

Interactions between macromolecules and aroma components: Comparison between mannoproteins isolated from two oenological yeasts (*Saccharomyces cerevisiae*) and the interactions with the volatile components in wine

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Objectives

- To study the effect of the mannoproteins, principal polysaccharides in wine, liberated by the yeast during the fermentation and their effect on volatile aromatic components: ethyl hexanoate, isoamyl acetate, β -ionone and hexanol.
- Evaluate the interactions with aromatic components and the concentration of mannoproteins found in wine: 150 mg/L
- Estimate the effect of the enological yeast used and the different fractions of isolated mannoproteins.

Materials and methods

The mannoproteins were obtained from the alcoholic fermentation in synthetic media from two strains of *Saccharomyces cerevisiae* from Institut Coopératif du Vin: ICV-D21 and ICV-D80.

An extract is obtained after centrifugation, dialysis, concentration and lyophilisation.

The mannoproteins are separated on a Superdex 30HR column, into two fractions: F-1 with MW greater than 15 kDa and F-2 with weights between 5 and 15 kDa.

Results and comments

Table I: Composition and structural characterization of the fractions (F1 et F2) of mannoproteins isolated from the strains ICV-D21 and ICV-D80 by exclusion chromatography.

Fractions	ICV-D21		ICV-D80	
	F1	F2	F1	F2
% Mannose *	88	65	91	68
% Glucose *	12	35	9	32
Proteins (%)	13	30	11	72

* % relative to the total polysaccharides

Comments on table I:

The analysis on the carbohydrate composition indicates that the fractions are mainly composed of mannose.

The analysis of the structure of the different mannoproteins (*results not presented here*) demonstrates that the F-1 fraction is constituted of long chains of mannose linked in $\alpha(1\rightarrow6)$, substituted by short chain mannose linked by $\alpha(1\rightarrow2)$ and $\alpha(1\rightarrow3)$. The F-2 fraction is rather made up of short chains and mannose linked in $\alpha(1\rightarrow2)$ and $\alpha(1\rightarrow3)$.

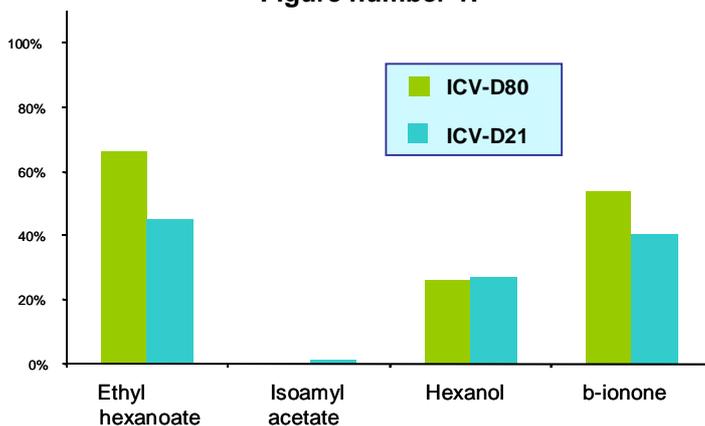
These structures correspond to the mannoproteins already described in scientific literature.

The F-1 and F-2 fractions of the strains ICV-D21 and ICV-D80 present significant differences on a composition and structural level.

Study with the raw extracts of mannoproteins

The study on interactions between the aromatic components and mannoproteins is accomplished by GC analysis of the headspace of model wines (12% ETOH /water, pH 3.5) with or without additions of mannoproteins (150 mg/L) and aroma components ethyl hexanoate: (19,98 ppm), isoamyl acetate (23,46 ppm), β -ionone (189,03 ppm) and hexanol (172,8 ppm).

Figure number 1:



The retention percentage of aroma components by raw mannoprotein extracts obtained from synthetic media fermented with strains ICV-D80 and ICV-D21 .

Comments on figure number 1:

With a mannoproteins concentration of 150 mg/L strong interactions are obtained by ethyl hexanoate, β-ionone and hexanol. On the other hand, isoamyl acetate is not stabilized by the mannoprotein interactions from neither ICV-D21 nor ICV-D80.

The interactive force increases with the hydrophobic nature of the aroma components: ethyl hexanoate > β-ionone > hexanol.

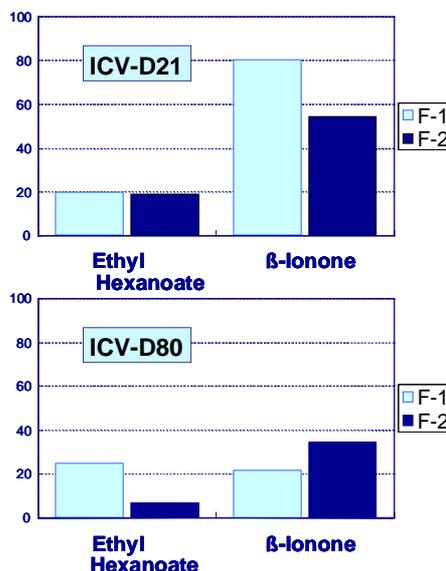
The two strains reacted similarly, with a slightly weaker retention of ethyl hexanoate for the mannoproteins from the ICV-D21.

Study on the purified fractions of the mannoproteins

The mannoprotein extracts were obtained from the strains ICV-D21 and ICV-D80 and purified by exclusion HPLC, and characterized.

The retention percentage of ethyl hexanoate and β-ionone were measured by head-space analysis in the presence of the purified fractions of mannoproteins.

Figure number 2:



The retention percentage of aroma Component by fractions isolated from mannoprotein raw extract from strains ICV-D80 and ICV-D21.

Comments on figure number 2:

The retention percentage varies with respect to the strain, the fraction of the mannoproteins and the aroma component, except for ethyl hexanoate and the fractions F-1 and F-2 for ICV-D21.

Ethyl hexanoate is weakly retained by the F-2 fraction from the strain ICV-D21.

β -ionone is strongly retained / stabilized by the first fraction (F-1) of the mannoproteins isolated from the strain ICV-D21. The fractions more rich in polysaccharides and higher molecular weight, mainly made up of N-glucan mannoproteins, have a more pronounced effect of the retention of ethyl hexanoate and β -ionone.

Conclusion

Mannoproteins modify the aromatic profile of wines due to the retention of certain aromatic components (ethyl hexanoate and β -ionone).

This effect is variable depending on the nature of the aromatic component (hydrophobic, hydrophilic, ionic, etc...), but also depends on the strain of yeast used: ICV-D21 or ICV-D80.

A better comprehension of the phenomenon requires further in depth analyses on the composition of these macromolecules. It seems that other macromolecules, such as the proteins would also interact with the aromatic components of the wine.

Translation from French: Sigrig Gertsen Briand, Lallemand USA



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