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 hetero-polysaccharides belonging to the arabinogalactan-protein (AGP) family. GA can be defined as a continuum of molecular species differing especially by their molar mass, charge density and hydrophobicity index. GA are composed of galactose, arabinose, rhamnose, glucuronic acid and a small amount of protein (0.5-3%). GA is widely used in food and non-food industries for its functional properties. In oenology, GA is used as additive to ensure the colloidal stability of young red wine precluding or minimizing the precipitation of polyphenols. In this study, we investigated the efficiency of GA and its molecular fractions towards 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 (85-94% of GA), HIC-F2 (6-18% of GA) and HIC-F3 (1-3% of GA), and classified in that order according to a growing hydrophobic index.
The stability of polyphenols in hydro-alcoholic matrix at pH 3.5 and 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 polyphenols were determined.

Results

Table 1. Biochemical composition of GA and its HIC fractions.

	Galactose (%)	Arabinose (%)	Rhamnose (%)	Glucuronic Acid (%)	Amino acids ($mg.g^{-1}$)
GA	33.9	33.9	14.7	16.6	21.5
HIC-F1	36.9	29.7	14.1	18.1	5.6
HIC-F2	35.9	33.4	13.0	17.2	52.5
HIC-F3	33.0	37.1	12.9	16.4	105.9

- Sugar composition of GA and its three HIC fractions is similar.

- HIC fractions differ by their amino-acids content: HIC-F3 and HIC-F2 fractions contain ~20 and ~10 times more amino acids than HIC-F1 fraction.

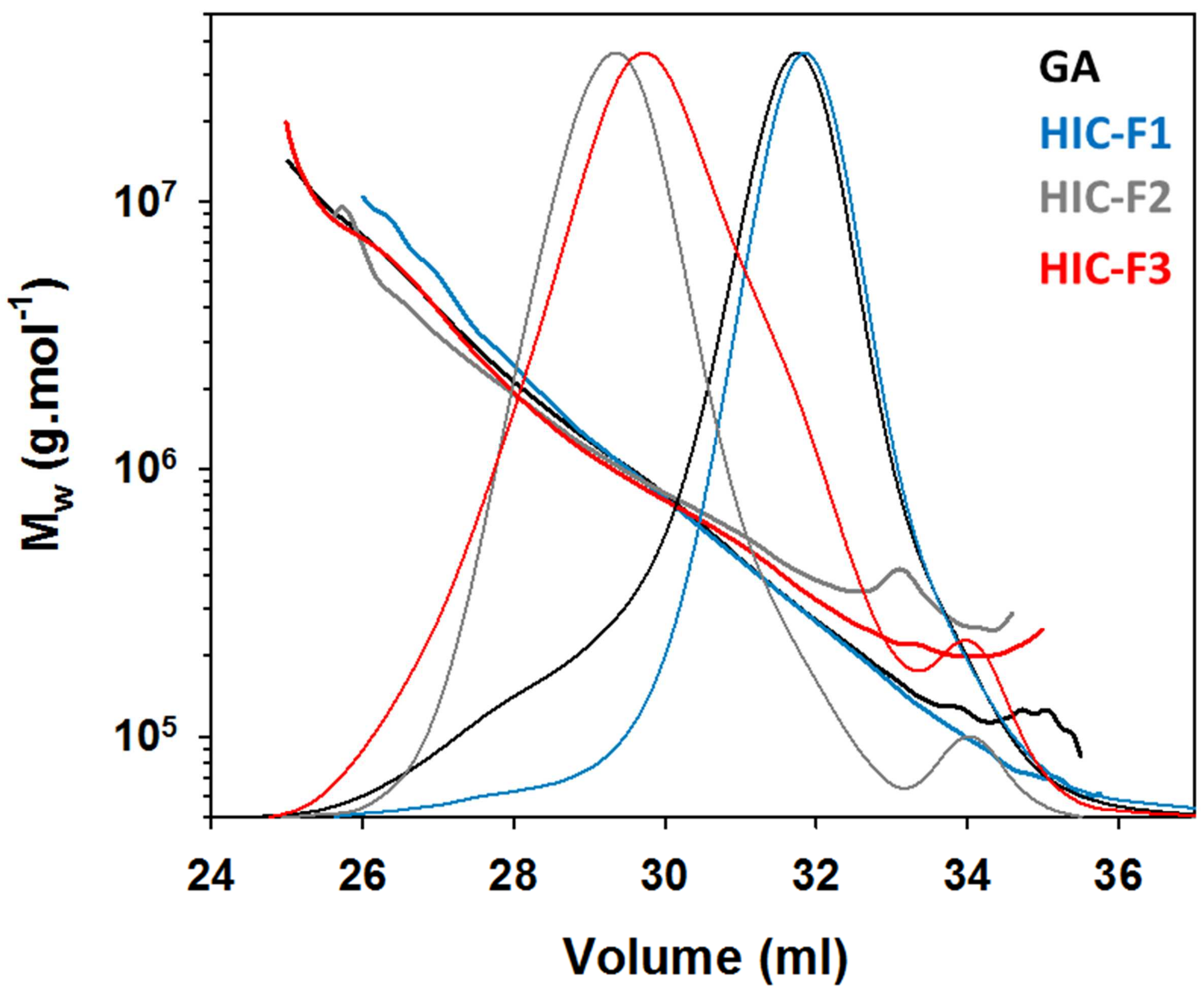

Fig 1. Molar mass (M_w) distribution of GA and its HIC fractions.

- HIC-F1 contains mainly low M_w macromolecules (Mw < 7.5×10^5 $g.mol^{-1}$).

- HIC-F2 and HIC-F3 contain mainly high M_w macromolecules (Mw > 7.5×10^5 $g.mol^{-1}$).

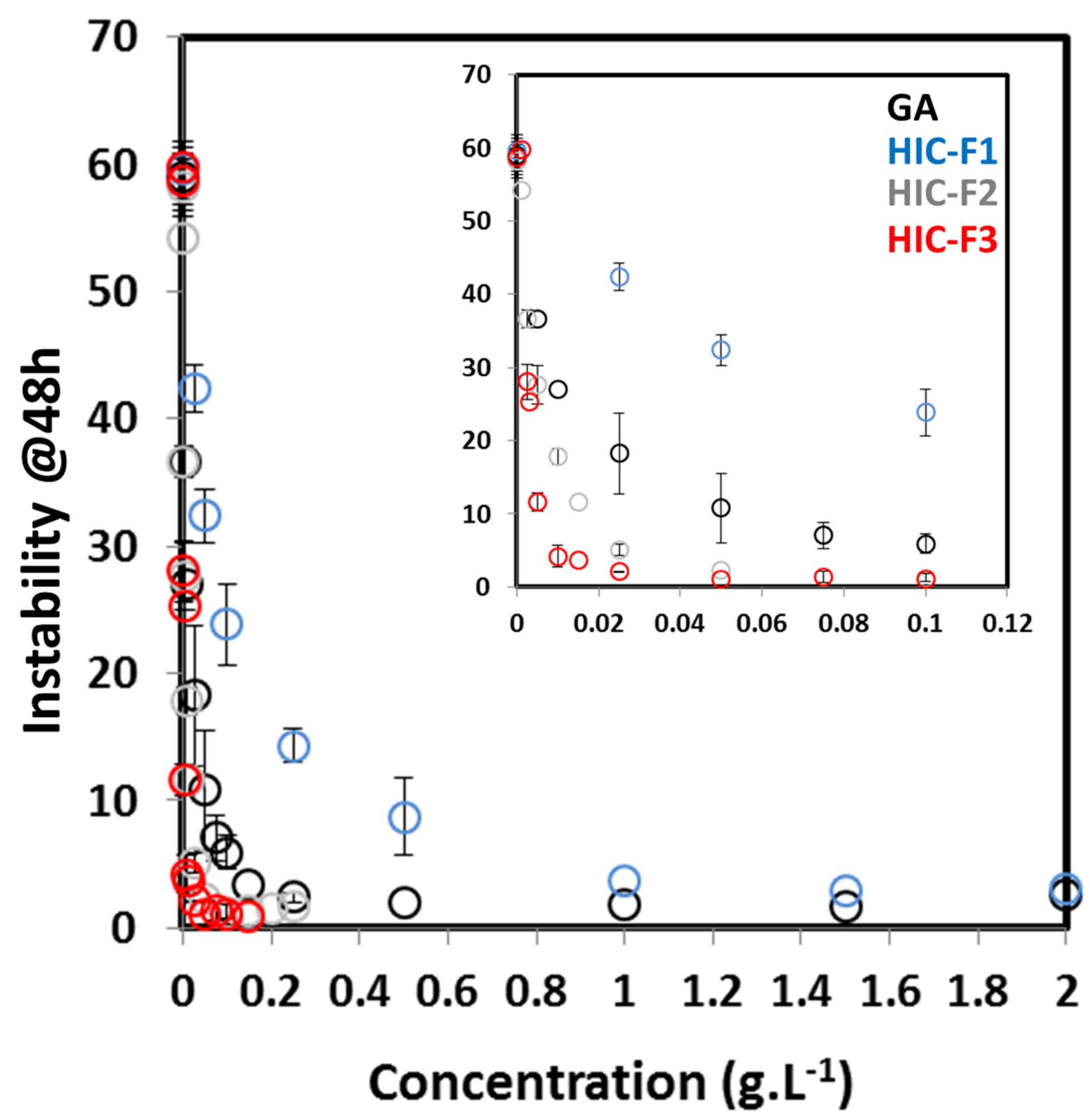

Fig 2. Stability of polyphenols in presence of GA and its HIC fraction.

Table 2. Critical concentration (C_{crit}) of GA and its HIC fractions towards polyphenols instability.

Samples	Critical Concentration ($g.L^{-1}$)
GA	0.245 ± 0.006
HIC-F1	0.996 ± 0.090
HIC-F2	0.059 ± 0.002
HIC-F3	0.027 ± 0.003

- HIC fractions differ by their efficiency towards the polyphenols instability: HIC-F3 and HIC-F2 fractions are ~37 and ~17 times more efficient than HIC-F1 fraction.

Conclusions

GA and its molecular HIC fractions prevent the polyphenols instability in hydro-alcoholic solutions. The HIC fractions can be classified according to their efficiency towards polyphenols instability as the following: HIC-F3 > HIC-F2 >> HIC-F1.
The polyphenols are preferentially 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.