EFFECT OF CARBOXYMETHYL CELLULOSE ON TARTRATE SALT, PROTEIN AND COLOR STABILITY OF RED WINE

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Introduction

Since the 80ies, the long-lasting effect of carboxymethyl-cellulose (CMC) for tartrate stabilization of white wines is known. However, in red wine-making the efficiency is discussed controversially. Here, CMC is often considered to be ineffective, and frequently haze formation occurs, caused by the interaction of proteins and polyphenols. In addition, wine color can be affected. In order to explain these effects, we studied in detail the impact of CMC on haze formation and color stability in red wine. The haze-forming material was analyzed by sodium dodecyl-sulfate polyacrylamide electrophoresis and the protein composition by high-performance liquid chromatography-mass spectrometry. Color alteration was documented by Vis-spectroscopy. The nature of several proteins which have been identified susceptible for precipitation allows conclusions about the influence of the microbiota and the immune defense of the grapes.

Impact of CMC on turbidity, color loss and crystal stability

In the test, red wines could be stabilized by applying CMC at very high saturation temperatures and conductivity differences [1].
The dosage was dependent on the crystal instability of the investigated wine. Crystal stability was not always achieved immediately after the CMC application. High saturation temperatures along with low conductivity differences were observed (cf. tab. 1, [1]). Three out of ten investigated wines show significant haze formation after applying CMC. Untreated wines with high turbidity values show intensified haze formation when CMC was applied. CMC treatment of wines which were protein instable leads to increased turbidity.
The loss of color in CMC treated wines which were rich in proteins and phenols correlates with the dosage of CMC. (cf. fig. 1 and fig. 3) The co-precipitation of color and protein leads to loss of color in red wine.

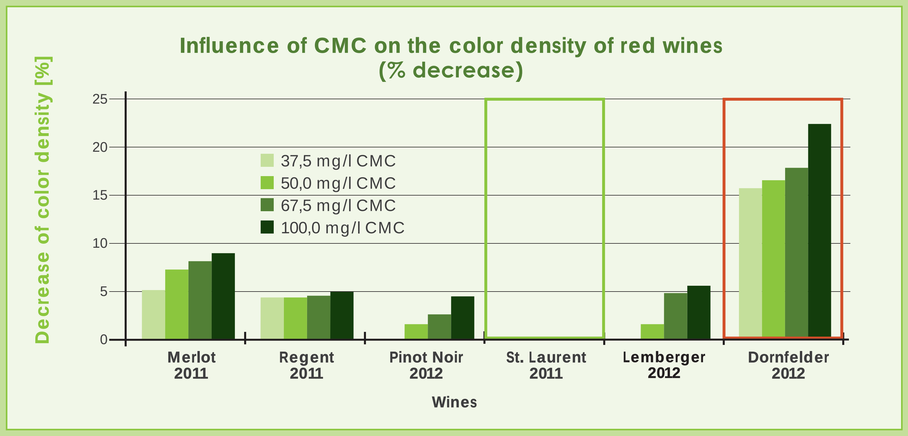

Fig. 1: *Influence of CMC on decreasing color intensity (cf. tab. 1)*

	Merlot 2011	Regent 2011	Pinot Noir 2012	St. Laurent 2011	Lemberger 2012	Dornfelder 2012
Colour density (∑ E420, E520, E620)	10,03	11,4	2,31	6,08	6,05	9,82
Colour hue (420/520nm)*	0,79	1,04	0,95	0,8	0,58	0,58
Phenol content (mg/mL)**	1,91	3,01	0,96	1,64	0,84	1,23
Turbidity (FNU)	0,42	0,9	1,36	0,62	1,48	0,8
Turbidity (FNU) after Heattest 4h; 80°C	2,7	7,85	7,08	0,71	2,33	185,4

*<0.8: velvet; 0.8 - 1.2: red; > 1.2 orange-red; **Ferulic acid equivalents

Tab. 1: *Relationship of color intensity, phenol contents and protein stability of red wines.*

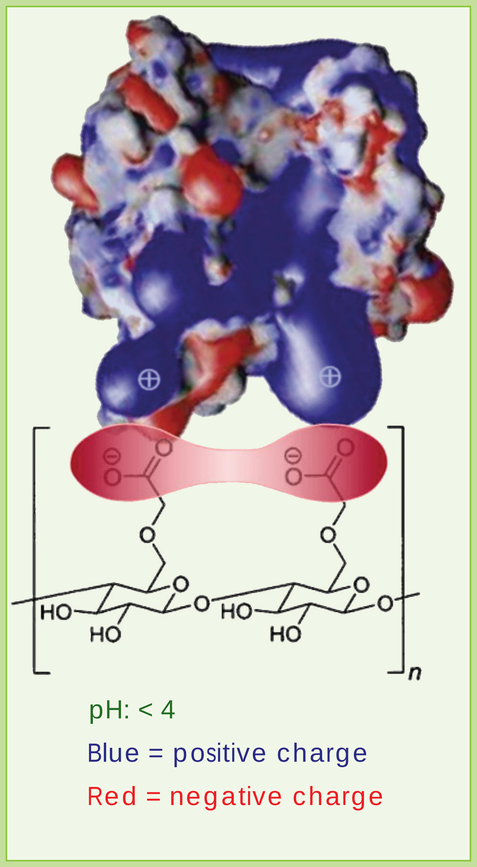

Fig. 2: *CMC-thaumatin complex: formation by attraction of different charges.*

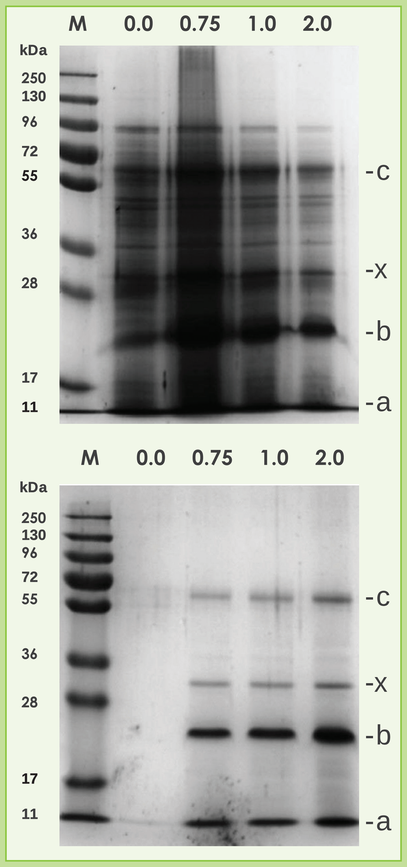

Fig. 3: *SDS PAGE (12,5%) of the precipitate formed in a Dornfelder red wine after addition of different CMC concentrations (VinoStab: 0, 0.75, 1.0 and 2.0 mL/L).*

Above: untreated crude wine.

Below: wine clarified by centrifugation (9000 g); Gels were stained with Coomassie Blue.

M: protein molecular size standard.

a: Lipid transfer protein 1;

b: Thaumatin-like protein;

c: Vacuolar invertase;

x: size corresponds to a β-1,3 glucanase of S. cerevisiae

Results and discussion

The haze formation coincided with a high-color density and protein instability of the wine. The insoluble fraction contained pathogenesis-related or late vintage wine proteins. Carboxymethyl cellulose is of value for tartrate salt stabilization in red wine. Occasionally, it promotes development of protein haze and color loss. At a first glance, this behavior appears to limit the oenological suitability of CMC, but it might also be considered as a new tool to remove unstable wine proteins. The results indicate the conditions under which red wine turbidity is triggered by CMC. Thus, they are important for the elaboration of recommendations for the optimal use of the polymer.

General aspects

1) Independently of CMC treatment, glycosylated proteins are precipitable.
2) Molecular weight (range) of CMC sensitive proteins: 10-100 kD.
3) Polyphenols, anthocyanins and tannins are also sensitive to CMC.
4) Most susceptible to CMC are thaumatin (cf. fig. 2), LPT1 (lipid transfer protein) and invertase. (Mainly proteins of the immune defense of plants in consequence of fungi infections).

Reference

[1] Claus H, Tenzer S, Sobe M, Schlander M, König H, Fröhlich J (2014) Effect of carboxymethyl cellulose (CMC) on protein and color stability of some red wines. Australian Journal of Grape and Wine Research, AJGWR; 20:186-193