consensus about a direct relationship between higher fiber consumption and low cancer risk (Alberts et al., 2000; Barnard et al., 2004). That is why phytochemicals, specifically polyphenols, associated to dietary fiber could have an added value for gastrointestinal health and maybe anticancer properties. Polyphenols and cell-wall are strictly compartmentalized in the plant. However, once fruit are harvested, processed and eaten, these vacuolar polyphenols, most specifically procyanidins, have an opportunity to interact non-covalently with cell-walls whenever they are released from the cell (Renard et al., 2001). After heat treatment (cooking, pasteurization) procyanidins cell-wall complexes could become irreversible due to formation of covalent bonds (Le Bourvellec et al., 2013). These interactions may play an important role in controlling the release of polyphenols from food matrices for absorption in the gastrointestinal tract and in the matrix fermentation by microbiota. The main objectives of this work were to investigate covalent interactions between cell-walls (from pear) and procyanidins and to evaluate the consequences of these interactions on cell-wall composition.

Cell-walls were extracted from pear parenchyma either directly or after separation of stone cells and parenchymatous cells. We artificially created complexes of the different cell-walls and procyanidins (DPn 9) at 25 °C and 95 °C. The complexes were analysed for polyphenols (HPLC-DAD) and polysaccharides (GC and colorimetry). The different cell-walls were also characterized after incubation at 95 °C with and without procyanidins. The nature of interaction was investigated by ITC.

Procyanidins bound to the various cell-walls, at 25°C and 95°C, indicating complex formation. More procyanidins were bound to parenchymatous cell-walls (parenchymatous cells > stone + parenchymatous > stone cells) and after treatment at 95 °C. Undisrupted cell walls that contained a balanced ratio of the various polymers retained procyanidins with higher DPn. Neutral sugars contents decreased significantly for all the different cell-wall types after contact with procyanidin solutions, especially for the cell-wall coming from parenchymatous cells. Arabinose was highly decreased followed by fucose and galactose. ITC assays at 25 °C revealed hydrophobic interactions. At 45 °C very high association constants and positive enthalpy and entropy were observed.

Keywords :

Cell wall, procyanidins, irreversible, binding

References :

Alberts D.S., Martinez M.E., Roe D.J. Guillen-Rodriguez J.M., Marshall J.R., van Leeween J.B., Reid M.E., Ritenbaugh C ., Vargas P.A., Bhattacharyya A.B., Earnest D.L., Sampliner R.E., Parish D., Koonce K., Fales L. (2000): lack of effect of a high –fiber cereal supplement on the recurrence of colorectal adenomas. Phoenix colon cancer prevention physician's network. *New England Journal of Medecine* 342, 1156-1162.

Barnard R.J, (2004): prevention of cancer through lifestyle changes. *Evidence-based Complementary and Alternative Medecine* 1, 233-239.

Le Bourvellec C., Gouble B., Bureau S., Plé Y., Renard C.M.G.C., (2013). Pink discoloration of canned pears: Role of procyanidin chemical depolymerization and procyanidin/cell wall interactions. *Journal of Agricultural and Food Chemistry* 61, 6679-6692.

Renard C.M.G.C., Baron A., Guyot S., Drilleau J.F. (2001): Interactions between apple cell walls and native apple polyphenols: quantification and some consequences. *International Journal of Biological Macromolecules* 29: 115-125.
Acknowledgments :
We gratefully thank PACA (regional), Agropolis Foundation and Toupargel for funding the project and Line Tichit for technical support.