

XIV Encontro de Química dos Alimentos

Indústria, Ciência, Formação e Inovação



LIVRO DE ATAS DO CONGRESSO

6 a 9 de novembro de 2018

Viana do Castelo, Portugal

N. DL: **447939/18**
Nome fornecedor: IPVC - INSTITUTO POLITÉCNICO DE VIANA DO CASTELO
Título: Livro de Atas do XIV Encontro de Química dos Alimentos Indústria, Ciência, Formação e Inovação
Autor: Comissão organizadora
Tipo: Monografia
Editor: Comissão Organizadora
Local de Publicação: Viana do Castelo
Data prevista de publicação (mês/ano): 11/2018
Nº de Edição: 1ª edição
Estado: Atribuído
Atribuído em: 2018-10-29
Criado a: 2018-10-29

ISBN: **978-989-98936-9-6**

Esta publicação reúne as comunicações apresentadas no XIV Encontro de Química dos Alimentos sob a forma de ata científica. O conteúdo dos textos compilados é da inteira responsabilidade dos seus autores.

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Optimization and development of analytical methods for the determination of new brominated flame retardants and polybrominated diphenyl ethers in chili peppers	102
Estudo dos efeitos da digestão gastrointestinal <i>in vitro</i> e fermentação colónica em extratos fenólicos e bioatividades de <i>Rosmarinus officinalis</i> L.	106
Determination of benzoic acid and sorbic acid in foodstuffs by high performance liquid chromatography with UV detection.....	111
Evaluation of natural extracts as potential enzymatic browning inhibitors	116
Impact of addition of pomegranate peel extract and high-pressure on carrot juice preservation: quality, safety and sensorial aspects.....	120
Use Of Digital Image Analysis For Monitoring The Ripening Of Pdo Serpa Cheese	125
Effect of shoot maturity and different withering duration on the catechins and xanthines contents of tea from Azorean <i>Camellia sinensis</i>	127
Variability of catechins and xanthines contents on tea from different parts of Azorean <i>Camellia sinensis</i>	131
Maximização da extração de antocianinas de <i>Hibiscus sabdariffa</i> por diferentes métodos para obtenção de corantes alimentares	135
Quantification of L-theanine in Azorean green and black tea: psychoactive amino acid with beneficial impact on cognitive functions	139
Avaliação do perfil fenólico de duas plantas comumente utilizadas na medicina tradicional, após aplicação de irradiação ionizante	143
Gastrointestinal Absorption of Anthocyanins: A Molecular Approach.....	147
Physical and Chemical Characterization of Anthocyanins from Purple-Fleshed Sweet Potato..	150
<i>Gomphrena globosa</i> L.: otimização do processo de extração de corantes, avaliação da sua atividade antimicrobiana e incorporação numa matriz alimentar	154
A multi-spectroscopic and thermodynamic study on the interaction of food polyphenols with gluten reactive peptides: from chemistry to health implications.....	158
Interação de uma mistura de procianidinas com saliva humana de diferentes indivíduos	161
Incorporation of <i>Spirulina</i> and <i>Himanthalia elongata</i> algae in integral pasta: a real protein meal	165
Detection of γ -glutamyl-S-ethenyl cysteine in <i>Vicia narbonensis</i> L.: improvement of the extraction process	170
Functional bioactivity value of <i>Fucus spiralis</i> from two different Azorean Islands	174
Seasonal variation in the biochemical composition of Azorean <i>Fucus spiralis</i>	179
Avanços dos sistemas alimentares integrados com o ambiente	184
LIGNIN nanoparticles loaded with bluish pyranoanthocyanin pigments. Increased stability in aqueous systems.	185
Phenolic profile of different <i>Cichorium spinosum</i> L. ecotypes.....	189
Composição nutricional e atividade antioxidante de macroalgas vermelhas provenientes de aquacultura sustentável	193
Effect of ion exchange resins on white and red wine pH: Impact on wine sensory characteristics	197
Tartrate stabilisation of rosé wine using ion exchange resins: Impact on wine sensory characteristics.....	201
Aplicação em waffles de um corante natural obtido de frutos de <i>Arbutus unedo</i> L.	205
<i>Coix lachryma-jobi</i> : A new promising cereal as functional food with important nutritional value	209
Increased accumulation of anthocyanins in vine stems upon chitosan application: alternate use of winery waste produce to extract natural colour additives for the food industry	213
Variedade portuguesa de maçã “Bravo de Esmolfe” como fonte de compostos bioativos com propriedades antioxidantes e antibacterianas	217

Effect of ion exchange resins on white and red wine pH: Impact on wine sensory characteristics

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Keywords: White wine; red wine; pH; acidity; ion exchange resins; sensory quality.

ABSTRACT

The pH control during winemaking is a fundamental parameter by their influence on colour, freshness and to achieve wine microbiological stability. The application of ion exchange resins for wine acidification is based on ability of exchanging ions fixed on functional groups, namely by exchanging cations, such as potassium, with hydrogen ions. Nevertheless, there is an important lack of knowledge on the impact of this operation on wine sensory characteristics. Therefore, the aim of this work was to evaluate the effect of cation exchange resins, on wine pH control and to evaluate their impact on wine sensory quality at industrial scale. In this study a white and a red wine, both from the Douro Valley demarcated region, 2015 vintage, were used. The ion exchange resin treated wine was almost 20% from total white wine volume and almost 30% from total red wine volume. The results obtained in the present study indicated that there were no considerable changes in sensory attributes, although a slight improvement in the aroma and taste, as a result of the ion-exchange pH adjustment. Therefore, the application of ion exchange resins process to wine could be an interesting tool for white and red wine pH adjustment, without interfering with wine sensory quality.

1. INTRODUCTION

Wine pH and acidity control during winemaking is vital for maintaining the wine quality during storage. The most common acidify correction performed in wineries is addition of natural tartaric acid; however, in some cases, this operation increases the risks of potassium bitartrate precipitations [1, 2]. Resin-based ion exchange have been investigated to adjust wine acidity and pH since the 1950s [3]. However, ion-exchange resin technology is accepted for the wine pH reduction only from 2000, according to the OIV Resolution 43/2000 [1]. The most use ion exchange resins involves cation-exchange resins in the hydrogen form, for increasing acidity and removing potassium from wine. To adjust wine pH, a certain amount of treated wine by ion exchange resins is mixed with the untreated wine [4]. According to OIV [5], treatment must not lower the wine pH below 3.00 and the decrease should not exceed 0.30 pH units. Anion exchangers are not allowed by the OIV [3] due to the negative effects on the wine sensory quality [6, 7]. So, the aim of this study was to evaluate, at industrial scale, the effect of cation exchange resins on wine pH control and consequently their impact on wine sensory quality, in white and red wine from the Douro Valley Demarcated Region, 2015 vintage.

2. MATERIAL AND METHODS

Wine characteristics: A young white wine and red wine from Douro Valley Demarcated Region, vintage 2015, was used. Chemical characteristics of white wine and red wine were as

follow, respectively: Alcohol content 13.0% and 12.0%, titratable acidity 5.1 g/L and 4.9 (expressed as tartaric acid), volatile acidity 0.27 g/L and 0.38 g/L (expressed as acetic acid) and pH 3.32 and 3.61.

Experimental design: Treatments using cation exchange resins pH-Stab/AEB laboratory, was performed in a winery at industrial scale, being the treated wine almost 20% from the total volume for the white wine and 30 % of the total volume for the red wine. All experiments were run in duplicate.

pH and titratable acidity: Wine pH and titratable acidity (tartaric acid in g/L) were determined according OIV [8].

Mineral composition: Potassium, calcium and magnesium were measured by atomic absorption flame spectrophotometry, according to the methods described by OIV [8].

Sensory analysis: A trained panel of 7 members was used for sensory analysis. Samples were stored at appropriate light and temperature conditions, and were presented to panellists in tasting glasses, marked with three-digit numbers, in a randomised order. Fifteen attributes were selected: visual (*limpidity, colour*), aroma (*aroma intensity, fruity, floral, vegetable, oxidised, chemist*) and taste (*sweetness, bitterness, acidity, flavour intensity, body, balance, persistence*). The attributes were quantified using a five-point intensity scale [9], in individual booths [10] and according to standardised procedures [11].

Statistical analysis: Data are presented as means \pm standard deviation. Physicochemical and sensory data were statistically tested by analysis of variance (ANOVA) using the Statistica 7 software (Statsoft, Tulsa, Oklahoma, USA). Tukey honestly significant differences test was applied ($p < 5\%$) for physicochemical data and Duncan test for sensory analysis data ($p < 5\%$).

3. RESULTS AND DISCUSSION

3.1 Effect of ion exchange resins on white and red wine pH, titratable acidity and mineral composition

As expected ion exchange resin treatment lowered the pH of white wine, namely from 3.32 to 3.10 and the pH of red wine from 3.61 to 3.31 as shown in table 1. Titratable acidity increased, in both wines, after ion exchange resin treatment, as compared to the control wine, due to the increased hydrogen content of the pH-adjusted wines.

Table 1. Titratable acidity and pH of the control wines and wines after cation exchange resin treatment (mean \pm SD).

	White wine		Red wine	
	pH	Titratable acidity (g of tartaric acid/L)	pH	Titratable acidity (g of tartaric acid/L)
Control	3.32 \pm 0.00 ^a	5.10 \pm 0.29 ^a	3.61 \pm 0.00 ^a	4.87 \pm 0.31 ^a
Resins	3.10 \pm 0.00 ^b	6.15 \pm 0.48 ^b	3.31 \pm 0.00 ^b	6.58 \pm 0.08 ^b

Means within a column followed by different letter are significantly different ($p < 0.05$).

Ion exchange resin lowered potassium and magnesium concentration in white and red wine. However, calcium only decreased significantly in red wine treated with ion exchange resin (Table 2).

Table 2. Mineral composition (potassium, calcium and magnesium) of the control wine and wine after cation exchange resin treatment (mean \pm SD).

	White wine			Red wine		
	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)
Control	770.56 \pm 69.64 ^a	22.20 \pm 1.27 ^a	84.22 \pm 0.19 ^a	1092.68 \pm 8.73 ^a	52.15 \pm 2.43 ^a	86.96 \pm 0.36 ^a
Resins	473.43 \pm 24.89 ^b	19.45 \pm 0.92 ^a	71.72 \pm 0.83 ^b	696.93 \pm 1.99 ^b	31.57 \pm 2.42 ^b	51.67 \pm 0.30 ^b

Means within a column followed by different letter are significantly different ($p < 0.05$).

The decrease observed in pH and potassium concentration of both wines indicated that ion exchange resin was effective in exchanging potassium for hydrogen.

3.2 Effect of ion exchange resins on white and red wine sensory characteristics

After white and red wine sensory analyses no significant differences were observed among the wine treated with ion exchange resins and the control, for all the wine attributes evaluated. However, it was observed that the white wine treated with ion exchange resins was more scored for attributes *flavour intensity*, *fruity flavour* and *persistence* and the red wine treated with ion exchange resin was more scored for the attributes *red fruits aroma* and *red fruits flavour* and for the attributes *floral aroma* and *floral flavour* (Figure 1).

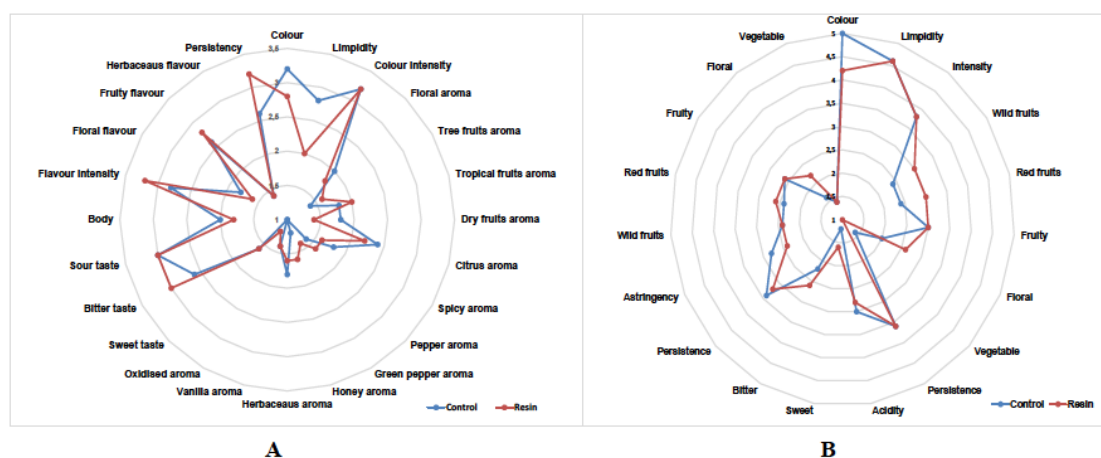


Figure 1. Sensory profile of the white wine (A) and red wine (B) treated with ion exchange resin (red-line) and control wine (blue-line).

3. CONCLUSIONS

Results showed, as expected, that ion exchange resin treatment lowered the pH of white and red wine and consequently increased the titratable acidity of both wines. In both wines, a significant decrease in the potassium and magnesium cations was verified, whereas calcium only decreased significantly in red wine. Sensory analysis revealed that treated wines present identical performance relative to the control wines. So, results from this work showed that the use of ion exchange resin to adjust white and red wines pH could be a good solution for wine industry.

Acknowledgements

This work was funded by the Chemical Research Centre (CQ-UTAD). AEB Bioquímica Portuguesa is also gratefully acknowledged.

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