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Impact of grape juice press fractioning on polysaccharide and oligosaccharide composition of Pinot meunier Champagne base wines

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Champagne – Pinot meunier – press fractioning – poly- and oligosaccharides

Introduction

The separation of different grape juice fractions during the pressing cycle is an important step in the production of sparkling base wines. A complete pressing cycle for this style of wine is a series of pressure increases resulting in a considerable variation in juice composition during the pressing cycle [1-4]. After alcoholic fermentation, wines obtained from “Cuvées” (first quality) and “Tailles” (second quality) grape juices also exhibit strong differences for several oenological characteristics such as pH, total acidity, and tartaric acid level. These parameters change from a wine produced with a grape juice originating from the heart of the flesh to a wine produced with the juice released at the end of the pressing cycle. Nevertheless, the impact of the pressing cycle on wine oligosaccharide fraction (OS) and wine polysaccharides (PS), implicated in wine foaming properties [5-8], has never been studied at industrial or laboratory scale. The aim of this study performed on Pinot meunier wines (vintage 2013) was to better understand wine OS and PS composition and change along the 3h30 pressing cycle.

Materials and methods

Grape juices and white base wines

Eleven Pinot meunier grape juice fractions (Champagne region - France) were collected during the pressing cycle (8000 kg pneumatic press). The eleven fractions (AP = autopressing, S = squeeze juices and R = return juices) were vinified separately in 1.5-L bottles. Wines were sulfited (+ ullage) after alcoholic fermentation to avoid malolactic fermentation, centrifuged (17000 g, 10 min), stored one month at cellar temperature + 2 months at 4°C and finally filtered to remove insoluble colloidal particles and tartrate crystals.

Isolation of polysaccharide and oligosaccharide fractions

Wine polysaccharides and oligosaccharides were isolated by high resolution size-exclusion chromatography on a Superdex-30 HR column as previously described [9].

Sugar composition of oligosaccharide fractions

The neutral and acidic glycosyl residues of wine oligosaccharides were determined after acidic methanolysis with anhydrous MeOH containing 0.5 M HCl (80°C, 16 h), by gas chromatography (GC) of their per-O-trimethylsilylated methyl glycoside derivatives as previously described [10].

Polysaccharide analysis and concentration

Neutral monosaccharides were released after hydrolysis of the wine polysaccharides by treatment with 2 M trifluoroacetic acid (75 min at 120°C) [11]. They were then converted to the corresponding alditol acetate derivatives by reduction and acetylation and quantified by GC analysis.

The polysaccharide composition of each wine was estimated from the concentration of individual glycosyl residues, as determined by GC, and did not differ from previously described wine polysaccharide compositions [12].

Results and discussion

The changes in total PS and OS were monitored for the 11 Pinot meunier Champagne base wines (Figure 1). The results show significant changes in PS base wine composition and concentration as the pressing cycle progressed. For the total polysaccharides, we determined a concentration of 282 mg/L in the base wine corresponding to pressing cycle beginning. This concentration decreases by 40% (167 mg/L) at the last step of the pressing cycle.

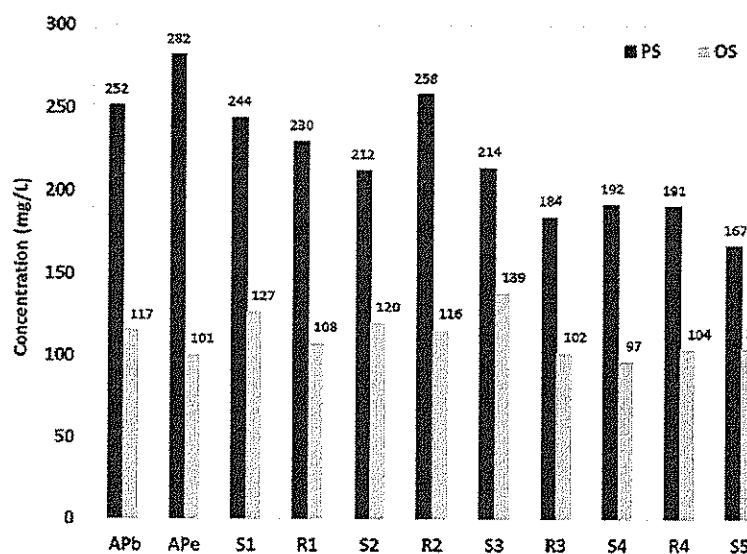


Fig. 1 - Changes in total polysaccharides (PS) and oligosaccharides (OS) of Pinot meunier Champagne base wines elaborated from grape juices collected during the press fractioning. AP, autopressing (b, beginning; e, end); S, squeeze juices; R, return juices.

The major wine PS can be grouped into three families: (i) polysaccharides rich in arabinose and galactose (PRAGs) from the cell wall of grape berry, (ii) those rich in rhamnogalacturonans, mainly rhamnogalacturonan II (RG-II), which comes from the pecto-cellulosic cell wall of grape berry, and (iii) mannoproteins (MPs), released from the yeast during fermentation and on-lees aging. The concentration of MPs, PRAGs and RG-II in Pinot meunier Champagne base wines is shown in Figure 2. A wide variation of concentration of the four major glycosyl residues of the total polysaccharides, namely glucose, arabinose, galactose and mannose, was observed. In Figure 2, we can observe a higher MPs concentration in the base wine corresponding to pressing cycle beginning (106 mg/L) than in the base wines obtained from the different steps of the pressing cycle. This concentration decreases by around 24% (81 mg/L) at the last step of the pressing cycle. Taking into account that the yeast strain was similar in the Champagne base wines studied, the decrease during the pressing cycle of wine MPs might be attributed to initial composition of the must [13] but also to winemaking conditions such vinification temperature.

The concentration of PRAGs significantly decreased, by 52%, in the base wine from the pressing cycle beginning to the last step of pressing cycle (from 146 to 70 mg/L). At the pressing cycle beginning, higher concentration of PRAGs in wine reflected a greater release of this polysaccharide family by berry endogenous pectolytic enzymes in grape juice. The differences observed can be related to differences in maturity stages into the grape berry pulp and the cell wall. In fact, the pH increases and the total acidity decreases in the grape juice from the pressing cycle beginning to the last step of the pressing cycle. That might modulate the extraction of components such PS during pressing cycle. Furthermore, enzymatic degradation or precipitation phenomenon of some PRAGs during vinification, as suggested by previous results [14], could affect their concentration in Champagne base wine.

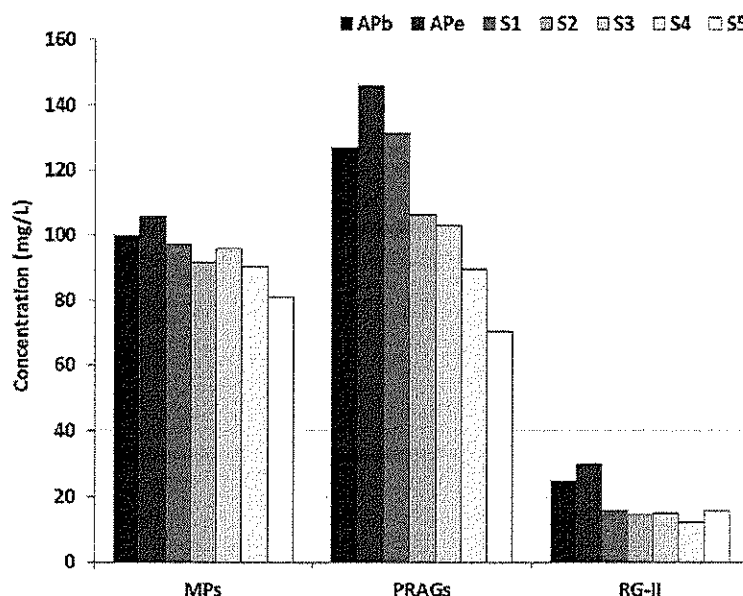


Fig. 2 - Concentration of mannoproteins (MPs), polysaccharides rich in arabinose and galactose (PRAGs) and rhamnogalacturonan II (RG-II) in Pinot meunier Champagne base wines elaborated from grape juices collected during the press fractioning. AP, autopressing (b, beginning; e, end); S, squeeze juices.

On the other hand, the concentration for RG-II was 30 mg/L in the base wine corresponding to pressing cycle beginning. This concentration decreases by 47% (16 mg/L) at the S1 step, and it remains stable until the last step of the pressing cycle. Although RG-II was present in low concentration, this polysaccharide was detected in all Pinot meunier Champagne base wines. These results contrasted with the absence of the RG-II molecule observed in Spanish monovarietal white base wines [7]. These authors attributed this absence to the winemaking process but it could be explained by varietal characteristics or by different maturity stages of grape berries.

The total oligosaccharide amount was calculated as the sum of individual monosaccharide amounts measured by GC. For the total oligosaccharides (Figure 1), we determined a concentration of 127 mg/L in the base wine corresponding to the S1 step. This concentration decreases by 23.8% (97 mg/L) at the S4 step of the pressing cycle. These results reveal, for the first time, changes in OS Champagne base wine concentration as the pressing cycle progressed.

Conclusion

This study is the first report proving that the OS and PS composition and content of Champagne base wines are affected by press fractioning technique. The understanding of release of OS and PS into the grape juice, and during alcoholic fermentation, is a first approach to investigate the effect of these complex fractions on the organoleptic and technological properties of Champagne still and sparkling wines. Further experiments such as “champagnisation” with on-lees aging are needed to complete the impact of press fractioning on polysaccharide and oligosaccharide fraction on Champagne wine quality as foaming properties.

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