

Polyphenols in foods and their interactions with proteins and sugar degradation products

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Polyphenols are widely distributed in foods either naturally in most plant-based foods or added as functional ingredients due to their antioxidative capacity. The inhibitory effect of polyphenols on lipid oxidation and development of rancidity is well-established, but during the antioxidative reactions of polyphenols they become oxidized. Polyphenols in their oxidised form (i.e. in the form of quinones) react with nucleophilic groups on proteins and create protein-quinone adducts in foods, which have been shown to lead to increased protein cross-linking and altered textural properties in meat. Thiol groups on cysteine residues are kinetically preferred targets for quinone modifications, but amine groups on lysine residues and N-terminals, and histidine and arginine residues have also been shown to react with quinones. The consequence of these protein modifications on food quality is not understood in detail yet; some amine-quinone adducts are highly colored and will this lead to discoloration of food products (e.g. red color formation in milk drinks), while thiol-quinone adducts are uncolored. Furthermore, protein digestibility is affected by quinone modifications, and it is unknown how the formation of protein-quinone adducts affects the uptake of both the modified amino acids and polyphenols.

Polyphenols have also been shown to effectively inhibit Maillard reactions (non-enzymatic browning) by trapping alfa-dicarbonyls (such as methylglyoxal), which are reactive intermediates that accelerate Maillard reactions. Interestingly, it has recently been shown that polyphenols may also trap Strecker aldehydes (flavor compounds formed during Maillard reactions) as well as secondary lipid oxidation products by a similar mechanism, but it is uncertain how pronounced these reactions are in foods. The reaction mechanisms and likelihood of the different possible reactions of polyphenols in foods will be discussed based on quantitative data on concentrations of reactants in foods and rate constants of the reactions.