Characterisation and Oenological Interest of Nine Commercial Bentonites

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CHARACTERISATION AND OENOLOGICAL INTEREST OF NINE COMMERCIAL BENTONITES

Salazar F.N.*[a], Silva C.[a], Marangon M.[b], Quiroz W.[c], Lobos M.[d], Lira E.[e], López F.[e]

[a]Facultad de Rescursos Naturales, School of Food Engineering, Pontificia Universidad Católica de Valparaíso, Waddington 716, Valparaíso. Chile. E-mail: fernando.salazar@ucv.cl
[b]The Australian Wine Research Institute, P.O. Box 197, Glen Osmond, SA 5064, Australia
[c]Laboratorio de Química Analítica y Ambiental, Instituto de Química, Pontificia Universidad Católica de Valparaíso, Av. Universidad 330, Valparaíso, Chile
[d]Facultad de Ciencias, Universidad de Valparaíso, Departamento de Química y Bioquímica, Universidad de Valparaíso, Av. Gran Bretaña 1111, Valparaíso, Chile
[e]Departament d'Enginyeria Química, Facultat d'Enologia, Universitat Rovira i Virgili, Avinguda dels Països Catalans 26, Tarragona, 43007, Spain

INTRODUCTION

Bentonites are hydrous aluminium silicates belonging to the montmorillonite group (Fig. 1). The brute formula is: Si4 (Al (2-x) R x) (O10, H2O)(Cex, nH2O) or Si4(Al(2-x)Rx)(H2O)n **[1]**.

Information on elemental composition and technical properties of commercial bentonites can be not accessible in the literature or provided by the manufacturers. Bentonite addition may influence the elemental composition of the wine and affect its sensory properties, legal quality and health safety **[2]**.

The aim of this work was to study the release and removal of elements from commercial bentonites to wine by using inductively coupled plasma optical emission spectrometry (ICP-OES). Fining trials were performed using a Chardonnay standard wine and nine types of bentonite added each at three different rates. The structure and morphology of the bentonites were determined by BET method and X-ray diffraction, respectively. The technological efficiency of bentonites was evaluated by measuring the amount of protein removed, the residual protein instability of the wine, and their settling capacity.

The elemental composition of the bentonites studied showed concentrations of Fe and Al above the OIV specifications, while As was below the OIV limit in only one bentonite sample **[1]**.

The element analysis classified the commercial bentonites as sodium, calcium and sodium-activated calcium which is not agreement with the reported by the manufacturers to all case. It was also demonstrated that the use of commercial bentonites in white wine affect the elemental composition of the wine.

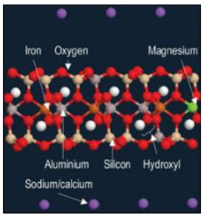

Fig. 1 The crystal lattice structure of Montmorillonite.

MATERIALS & METHODS

Bentonites and wine samples: Fining trials were performed using nine types of bentonite (Fig. 2) added each at three different rates (50, 100 and 200 g/hL) to a Chardonnay standard wine vintage 2012 from Casablanca valley, Chile. All the bentonites were water hydrated at 5% (p/V) for 24 hours before use.

Elements analysis: The determination of elements in bentonite, wine sample and treated wine was done by using inductively coupled plasma optical emission spectrometry (ICP-OES) and specifically by atomic fluorescence spectrometry to As case.

Physical properties of bentonites: The surface properties of the bentonites were studied with Brunauer-Emmett-Teller (BET) model adsorption with liquid N using a surface analyzer (Micromeritics ASAP 2000, USA) and assuming a cross-sectional area of 0.162 nm^2 for nitrogen. Before the adsorption measurements were taken, the samples were outgassed under a vacuum of 0.001 mbar at 120 °C. The morphology of the material was studied by X-ray diffraction (XRD) using a nickel-filtered Cu Kα_1 radiation (λ=1.5418 Å) in the 2θ range 10-70° through a SIEMENS D5000 diffractometer.

Protein content and heat protein instability: The protein content was determined by Bradford's method and the protein stability according to heat test at 80 ° C for 2 h and at 4 ° C for 2 h, with ΔNTU < 2 taken to mean stability.

RESULTS & DISCUSSION

Elements analysis: A total of fifteen elements were detected. The addition of bentonite resulted in an increased concentration of As, Cd, Fe, Mn, Mo, Na, Ni, and Zn in wine, while for Cu and K reductions proportional to the dosage used were observed.

Physical properties of bentonites: An average pore size of 20 Å was observed in all bentonites, while their surface areas presented high distribution, with the sodium-activated calcium bentonite showing the highest (Table 1). X-ray diffraction profiles highlighted the presence of different levels of diffraction patterns, with cristobalite and quartz being the most represented (Fig. 3).

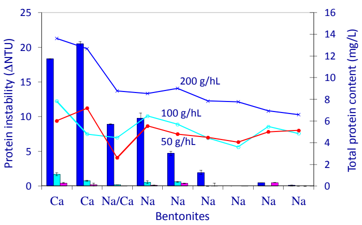

Fig. 2 Capacity of protein removal and protein stability of different commercial bentonites classified according to elements analysis and using different doses.

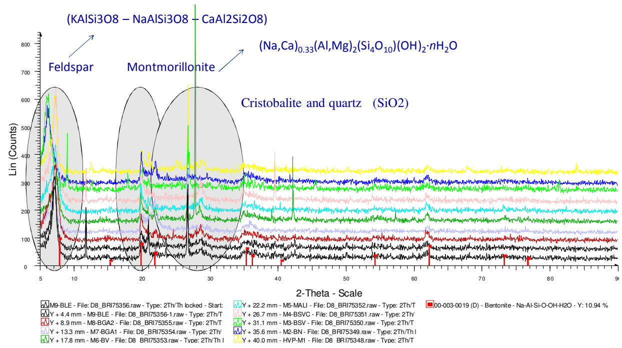

Fig. 3 Power x-ray diffraction of different commercial bentonites

Protein content and heat protein instability: Among the nine bentonites studied, a great variability in terms of protein removal (Fig. 2) and settling capacity (Fig. 5) was observed, with only four bentonites being able to stabilize the wine at 50 g/hL (Fig. 2).

Table 1 Physical properties of different commercial bentonites

SAMPLE*	Area BET (m^2/g)	Pore volume (cc/g)	Half pore width Å
Na	23.483	0.043	18.972
Na/Ca	60.965	0.112	20.758
Na/Ca	63.801	0.078	20.758
Na	27.367	0.077	19.845
Na	32.771	0.070	20.758
Na	26.565	0.070	18.972
Na	57.625	0.129	19.845
Na	28.107	0.069	20.758
Na	44.820	0.073	18.972

* Classification of the bentonites according to the manufacturer information

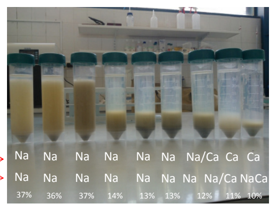

Fig. 4 Swelling property of different commercial bentonites

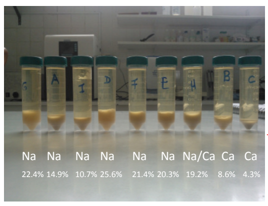

Fig. 5 Wine lees obtained by using 200 g/hL of different commercial bentonites

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