MICROWAVE TREATMENT OF GRAPES: EFFECT ON THE MUST AND RED WINE POLYSACCHARIDE COMPOSITION

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INTRODUCTION

- Polysaccharides are one of the main groups of macromolecules in red wines which have an important influence on several stages of the winemaking process as well as on organoleptic characteristics.
- Microwave technology (MW) applied to the grape is a technique which can reduce the contact time with pomace because it allows to break the cell walls of the berry.
- Studies found in the literature on the use of MW applied to red wines show that they facilitate the extraction of phenolic compounds during pre-fermentative maceration, but no studies analyzed the influence of MW on the must and red wine polysaccharide content with 3 days of maceration.

OBJECTIVE

To investigate the changes in the composition of polysaccharides in Cabernet Sauvignon musts and wines using microwave treated crushed grape with 3 days of maceration.

MATERIALS AND METHODS

Winemaking process

- Red grapes from *Vitis vinifera* var. Cabernet Sauvignon were harvested at commercial maturity. Grapes were destemmed and crushed and divided into two batches. One batch were microwaved at 700 Watts for 12 min using a domestic LG MJ3965ACS microwave oven (LG electronics, Madrid, Spain). The other batch was not treated to be used as control. The crushed grapes were fermented in in 10 L glass containers maintaining the same pomace solid/liquid ratio and were named as control must (C-M) and microwaved-treated must (MW-M). All treatments were executed by triplicate, all of them with 3 days of maceration. The wines were cold-stabilized, racked and bottled. Samples for analysis were taken in the must (C-M and MW-M) and in the wines at the time of bottling (C-W and M-WW).

Chemical analysis

- Oenological parameters were measured according to the official methods established by the International Organization of Vine and Wine (1).
- Must and wine polysaccharides were recovered by precipitation after ethanolic dehydration as previously described (2, 3). The monosaccharide composition was determined by GC–MS as previously described (2). The content of each polysaccharide family in the must and wine samples was estimated from the concentration of individual glycosyl residues which are characteristic of structurally identified must and wine polysaccharides (3, 4).

RESULTS

Table 1. Oenological parameters of must and wines.

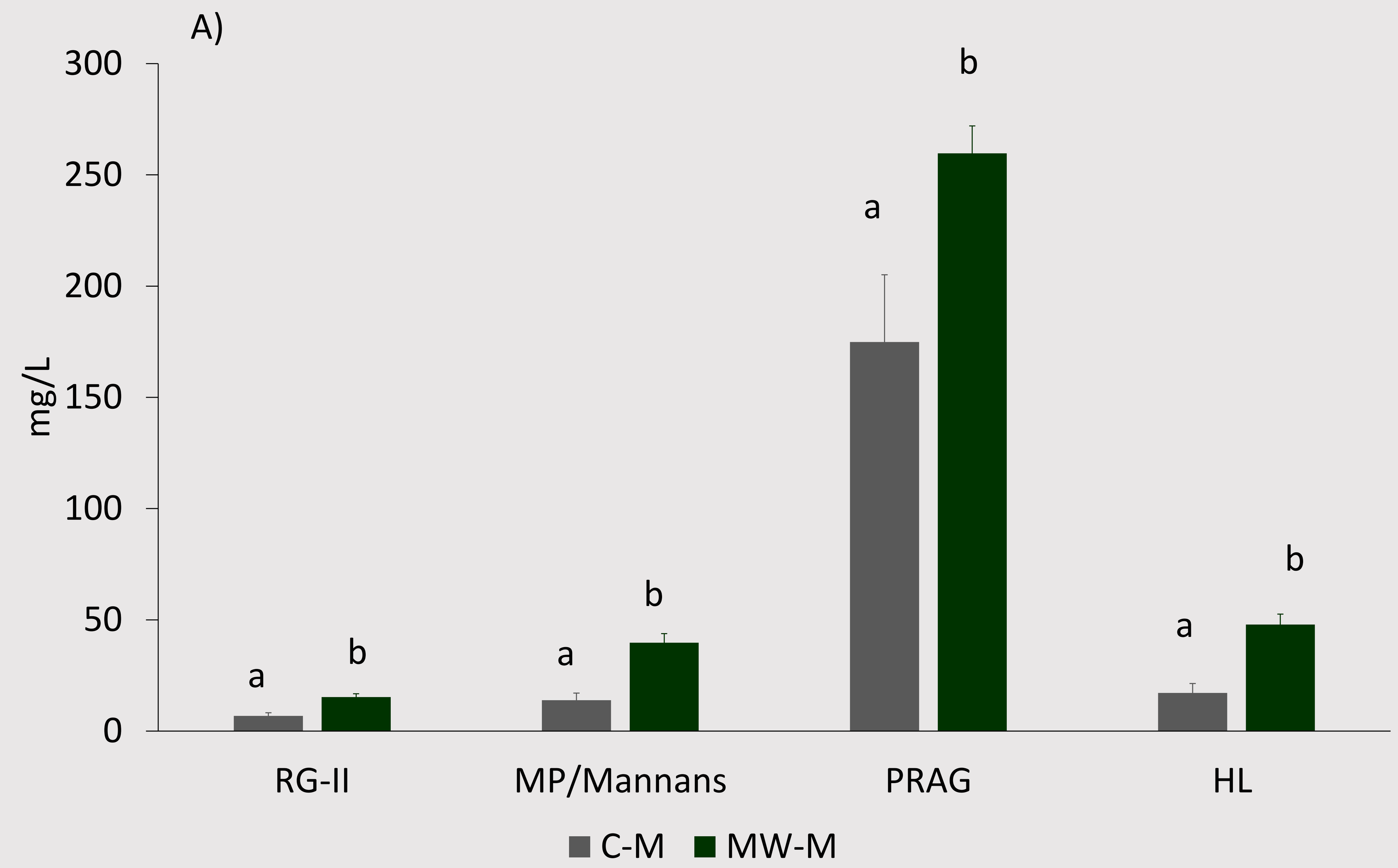
Parameter[a]	C-M[b]	MW-M[b]	C-W[b]	MW-W[b]
pH	3.45 ± 0.02 a	3.55 ± 0.03 b	3.20 ± 0.06 a	3.30 ± 0.04 a
TA	3.35 ± 0.04 a	3.29 ± 0.02 a	8.48 ± 0.61 a	7.88 ± 0.10 a
Brix	24.43 ± 0.06 b	25.00 ± 0.00 a		
Alcohol			12.87 ± 0.06 a	12.73 ± 0.21 a
VA			0.06 ± 0.02 a	0.09 ± 0.01 a
CI	5.51 ± 0.06 a	15.84 ± 0.35 b	13.97 ± 0.76 a	16.16 ± 0.29 b
Hue	1.30 ± 0.02 b	0.85 ± 0.05 a	0.54 ± 0.00 a	0.56 ± 0.00 b
TPI	9.21 ± 0.15 a	17.28 ± 0.23 b	39.55 ± 1.93 a	45.22 ± 0.20 b

[a]TA: Titratable acidity as g sulfuric acid equivalents/L. Alcohol: % ethanol by volume at 20°C. VA: volatile acidity as g acetic acid/L. CI: color intensity as sum of absorbances at 420, 520, and 620 nm. Hue: A420/A520. TPI: total polyphenol index. [b]C-M: control must. MW-M: must from microwave-treated grapes. C-W: control wine. MW-W: wine from microwave-treated grapes. [c]Average of the three measurements. Different letters in the same winemaking stage indicate statistical differences ($p < 0.05$).

Table 2. Monosaccharide composition (mg/L) of polysaccharides

Parameter[a]	C-M[b]	MW-M[b]	C-W[b]	MW-W[b]
2-O-CH_3-Fucose	0.91 ±0.24 a	1.44 ±0.14 b	4.24 ±0.95 a	4.74 ± 0.92 a
2-O-CH_3-Xylose	0.31 ± 0.01 a	1.18 ± 0.15 b	1.94 ± 0.46 a	2.31 ± 0.35 a
Apiose	0.35 ± 0.03 a	0.42 ± 0.02 b	0.93 ± 0.05 a	2.19 ± 1.44 a
Kdo	0.15 ± 0.08 a	0.80 ± 0.12 b	2.33 ± 1.05 a	1.19 ± 0.47 a
Galactose	123.67 ± 16.61 a	143.83 ± 1.65 a	225.58 ± 36.21 a	285.25 ± 35.17 a
Arabinose	39.07 ± 10.18 a	85.90 ± 8.70 b	75.12 ± 10.88 a	79.01 ± 12.70 a
Rhamnose	13.30 ± 4.59 a	24.66 ± 0.52 b	22.08 ± 3.31 a	32.94 ± 18.84 a
Galacturonic acid	25.32 ± 6.33 a	60.83 ± 4.95 b	101.20 ± 17.68 a	109.09 ± 15.09 a
Glucuronic acid	6.13 ± 0.67 a	16.82 ± 1.75 b	15.65 ± 8.80 a	35.60 ± 15.80 a
[1]ΣPectic monosaccharides	209.19 ± 38.74 s	335.88 ± 17.87 b	449.07 ± 73.39 a	552.32 ± 100.78 a
Fucose	1.15 ± 0.64 a	4.05 ± 1.45 b	2.14 ± 1.08 a	2.60 ± 1.30 a
Xylose	6.35 ± 1.82 a	15.49 ± 2.70 b	7.42 ± 1.76 a	12.10 ± 4.14 a
Glucose	1280.92 ± 384.28 a	1765.80 ± 618.03 a	49.02 ± 11.54 a	60.94 ± 16.70 a
[2]ΣGlucosyl monosaccharides	1288.42 ± 386.73 a	1785.34 ± 622.18 a	58.58 ± 14.38 a	75.64 ± 22.14 a
Manose	13.92 ± 3.20 a	39.70 ± 4.14 b	186.26 ± 42.64 a	168.31 ± 23.50 a
Σ1+Σ2+Manose	1511.53 ± 428.46 a	2160.92 ± 641.07 a	693.91 ± 136.41 a	796.27 ± 146.42 a
Σ1+Σ2+Mn-Glucose	230.61 ± 44.20 a	395.12 ± 23.41 b	644.89 ± 124.87 a	735.33 ± 129.72 a

[a]Kdo: 2-keto-3-deoxyoctonate ammonium salt. [1]ΣPectic monosaccharides: as sum of 2-*O*-CH_3-fucose, 2-*O*-CH_3-xylose, Apiose, Kdo, Galactose, Arabinose, Rhamnose, Galacturonic acid and Glucuronic acid. [2]ΣGlucosyl monosaccharides: as sum of Xylose, Fucose and Glucose. Σ1+Σ2+Mn: as sum of pectic monosaccharides, glucosyl monosaccharides and Manose. Σ1+Σ2+Mn-Glc: as sum of pectic monosaccharides, glucosyl monosaccharides and Manose and the subtraction of Glucose. [b]C-M: control must. MW-M: must from microwave-treated grapes. C-W: control wine. MW-W: wine from microwave-treated grapes. [c]Average of the three measurements. Different letters in the same winemaking stage indicate statistical differences ($p < 0.05$).



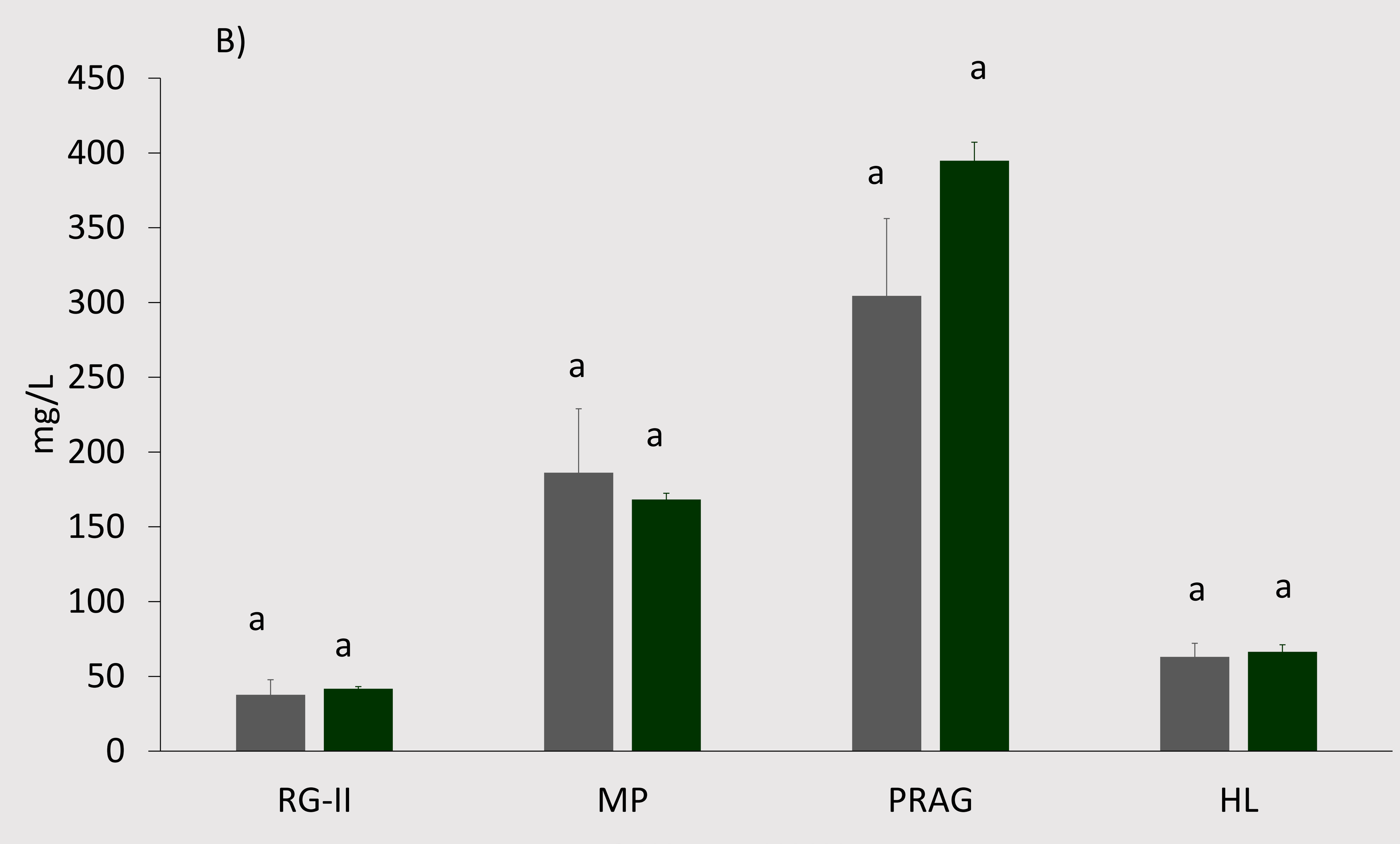


Figure 1. Concentration of rhamnogalacturonan type II (RG-II), mannoproteins (MP) or mannans, polysaccharides rich in arabinose and galactose (PRAG), and homogalacturonans (HL) in musts (A). Concentration of rhamnogalacturonan type II (RG-II), mannoproteins (MP), polysaccharides rich in arabinose and galactose (PRAG), and homogalacturonans (HL) in wines (B). C-M: control must. MW-M: must from microwave-treated grapes. C-W: control wine. MW-W: wine from microwave-treated grapes. Average of the three measurements. Different letters in the same winemaking stage indicate statistical differences ($p < 0.05$).

CONCLUSION

MW improved the breakdown of cell walls of crushed grapes, thereby it significantly increased the content of polysaccharides rich in arabinose and galactose (PRAG), rhamnogalacturonans-II (RG-II), homogalacturonans (HL) and mannans/mannoproteins (MP) in musts. However, its effectiveness was not maintained in wines and no significant differences were observed between the control and MW wines in the content of PRAG, RG-II, HL and MP.

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