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Colloidal stability of polyphenols in young red wine by Acacia gum: The major implication of arabinogalactan-proteins rich in proteins

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Introduction

Acacia gum (GA) is a dried exudate obtained from *Acacia senegal* and *Acacia seyal* trees. GA macromolecules are highly branched glycoproteins belonging to the arabinogalactan-protein (AGP) family. GA is defined as a continuum of AGPs differing especially by their molar mass, charge density and hydrophobicity index. GA is widely used in food and non-food industries for its functional properties. In oenology, GA is added to ensure the colloidal stability of young red wine precluding or minimizing the precipitation of polyphenols. Before its addition in young red wine, the efficiency of GA is evaluated according to a “hydro-alcoholic – mineral efficacy test” (COEI-1-GOMARA: 2000). In this study, we investigated the efficiency of GA and its molecular fractions towards hydro-alcoholic – mineral solution and polyphenols instabilities.

Materials & Methods

Acacia *senegal* gum was fractionated by Hydrophobic Interaction Chromatography (HIC) with the recovery of three fractions. They were named HIC-F1 (83% of GA), HIC-F2 (15% of GA) and HIC-F3 (2% of GA), and classified in that order according to a growing hydrophobic index. The amino acid content of GA, HIC-F1, HIC-F2 and HIC-F3 was 21, 5, 63 and 138 mg.g^{-1}, respectively.
The colloidal stability of the hydro-alcoholic – mineral solution (pH 3.1) at 25° C and polyphenols in hydro-alcoholic – grape marc solution (pH 3.5) at 10° C was investigated in the presence of GA and its HIC fractions. The critical concentrations (C_{crit}) of GA and HIC fractions needed to stabilize the hydro-alcoholic – mineral and hydro-alcoholic – grape marc solutions were determined.

Results

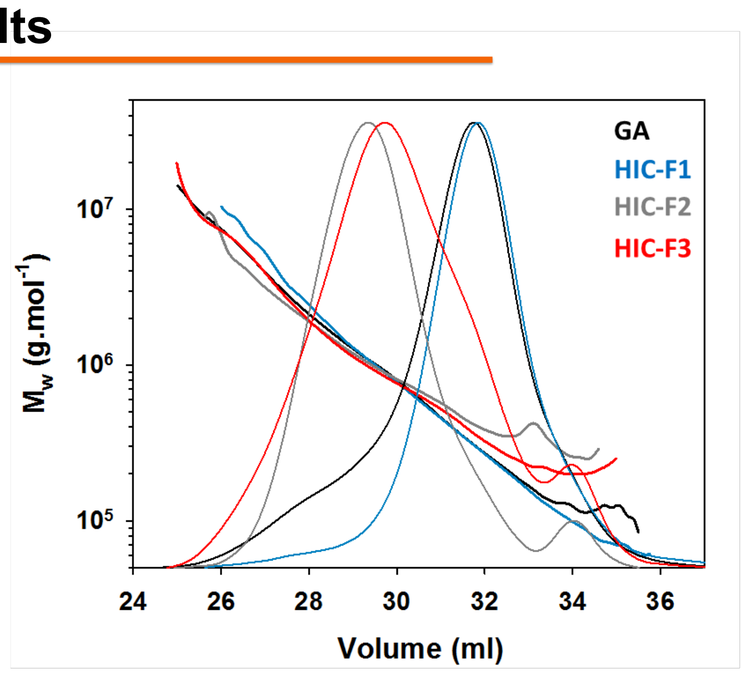

Fig 1. Molar mass (M_w) distribution (thick line) and refractive index signal (thin line) of GA and its HIC fractions.

- HIC-F1 contains mainly low M_w AGPs (95% of AGPs with Mw < 1x10^6 g.mol^{-1}) poor in proteins.
- HIC-F2 and HIC-F3 contain a greatest proportion of high M_w AGPs rich in proteins (50% and 35% of AGPs with Mw > 1x10^6 g.mol^{-1} for HIC-F2 and HIC-F3, respectively).

Table 1. Critical concentration (C_{crit}) of GA and its HIC fractions towards hydro-alcoholic – mineral and hydro-alcoholic – grape marc solutions instability.

	AG	HIC-F1	HIC-F2	HIC-F3
Hydro-alcoholic mineral solution (pH 3.1)	0.114 ± 0.002	0.570 ± 0.013	0.083 ± 0.005	0.012 ± 0.001
Hydro-alcoholic grape marc solution (pH 3.5)	0.245 ± 0.006	0.996 ± 0.090	0.118 ± 0.014	0.027 ± 0.003

- The same HIC fractions, HIC-F2 and HIC-F3, are involved in the colloidal stability of the hydro-alcoholic mineral and hydro-alcoholic grape marc solutions.

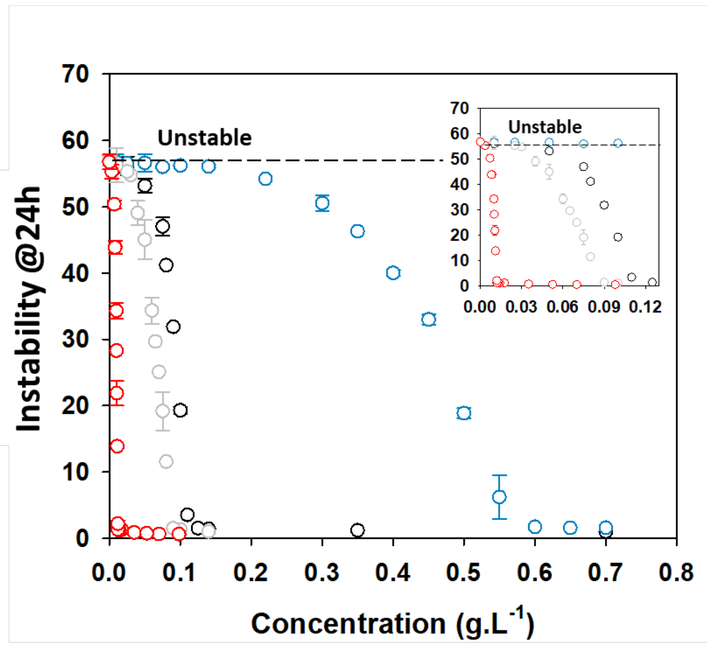

Fig 2. Colloidal stability of the hydro-alcoholic – mineral solution in presence of GA and its HIC fraction.

- HIC fractions differ by their efficiency towards the mineral instability: HIC-F3 and HIC-F2 fractions are ~47 and ~7 times more efficient than HIC-F1 fraction.

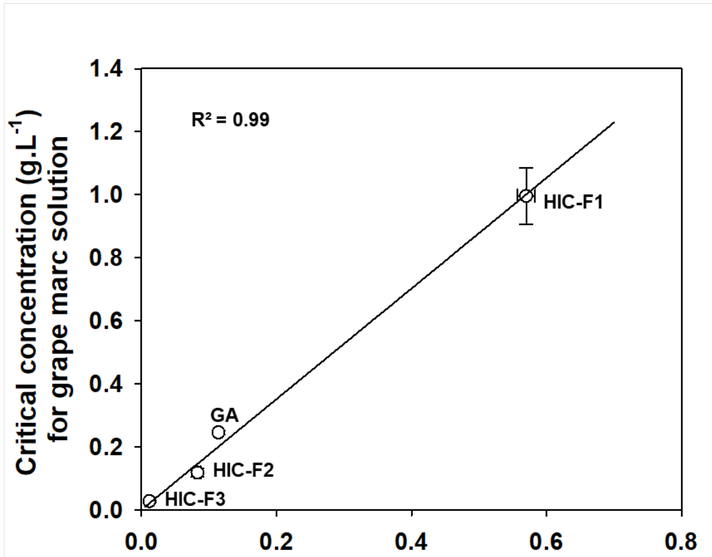

Fig 3. Correlation between the colloidal stability properties of GA and its HIC fraction determined in hydro-alcoholic – mineral and hydro-alcoholic – grape marc solutions.

Conclusions

These results confirmed and strengthened the relevance of the hydro-alcoholic – mineral test for the evaluation of GA colloidal stability properties towards polyphenols instability.
The HIC fractions can be classified in the same order according to their efficiency towards mineral and polyphenols instability as the following: HIC-F3 > HIC-F2 >> HIC-F1.
The mineral and polyphenols are stabilized by the high molar mass macromolecules rich in proteins (amino-acids) of Acacia *senegal* gum. The colloidal stabilizing properties of these macromolecules could be attributed to their remarkable physico-chemical properties such as their charge density and their hydrophobic behavior.

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