Reducing wheat allergic response by polyphenol-allergen interactions

Maxime Perot, Roberta R. Lupi, Sylvain Guyot, Carine Delayre-Orthez, Pascale Gadonna-Widehem, Jean-Yves Thebaudin, Marie Bodinier, Colette C. Larre

REDUCING WHEAT ALLERGIC RESPONSE BY POLYPHENOL-ALLERGEN INTERACTIONS

Maxime Perot [a, b, c], Roberta Lupi [a], Sylvain Guyot [a], Carine Delayre-Orthez [b], Pascale Gadonna-Widehem [b], Jean-Yves Thebaudin [c], Marie Bodinier [a], Colette Larre [a,*]

[a] INRA, UR 1268 Biopolymères Interactions Assemblages, 44300 Nantes, France
[b] Institut Polytechnique LaSalle Beauvais, UP 2012.10.101 EGEAL, 60000 Beauvais, France
[c] Guaranteed Gluten Free, 80700 Roye, France

MAIN CONCLUSION

The complexes formed by interaction between cranberry extract and gliadins showed a decrease in the recognition by antibodies (IgG and IgE) which implies that the allergic potential of gliadins could be reduced.

INTRODUCTION

Wheat allergy is an IgE-mediated disease increasing in the last years. The only treatment is based on dietary restriction and no prevention strategies have been reported. The use of polyphenols which are known to contribute health-promoting benefits has been suggested in relation with antioxidant activity, anti-inflammatory and anti-allergenic potential amongst others. Dietary plant phenolic compounds are known to interact with proteins via non covalent or covalent interactions. Some of them are able to interact with gluten (consisting of a mixture of gliadins and glutenins) which includes major wheat allergens. In this study, we screened different polyphenols sources for their capacity to interact with gliadins, to mask epitopes and finally to impact degranulation which is the effector phase in allergic reaction.

MATERIALS AND METHODS

Polyphenols were extracted from four plant extracts: artichoke leaves provided by EVEAR (Coutures, France), cranberry, apple and green tea leaves provided by NATUREX (Avignon, France) according to the purification procedure previously described [1]. The total phenolic compounds content was determined by Folin-Ciocalteu method. The analysis of purified extracts was performed by HPLC-DAD-MS.

Gliadins were extracted as previously described [2]. Hydrolysed gliadins were obtained by digestion with pepsin from porcine gastric mucosa for 15 minutes in acidic conditions (pH 3). Digestion was stopped by heating at 100°C for 1 minute.

Plant Extracts	Glia:Pp	Gliadins (mg/ml) Mean		SD
Artichoke leaves	1:1	0,72	±	0,18
	2:1	0,94	±	0,08
	1:3	0,55	±	0,06
Cranberry	1:2	1,45	±	0,02
	1:1	1,82	±	0,21
	1:4	0,92	±	0,20
Apple	1:3	2,01	±	0,03
	1:1	2,21	±	0,11
	1:4	1,94	±	0,19
Green tea leaves	1:3	2,09	±	0,30
	1:1	2,23	±	0,11

Table 1: RP-HPLC analyses of gliadins in supernatant (soluble) after centrifugation of complex formed by interaction with plant extract at different ratio gliadins:polyphenol (w/w).

Gliadins/Polyphenols interactions were obtained mixing solutions of native or hydrolysed gliadins at 2.5 mg/mL with increasing amount of polyphenols. After centrifugation, electrophoresis and RP-HPLC were used to characterize the supernatant. The impact of these

* Colette.larre@nantes.inra.fr

interactions on the binding of IgG anti-gliadins and IgE-binding was determined by DotBlots and tested in RBL-2H3 model (rat basophilic leukemia cells).

RESULTS AND DISCUSSION

The plant extracts were chosen on the basis of their differences in polyphenol composition and their availability. Green tea leaves for its content in catechins, artichoke leaves for its hydroxycinnamic acid content (chlorogenic acid and cynarin), apple for its flavanol monomers (i.e. epicatechin) and oligomers (i.e. B-type procyanidins) contents, and cranberry for its content in A-type proanthocyanidin (PAC). Polyphenols were separated from contaminants and enriched by SPE chromatography. Polyphenols composition of the purified extracts was determined by HPLC-DAD/Ion Trap MS analysis. The four extracts revealed complex profiles with main components corresponding to the expected polyphenols previously cited.

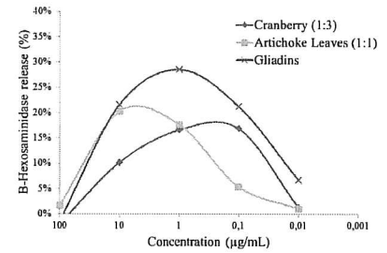

Figure 1: B-Hexosaminidase release of RBL 2H3 after stimulation with gliadins only or in interaction with artichoke leaves or cranberry.

All tested polyphenols were able to interact with native gliadins, leading to the formation of soluble and insoluble complexes characterized by the apparition of haze in particular at high polyphenols concentrations. Polyphenols from cranberry and artichoke leaves were the most efficient to induce the formation of insoluble complexes with gliadins either in their native (Table 1) or hydrolysed forms. Our results showing the ability of cranberry polyphenols (PACs) to interact with gliadins were in accordance to those of Plundrich et al [3] on peanuts proteins. When gliadins were in interaction with cranberry polyphenols, the recognition of gliadins by IgG anti repetitive domain and IgE was decreased; this suggested that epitopes were hidden by polyphenols. A similar effect was found with sera from wheat allergic patients. The gliadins-polyphenols complex tested in a RBL model affected the magnitude of effector cell activation (Figure 1).

These interactions could have a masking effect on allergens epitopes or may result in a structural change of gliadins reducing their recognition by immunoglobulin G and E type as suggested by Tozzi et al [4] from NMR analysis of gliadins-anthocyanidins complexes.

REFERENCES

[1] Sylvain Guyot et al, *Journal of Agricultural and Food Chemistry*, **2001**, 49, 14-20

[2] Fabrice Battais et al, *Clinical & Experimental Allergy*, **2003**, 33:962-970

[3] Nathalie J. Plundrich et al, *Journal of Agricultural and Food Chemistry*, **2014**, 62 (29), 7010-7021

[4] Silvia Tozzi et al, *Food Chemistry*, **2013**, 141, 3586-3597

ACKNOWLEDGMENTS

This work is part of the ProtAlSafe project which is financed by "Région Picardie", "Région Pays de la Loire" and BPI France, certified by Valorial and IAR poles and in partnership with Biofortis, Mérieux NutriSciences, ABCD Nutrition and AFDIAG. Maxime PEROT was supported by a doctoral grant from the ANRT.