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New insights into the interactions between Maillard reaction and oxidation: role of sugar, catechol and metals

A. R. MONFORTE[a], S. I. F. S. Martins[b], A. C. Silva Ferreira[ac]

[a]*Faculty of Biotechnology – Portuguese Catholic University, Apartado 2511, 4202, Porto, Portugal, ritamonforte4@gmail.com*
[b]*Unilever R&D Vlaardingen, 3130 AC Vlaardingen, Netherlands*
[c]*IWBT-DVO University of Stellenbosch, Private Bad XI, Matieland 7602, South Africa*

Strecker degradation is a crucial reaction in relation to flavour formation, and it was established that the formation of Strecker aldehydes could be related with the Maillard reaction [1], with the reaction of the amino acid with a quinone formed by the oxidation of a phenolic compound where metals are required [2] and lately a new pathway has been proposed for the reaction of a catechol with the amino acid without the presence of the metals [3].

However the relationship between reactions in wine conditions has never been tested together, as well as the impact of the both mechanisms on the SA formation. In order to gather more information about what extended the SA formation pathways can be promoted or inhibited by the presence of Maillard and oxidation substrates, namely: sugar, catechol, amino acid and metals a full factorial design with two levels (presence and absence) of the 4 main substrates of the two reactions have been performed. The model solutions were prepared mimic each mechanism in study and considering wine concentrations and equimolar concentrations of the reactants.

Three main solutions were monitored: equimolar solution (2.4mM gallic acid+2.4mM) with and without metals and a wine model solution (0.6mM gallic acid+2.4mM phenylalanine+ metals). Quantitative measurements on phenylacetaldehyde (PA) and other compounds such as benzaldehyde and methyl glyoxal were performed by derivatization with PFBHA and the solution were analyzed by HS-SPME-GC-MS.

Results revealed that PA formation increase with time and its formation its favoured in the model solution simulating oxidation (p-value < 0.05) becoming the differences more predominant after 18 hours of experience. This observation suggest that when we promote oxidation plus Maillard reaction the quinone and the α-dicarbonyl will compete for the amino acid consumption. Moreover for the same concentrations of catechol and amino acid the presence of metals don't have impact at the experience conditions.

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2. Rizzi G. P. (2006) J. Agric. Food Chem., 54(5):1893–1897.
3. Delgado R. M., et al. (2015) J. Agric. Food Chem., 63(1): 312–318.