The pinking of white wine: are certain antioxidants involved?

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Pinking of white wine leads to the turning of color from yellow into salmon-red hue, an undesired change potentially occurring over storage. Recently, small concentrations of malvidin-3-O-glucoside (~ 0.3mg/L) was attributed to the appearance of pink color being detected in white wines produced under reducing conditions from Síria grape variety [1]. Moreover, the polymerization of anthocyanins under oxidative condition, the combination of more than ten different monomers and polymeric compounds, the formation of a derivative from 2-S-glutathionyl-caftaric acid were suggested as causes of pinking [2]. However, this color modification still needs to be clarified. This study aimed to elucidate the molecular mechanisms and the compound(s) involved in the pinking of white wine.

The formation of pinking was evaluated in model wine added with fixed amounts of the phenolics (i.e. catechin and caffeic acid) and increasing concentrations of sulfur-containing compounds [SCCs] (i.e. glutathione, cysteine, mercaptoethanol) of which some are used as antioxidant, added singularly or in combination. An assay with copper, with and without phenolics, was also carried out. The oxidation was generated by adding p-benzoquinone in both oxic and anoxic conditions. The intensity of pink color was measured at 520 nm. A major compound associated to pinking was detected by UPLC-UV and its molecular weight and structure were investigated by High Resolution Mass Spectrometry (HRMS) and Nuclear Magnetic Resonance (NMR), respectively.

The pink color appeared in most of the tested conditions and it resulted more intense with catechin. On the contrary, the color was yellow-brownish in the absence of phenolics notwithstanding the presence of copper. Considering the single addition of SCCs, the major pink intensity and the fastest appearance were due to cysteine. The pinking intensity was lower with glutathione and it was not detected with mercaptoethanol. Catechin was the phenolic mainly involved into the pinking that appeared even faster under anoxic condition. The rate of pinking formation was dependent on both SCC/p-benzoquinone and catechin/p-benzoquinone molar ratios with the former playing a paramount role. The major formation rate was observed when thiol/p-benzoquinone molar ratio ranged 0.7-1.2. The compound associated to the pink color showed a maximum adsorption at 505 nm, characteristic of anthocyanin-like moieties and its accurate mass ($[M+H]^+$) was 450.0635 Da. NMR analysis evidenced three molecular forms in equilibrium. The estimated conversion yield was 5%.

These data suggest that pinking phenomena, in our experimental conditions, is due to the oxidation of catechin with the aid of SCCs. The role of the latter, in particular cysteine, was crucial for the appearance of this color change.

Keywords: pinking, oxidation, quinones, cysteine, catechin

References

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