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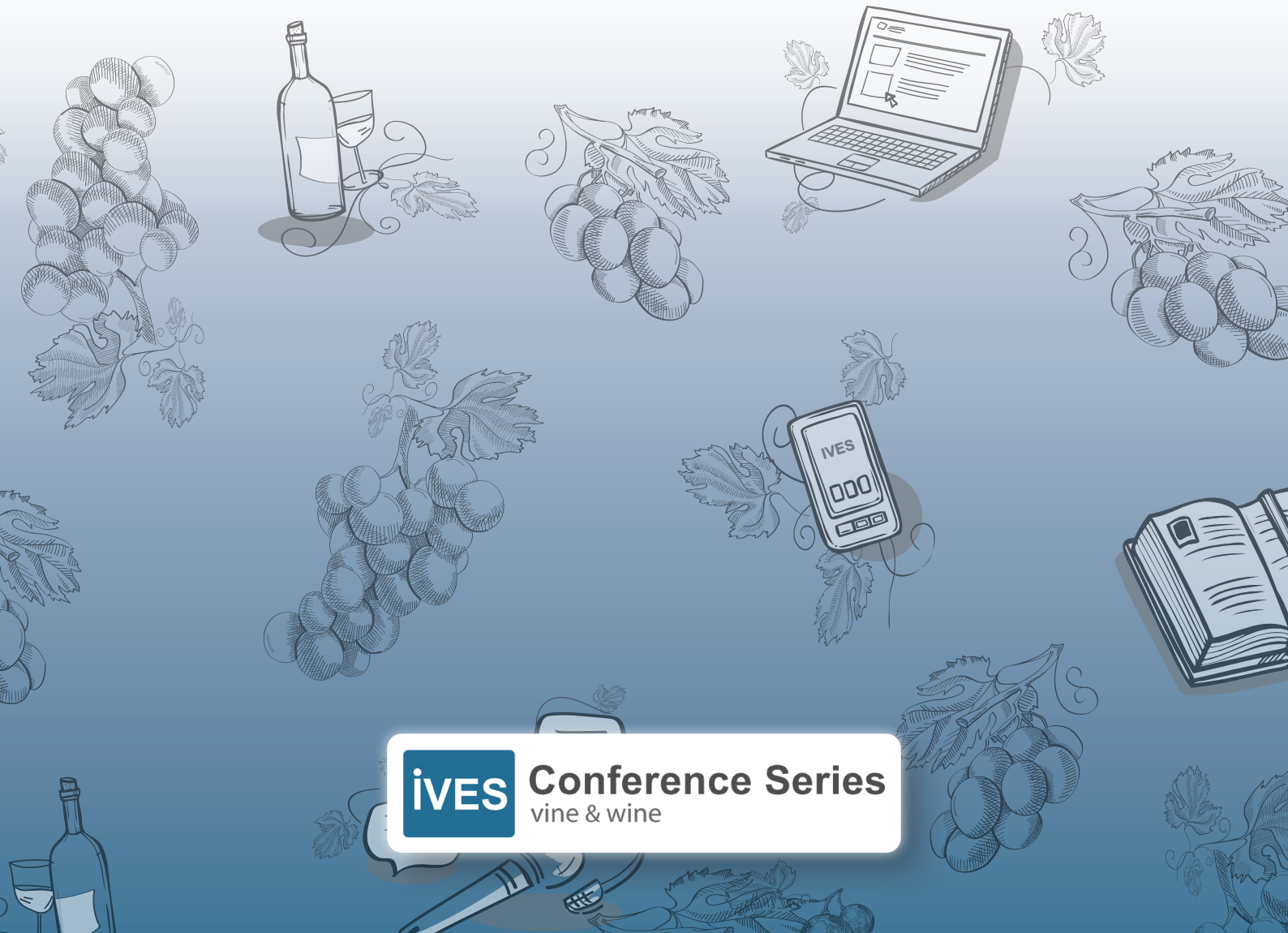
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MACROWINE 2025

24–27 June 2025 • Bolzano (Italy)

Book of Abstracts



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MACROWINE 2025

INFORMATIONS

This book of abstracts is the result of a collaboration between the Macrowine 2025 congress (held from 24 to 27 June 2025 in Bolzano, Italy) and the non-profit International Viticulture and Enology Society. It is available in digital format on the *IVES Conference Series* scientific diffusion platform.

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MACROWINE 2025

Book of Abstracts

24–27 June 2025 • Bolzano (Italy)

EDITORIAL

It is with heartfelt joy that we welcome you to Macrowine 2025. Hosting you here at the NOI Techpark in Bolzano—surrounded by mountains, vineyards, and a deep winemaking tradition—is not only an honour, but also a meaningful moment of exchange and community. Nearly 200 participants from 19 countries have come together to share ideas, findings, questions, and a memorable human experience centred around wine. For many, this will also be the opportunity to discover a new and dynamic wine region, where Alpine landscapes meet centuries of viticultural heritage and forward-thinking innovation.

This is the 10th edition of the Macrowine conference series, and the programme reflects the richness and complexity of the wine world: from the chemistry of aroma to sustainability, from instrumental analysis to sensory perception, and on to the major challenges of tomorrow, such as disease-resistant grape varieties, precision winemaking, and no- and low-alcohol innovations. These are not just scientific topics, but cultural and human ones—deeply connected to our shared identity as researchers, producers, and enthusiasts.

We are proud to welcome outstanding keynote speakers, including Vicente Ferreira, Pierre-Louis Teissedre, Silvia Rocha, Silvia Carlin, and Fulvio Mattivi, who will guide us through some of the most fascinating and timely questions in the field. Equally important are the many oral presentations, flash talks, and poster sessions that showcase the diversity and excellence of current research.

We are also pleased to share that a special issue of *OENO One*, dedicated to Macrowine 2025, has already been published. It represents just the beginning—a calling card—for what promises to be a vibrant and wide-ranging scientific dialogue in the days ahead.

Our warmest thanks go to all who made this event possible: the scientific and organising committees, the administrative staff, the colleagues who submitted their work, the students and volunteers working behind the scenes, the wineries and the professionals who contributed their expertise and support, and of course, each of you—for your presence, your curiosity, and your passion.

Macrowine has always been more than a congress. It is a community—growing, evolving, and looking forward. We hope these days offer you valuable opportunities to learn, be inspired, and create new connections—both scientific and personal.

Welcome to Macrowine 2025. We are truly happy to have you with us.

With warm regards and gratitude,
Emanuele Boselli and Michael Oberhuber (chairs)
on behalf of the Scientific Committee
Macrowine 2025 – Bolzano, Italy

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LECTURES SESSION

KEYNOTE LECTURE

Key learnings about the chemical bases of wine uniqueness and quality, essential companions for future developments

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Keywords: wine uniqueness, wine quality, wine personality, grape secondary metabolism, yeast metabolism, ageing

ABSTRACT

This presentation aims to demonstrate that the value attributed to wine as we today know it is based on three factors: 1) sensory balance, 2) personality, and 3) bioactivity. All three factors have an indisputable chemical basis that can be traced and is essentially related to the secondary metabolism of grape, yeast metabolism, and the chemical processes associated with ageing. In this presentation, this chemical basis will be unraveled point by point, showing the most recent advances and highlighting some of the points that remain unclear. The main corollary is that, if we want our industry to survive while maintaining its essential identity, we must consider how to translate and exploit these aspects in products (wine, non-alcoholic wine, and other new ideas) compatible with the needs and tastes of 21st-century societies.

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KEYNOTE LECTURE

Composition and biological potential of grape and wine phenolic compounds

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Keywords: grapes, wine, oak, phenolics, tannins, anthocyanins, ellagitannins, quality, colour, astringency, bitterness, health effects

ABSTRACT

Polyphenols are common in human diets, primarily in plant-derived food and beverages. They influence multiple sensory properties such as aroma, flavour, colour, and taste, such as astringency and bitterness [1]. The major phenolic compounds in grapes and wines are anthocyanins and tannins (proanthocyanidins or condensed tannins). Tannins are water-soluble phenolic compounds with a molecular weight of 500–3000 Da that can precipitate alkaloids, gelatine, and other proteins. Proanthocyanidins form a considerable portion of the tannins found in wine and in particular contribute heavily to the colour and flavour of red wines. Proanthocyanidins are high-molecular-weight polymers formed from flavan-3-ol monomeric units. Several oligomers, dimers, trimers, tetramers, and pentamers, exist. Tetramers or greater of these flavonols are known as polymeric proanthocyanidins and the astringency of the molecule increases with size. Oligomeric proanthocyanidins are less astringent, bind less strongly to proteins, and are more soluble [2]. A new subfamily of condensed tannin with an unusual skeleton, named crown procyanidins, have been reported [3]. Furthermore, the sensation of astringency caused by tannins is a direct function of their mDP and galloylation percentage [4]. Anthocyanins are glucoside of anthocyanidins. Anthocyanins are differentiated by the degree of hydroxylation and methylation, and also by the nature of the Oses bound to the molecule. Anthocyanidin is the chromophore moiety of the pigment. Acetylglucoside and cinnamoylglucoside anthocyanins have lower perception thresholds than the glucoside fraction at concentrations found in wines [5]. Descriptors associated with these fractions were bitterness and astringency. Anthocyanins also make a sensory contribution to the perception of wine, correlated with the acetylation of molecules. The presence of *C*-glucosidic ellagitannins in wines and spirits is due to their presence in wood species such as *Quercus petraea*, *Q. robur* and *Q. alba*. The main *C*-glucosidic ellagitannins extracted by wines during ageing in oak barrels are continuously transformed through condensation, hydrolysis, and oxidation reactions. Phenolic compounds are known to have health benefits, such as a chemopreventive role toward cardiovascular, cancer, and degenerative diseases, as well as pathologies with inflammation. Therefore, wine and grape pomace constitute an abundant source of a wide range of polyphenols, and are sources of antioxidants for nutrition and health.

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KEYNOTE LECTURE

Taking advantages of innovative chemometric tools to unveil vineyard ecosystem dynamics: look across volatile secondary metabolites

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Keywords: grapes, volatile secondary metabolites, GC × GC-TOFMS, chemometrics

ABSTRACT

Sustainable viticulture and winemaking continue to represent huge challenges, where a better knowledge about the functional role of biodiversity in the vineyard ecosystems is required. Particular attention should be devoted to the spatial and temporal interactions between varieties for a specific demarcated region and clime and vineyard conditions. Taking advantages of chemometric tools, this talk aims to provide advances to examine interactions between climatic conditions, vineyard ecosystem and physicochemical data, namely data from parameters related with grape technological maturity state and secondary volatile metabolites, associated to grapes aroma potential. High volume of information from high throughput technologies, namely from comprehensive two-dimensional gas chromatography (GC×GC-TOFMS) used for volatile fraction characterization, were selected. All the data are intrinsically correlated and generally produced by another multivariate set of factors or continuous variables, collected in what is defined as the design matrix. Such design factors usually involve the presence of a treatment, but other sources of biological or technical variability in the data are often measured as well. The ASCA framework, based on ANOVA and PCA, leads to promising results [1]. Also, Common components and specific weights analysis, has been reported as a chemometric method for dealing with complexity of food products [2]. Thus, on this talk it will be discussed the applicability of several chemometric tools, particular focus will be done on innovative approaches that combine data sets with fixed and random effects. As case study, it was selected a set of varieties cultivated in Bairrada Appellation (Portugal), collected across five consecutive years. Combination of linear mixed models with Principal Component Analysis (LiMM-PCA) was applied to analyse the impact of three factors, harvest, grape variety and vineyard on a set of several physical-chemical parameters. LiMM-PCA allowed to analyse dataset with underlying design, which included both fixed (harvest and cultivar) and random (vineyard) factors. The vineyards selected for sampling were considered representative of the Appellation. Thus, considering the vineyard as a random factor permitted to draw conclusions about the Appellation under study as a whole. In addition, the approach used enabled the ranking of variables importance and the assessment of the adaptability of each variety, providing a high-value tool for supporting vineyard and wine production management, amid current climate challenges.

ACKNOWLEDGMENTS

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KEYNOTE LECTURE

Exploring the presence of oligopeptides in wines into identify possible compounds with *umami* or *kokumi* properties

Fulvio Mattivi[1,*], Daniele Perenzoni[1], Luca Dellafiora[2], Florinda Perugino[2,3], Urska Vrhovsek[1], Gianni Galaverna[2], Paola Piombino[4], Raffaele Guzzon[1], Elisabetta Pittari[4]
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Keywords: wine, oligopeptides, *umami*, *kokumi*

ABSTRACT

Umami is defined as a pleasant and savory taste derived from glutamate, inosinate and guanylate, which are naturally present in meat, fish, vegetables and dairy products. The term «kokumi» refers to a complex flavour sensation, characterized by thickness, fullness and continuity. In the food sector, it has been associated with small oligopeptides. This sensation is important in determining the taste, aroma, flavour and aftertaste quality of a wide variety of foods. The presence of monosodium glutamate induces kokumi sensations and palatability in foods containing kokumi and basic taste substances. Surprisingly, the presence of kokumi compounds in wines has so far been almost completely ignored and has concerned only glutathione. Also, the combined role of glutamate and kokumi substances in wine has not been explored to date.

A targeted metabolomic method based on ultra-high performance liquid chromatography-mass spectrometry (UHPLC-MS/MS) capable of quantifying both amino acids and oligopeptides in wines has been developed and validated, confirming the presence of 50 oligopeptides in Trentodoc sparkling wines, most of which were previously unexplored [1]. The *in silico* analysis of peptides, investigated for their capacity to interact with the so-called Calcium Sensing Receptor (CaSR), the protein required to trigger kokumi sensations [2], highlighted the presence of 8 dipeptides and 3 tripeptides as potential kokumi compounds. This novel *in silico* approach has indeed the potential to identify new potential kokumi tasting sequences.

These putative kokumi compounds were ubiquitous in a representative sample of Trentodoc classic method sparkling wines, with a mean concentration of kokumi oligopeptides of 19.8 mg/L, ranging from 9.1 to 33.3 mg/L. Half of the sparkling wine samples analysed also contained glutamic acid at concentrations equal to or above the suggested threshold for umami taste in wine, i.e. 48 mg/L [3].

Sensory testing of wine oligopeptides is still ongoing, with encouraging results for the first dipeptide tested, Gly-Val [1]. Preliminary laboratory-scale fermentation tests have shown that the oligopeptide profile in wines is matrix-specific, i.e. linked to the starting matrix, which seems to determine the pattern and quantity of peptides produced under the action of yeasts.

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KEYNOTE LECTURE

Crafting wine's signature: exploring volatile compounds from terroir to aging

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Keywords: volatile compounds, grape origin, accelerated aging, wine evolution

ABSTRACT

The unique characteristics of terroir play a fundamental role in shaping the identity and quality of wines, influencing the aromatic complexity of young wines and their long-term aging potential. The volatile compounds responsible for these aromas are crucial to identifying and appreciating a given wine. Determining the best location for each grape is becoming increasingly difficult in the context of climate change. Agronomic practices [1] and appropriate clone selection can help winemakers maintain the desired aromatic trait when optimal placement is impractical. Some examples of sparkling and peppery wines illustrate the specific characteristics of terroir and grape. [2, 3].

Many decisions are then made by the winemaker in the cellar. One of these is which wines to intend to become a reserve. Several complex reactions occur during the aging of the wine in the bottle. In the case of classic method sparkling wines, the wine can improve its qualities during aging for decades until the moment of disgorgement. Selecting sparkling wine bases to create the cuvée for refermentation is one of the most challenging steps in producing the classic method. A deep understanding of the interaction between terroir and winemaking is essential, as the unique characteristics imparted by the vineyard influence the potential of each base wine. The questions we intend to answer include predicting which wines have the highest potential to evolve into fine reserves, the possibility of preserving the floral aroma of some aromatic wines over time, and finally, the influence of packaging on the maintenance of the sensory attributes of wine [4, 5].

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SPECIAL ISSUE

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SPECIAL ISSUE *OENO ONE*

The role of protein-phenolic interactions in the formation of red wine colloidal particles

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Keywords: red wine colloids, protein-tannin interactions, Asymmetrical Flow-Field Flow Fractionation (AF4), colour stability

ABSTRACT

Colloids play a crucial role in red wine quality and stability, yet their composition and formation mechanisms remain poorly understood. Recent studies from the D-wines (Diversity of the Italian Wines) project aimed to elucidate the structure, composition, and formation mechanisms of red wine colloids by analysing monovarietal wines from 10 Italian red grape varieties. Colloid-forming molecules, specifically proteins, polysaccharides, and tannins, were examined in over 100 wines Protein, polysaccharide, and tannin levels varied significantly across the wines [1, 2]. Electrophoretic analysis demonstrated that all proteins in the wines exist as high molecular weight aggregates, likely including tannins. Moreover, the wines could be categorized into two groups based on the mobility of the protein aggregates which seemed related to the quantity of protein-reactive tannins [1]. Asymmetrical Flow-Field Flow Fractionation (AF4) with online multidetection was used to isolate and characterize red wine colloids in their native state, revealing diverse colloidal populations across wines. This diversity was attributed to the varying proportions of proteins, polysaccharides, and phenolics present [3]. A correlation analysis of red wines' compositional data and their colloidal content and structures, as determined by MALS detection, showed that polymeric pigments associated with proteins should be important for red wine colour [2, 4]. Overall, the findings allowed for the proposal of an updated model for colloidal aggregation in red wines, suggesting that this process occurs through the assembly of protein-tannin sub-aggregates and their interaction with polysaccharides. The compactness of these colloidal particles has been linked to the wine protein content, with colloids containing a high protein level being less compact. These findings highlight the central role of proteins in determining red wine colloidal structure and their significance for red wine colour. This work provides an updated framework for understanding how compositional differences among grape varieties, particularly the content of protein-reactive tannins, shape colloidal structures, ultimately impacting key wine quality parameters such as colloidal stability and colour.

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SPECIAL ISSUE *OENO ONE*

Screening of Italian red wines for quercetin precipitation risk index

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Keywords: flavonols, anthocyanins, risk index, red wines

ABSTRACT

Quercetin (Q), a phenolic compound released from grape skins during red wine maceration, has been identified as a source of instability in bottled wines, particularly Sangiovese, due to crystallisation. This phenomenon represents an economic challenge for producers and affects wine clarity and consumer perception. Recent research [1;2] has highlighted the influence of phenolic composition, particularly anthocyanin concentration, on Q stability in model solutions. Results suggest that co-pigmentation phenomena can increase Q solubility, thereby reducing the risk of crystallisation. Based on these results, the aim of this study was to validate these findings in real red wines and to develop a predictive index of Q precipitation risk. We analysed 32 monovarietal red wines from the same harvest that differed significantly in phenolic composition, focusing on the quantification of quercetin glycosides (Q-Gs) and aglycone in the wine bulk and in the sediment when present at different time points. Hydrolysis of Q-Gs occurred in all wines during the first 8 months, but only in 9 wines Q was detected in insoluble precipitates. Considering all wines no clear precipitation threshold could be determined. Partial least squares (PLS) regression showed that the most influential risk categories for the risk of Q precipitation included not only initial Q, Q-Gs, but also pH and tannin content. Our results contribute to a deeper understanding of the factors influencing Q stability in red wines, with implications for producers seeking to mitigate crystallisation problems, with the ultimate aim of providing producers with a practical tool to manage and mitigate precipitation risks.

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SPECIAL ISSUE *OENO ONE*

Effects of Non-Grape Materials (MOG) on wine quercetin composition: insights from synthetic and Merlot grape juice fermentation

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Keywords: quercetin precipitation, Material Other than Grapes (MOG), polyphenols, fermentation

ABSTRACT

Quercetin precipitation has become an increasingly common issue in red wine, often resulting in visually unpleasant sediments and diminished product quality. As mechanical harvesting becomes more widespread, the unintentional incorporation of material other than grapes (MOG), including leaves and stems, during harvest is becoming more prevalent. While MOG is known to influence the chemical and sensory properties of wine [1, 2], its potential role in affecting quercetin concentration and triggering precipitation remains poorly understood. Given that climate change is expected to further exacerbate quercetin instability, investigating the impact of MOG on wine composition has become increasingly relevant. This study investigated the effects of grape leaves and stems, added at 1%, 2%, and 3% (w/v), on fermentation kinetics, polyphenol content, color, and quercetin evolution during alcoholic fermentation in both synthetic and Merlot musts. Grape leaves and stems exerted distinct, dose-dependent effects on wine composition during fermentation. Grape leaves led to a steady increase in quercetin-3-glucuronide and quercetin-3-glucoside during the early to mid-fermentation stages. These levels remained stable in synthetic must but showed a slight decline in Merlot must toward the end of fermentation. Quercetin aglycone gradually accumulated from mid to late fermentation, especially in synthetic must. In contrast, grape stems caused only minor changes in all quercetin forms. Total polyphenol content also increased with both MOG types, primarily during early fermentation. Leaves promoted a stronger and more sustained release in synthetic must, whereas stems contributed to higher final polyphenol levels in Merlot must. Stems also significantly accelerated fermentation compared to leaves. While leaves were the main source of quercetin derivatives, stems notably increased catechin and proanthocyanidin concentrations, especially in synthetic must. In terms of color, leaves enhanced red pigmentation and darkened the wine, while stems reduced color intensity and increased lightness, shifting tonality toward yellow. These findings demonstrate that grape leaves and stems exert distinct, dose-dependent effects on wine composition. Grape leaves promote quercetin enrichment and may increase the risk of precipitation, whereas stems primarily affect fermentation kinetics and catechin concentration. Therefore, careful management of MOG levels is crucial, especially in mechanically harvested grapes and in regions vulnerable to quercetin instability and climate-related variability in wine quality.

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SPECIAL ISSUE *OENO ONE*

Potential of native Uruguayan yeast strains for production of Tannat wine

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Keywords: native-yeast, fermentation, wine, aroma

ABSTRACT

Must fermentation is a complex process influenced by various factors, especially microbiological activities. The characteristics and quality of the resulting wine are closely linked to the stages that unfold throughout this progression. Winemakers usually use pure cultures like *Saccharomyces cerevisiae* to ensure a reliable and complete process. Alternatively, the use of commercial wine yeasts is somewhat controversial, as it may lack certain desirable characteristics provided by natural fermentation. A key challenge is finding non-conventional yeasts that complete fermentation while enhancing a wine's uniqueness, complexity, and appeal. In our previous studies, we isolated, identified, and conducted physiological and biochemical characterizations of indigenous yeasts from Tannat grapes in the Maldonado vineyard (1). Three strains demonstrated notable fermentation properties: *Saccharomyces cerevisiae* T193FS, *Saturnispora diversa* T191FS, and *Starmerella bacillaris* T193MS. In this study, we assessed the oenological potential of these strains at a semi-pilot scale during the vinification of a Tannat must with an expected ethanol content of 11-12%. All three native strains consumed around 98% of the must sugars, resulting in robust ethanol production in the range of 9-11%. Pilot-scale trials highlighted the strong fructophilic character of *S. bacillaris*, which left very low residual fructose levels (0.006 g/L compared to ≥0.01 g/L for the other species) while yielding lower ethanol (9%), a profile beneficial for crafting lower-alcohol wines.

Wines with native strains, stood out for presenting greater fruity notes, especially S. bacillaris, showed enhanced fruity notes like plum, raisins, and candied fruit, linked to higher ester, norisoprenoid, and terpene levels detected by GC-MS. The β-glucosidase activity of these strains was also investigated, as this enzyme enhances aromatic complexity by releasing aroma compounds from glycosidic precursors during fermentation. Given its notably high β-glucosidase activity under acidic conditions of *S. diversa* T191FS, it was subsequently evaluated as a pure starter in Muscat wine fermentation. Volatile compound analysis by GC-MS showed a significant increase in total terpenes compared to the commercial strain *S. cerevisiae* (145 vs. 45 ug/L, respectively). *S. diversa* stood out for its ability to release terpenic varietal aromas.

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SPECIAL ISSUE *OENO ONE*

Transforming winemaking waste: grape pomace as a sustainable source of bioactive compounds

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Keywords: grape pomace, phenolic compounds, antioxidant activity, sustainable valorisation

ABSTRACT

Grapevines (*Vitis vinifera* L.) are plants of great economic importance, with over 80% of grape production dedicated to wine production, yielding more than 258 million hectoliters annually [1]. However, the winemaking process generates a substantial amount of by-products, primarily grape pomace (GP), wine lees, and wastewater, posing serious environmental and economic challenges [2]. Efficient strategies for the sustainable valorisation of these residues are therefore essential. Recent research highlights the potential of grape pomace (GP), which has traditionally been considered as a mere waste, as a valuable source of bioactive compounds [3-5]. With up to 70% of the total phenolic content of grapes retained post-vinification [6], GP valorisation aligns with circular economy principles, presenting innovative and sustainable solutions.

This study investigated the phenolic composition and antioxidant capacity of GP from different grape varieties from the Rhône Valley area of France, including red (Alicante, Syrah, Mourvèdre, Grenache Noir), white (Vermentino, Grenache Blanc, Roussanne, Clairette), and rosé (Grenache Rosé) varieties. Total polyphenol content (TPC) was measured using the Folin-Ciocalteu method, while phenolic profiling—covering phenolic acids, flavonoids (flavan-3-ols, anthocyanins, flavonols, flavones, etc.), and stilbenes—was conducted using HPLC-UV-QqQ. Antioxidant capacity was evaluated through DPPH, ABTS, FRAP, and ORAC assays.

The results revealed significant phenolic retention in GP post-vinification, ranging from 15–35 GAE/g DW in fermented (red) GP and 20–25 GAE/g DW in non-fermented (white, rosé) GP. Fermented GP seeds, particularly from Syrah and Alicante varieties, displayed the highest phenolic content, rich in flavan-3-ol monomers and procyanidins, and exhibited superior antioxidant activity compared to GP skins. Non-fermented GP also demonstrated a notable phenolic profile, with elevated flavan-3-ol and flavonol levels and antioxidant capacities comparable to red GP varieties. Correlations between phenolic composition and antioxidant activity were explored to better understand the functional properties of bioactive compounds.

These findings underscore the potential of GP as a low-cost by-product that can be transformed into high-value polyphenolic extracts for applications in nutraceutical, cosmetic, and food industries.

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SPECIAL ISSUE *OENO ONE*

Convergence and divergence in chemical and sensory profiles of disease-resistant and *Vitis vinifera* white wines from South Tyrol: addressing strategies for market adoption

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Keywords: disease-resistant grape cultivars (DRHGCs), white wine, sensory analysis, chemometrics, chemical profiling, South Tyrol

ABSTRACT

This study investigates the chemical and sensory profiles of white wines produced from disease-resistant hybrid grape cultivars (DRHGCs) compared to traditional *Vitis vinifera* L. cultivars in South Tyrol, Italy. Using advanced metabolomic approaches, including liquid chromatography-mass spectrometry (LC-MS) and comprehensive gas chromatography-mass spectrometry (GC×GC-MS), alongside sensory analysis techniques (modified rate-all-that-applies, mRATA, and projective mapping), the research reveals unexpected similarities between DRHGC and *V. vinifera* wines. While significant differences were observed in specific sensory attributes, such as olfactory notes of 'honey' and 'pineapple', and volatile compounds like 1-hexanol and limonene, these differences were insufficient to clearly differentiate the wine types.

The findings challenge the traditional perception of DRHGC wines as fundamentally distinct from *V. vinifera*, suggesting that market resistance may stem more from consumer unfamiliarity than from intrinsic quality disparities. These results underscore the potential of DRHGCs as sustainable alternatives, providing high-quality wines with reduced environmental impact. Emphasizing the environmental benefits and addressing consumer perceptions could play a pivotal role in enhancing market acceptance.

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SPECIAL ISSUE *OENO ONE*

Comparison of the principal production methods for alcohol-free wine based on analytical parameters

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Keywords: dealcoholized wine, dealcoholization, chemical parameters, thermo and membrane technologies

ABSTRACT

Production, demand, and brand awareness of dealcoholized wine (<0.5% v/v) is steadily increasing worldwide. However, there have been few studies to date investigating and comparing the different physical processes for dealcoholizing wine. This study examines the differences in the analytical parameters of the main membrane and thermal methods currently employed to remove ethanol from wine and produce dealcoholized wine [1-7]. A total of 600 litres of Spanish white wine from the 2023 vintage served as the base. The wine was dealcoholized using leading thermal methods—vacuum distillation, Spinning Cone Column, and traditional distillation. Additionally, it underwent dealcoholization using key membrane techniques, such as osmotic distillation and dialysis, in combination with other methods: reverse osmosis followed by osmotic distillation of the permeate, reverse osmosis paired with dialysis, and reverse osmosis alone to produce an alcohol-free base by adding demineralized water to the retentate before applying dialysis. Each approach was replicated three times to ensure consistency in results. The batches were stabilized post-process with sulphur dioxide and Nagardo®, a natural preservative, before bottling. After one month of storage in bottles, each sample was analysed: colour parameters were measured with a spectrophotometer [8], key minerals were determined using, basic wine parameters assessed via FTIR [9], redox (mV) with ORP sensor, further parameters like total phenols was determinate by Folin-Ciocalteu reagent and spectrophotometer, and acetaldehyde are determined through UV-enzymatic method.

The findings demonstrated distinct variations in key analytical parameters across the different dealcoholization techniques. Membrane-based methods, particularly reverse osmosis combined with osmotic distillation, exhibited superior retention of essential compounds and colour stability compared to thermal processes. In contrast, thermal techniques, such as vacuum distillation and traditional distillation, resulted in significant colour degradation. Advanced analyses using atomic absorption spectrometry, FTIR, and NMR highlighted changes in mineral content and structural components of the wine matrix, underscoring the critical impact of the chosen dealcoholization process on wine quality. Further, the results obtained are extensively discussed in the presentation.

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Single plant oenotyping: A novel approach to better understand the impact of drought on red wine quality in *Vitis* × *Muscadinia* genotypes

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Keywords: water deficit, new varieties, automated fermentation, microvinification

ABSTRACT

Adopting disease-tolerant varieties is an efficient solution to limit environmental impacts linked to pesticide use in viticulture. In most breeding programs, these varieties are selected depending on their abilities to tolerate diseases, but little is known about their behaviour in response to abiotic constraints. In particular, the lack of normalised laboratory scaled fermentation tools hinders an accurate assessment of their potential for wine production, when they are exposed to water scarcity [1,2]. The aim of this study was to evaluate the effect of water deficit on wine analytical characteristics of new disease-tolerant varieties implementing a new design combining single plant phenotyping and oenotyping. Three red fungus-tolerant *Muscadinia* × *Vitis* hybrids (G14, 3176N, Artaban) and Syrah (control) were exposed to a wide water deficit gradient over 5 years (2018-2022) in the field. The objective was to monitor short and long-term effects of drought on water and carbon relations at the plant and fruit levels [3,4,5,6], and evaluate their impacts on wine composition during the last year of experiment. For this purpose, grapes from a selection of plants covering a range of response to drought were individually harvested at physiological ripe stage. They were analysed for their contents in major metabolites (primary and secondary) and cations. 900g were stored in trays and deep-frost for subsequent processing using the Vinimag device. This robotised platform was designed to allow standardised red wine processing [7] at single plant level (T=23°C, YAN=160mg/L). Besides oenological parameters, phenolic compounds (hydroxycinnamic acids, anthocyanins, flavanols) and aromas (thiols and precursors) analysis were performed on wines using UHPLC-DAD and a MS/MS detection for aromas. In complement to the observations reported about the effect of water deficit on grape composition at harvest, this experiment provided a new set of data about post-harvest effects of water stress on fermentation processing and wine composition. Collected data highlighted a negative correlation between field water stress and the mean degree of polymerisation (mDP) of flavanols (catechin and epicatechin mainly), as previously observed on grapes [8]. Along with the mDP, acidity and colour parameters were impacted by plant water status. This study demonstrated the interest of a new approach combining both single plant phenotyping and oenotyping to better understand the impact of plant water stress on red wine quality markers (aromas and phenolic compounds).

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ORAL

Evolution of oak barrels C-glucosidic ellagitannins in model wine solution

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Keywords: oak wood, ellagitannins, aging, organoleptic impact

ABSTRACT

Oak wood has a significant impact on the chemical composition of wine, leading to transformations that influence its organoleptic properties, such as its aroma, structure, astringency, bitterness and color. Among the main extractible non-volatile polyphenol compounds released from oak wood, the ellagitannins are found [1]. The primary ellagitannins are C-glucosidic ellagitannins, like vescalagin and castalagin. Other compounds, including lyxose/xylose derivatives (grandinin, roburin E) and dimeric forms (roburins A, B, C, and D), are also present [2,3]. The ellagitannins possess multiple hydroxyl groups in ortho-positions, facilitating oxidation and condensation reactions with other wine compounds. The hydroalcoholic nature of wine make possible the extraction of these compounds from oak into the wine, but their high reactivity results in lower concentrations than expected in the final wine. In order to observe the compounds transferred from oak to wine, a model wine solution was used, ensuring the absence of microbial activity and preventing contamination from fermenting compounds. A model wine solution was put in two 225 L oak barrels for a period of twelve months to minimize the influence of naturally occurring wine components and microbial interference. The objectives of this study were i) to evaluate the evolution of ellagitannin levels in oak barrels after 12 months of aging, and ii) to analyze their derivative forms using liquid chromatography-mass spectrometry (LC/MS) and nuclear magnetic resonance (1D/2D-NMR). Results showed significant changes in the composition of ellagitannins over time, revealing the formation of new oxidation products and condensation products. The concentration of the eight main C-glucosidic ellagitannins extracted after twelve months of contact with oak wood tend to increase. Ellagitannins monomers (vescalagin, castalagin, grandinin and roburin E) increased drastically in concentration up to 8 months, from 1,93 mg/L to 23,84 mg/L in the case of vescalagin. The dimer concentrations, on the other hand, rise progressively, stabilizing from the 7th month. The derived compounds were observed in oxidative forms, hydrolyzed forms, or as ethanol adducts. Most of these compounds appear within the first months of analysis, initially at low concentrations that progressively increase over time. Nevertheless, the concentrations of certain compounds, for example, the oxidation form resulting from the oxidative solvolysis of vescalagin and β-1-O-ethylvescalagin, remain consistently low even after 8 months of aging. These findings contribute to a deeper understanding of the chemical dynamics between oak and wine, offering insights into the aging process and its impact on the final wine quality.

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ORAL

Quality assessment of partially dealcoholized and dealcoholized red, rosé, and white wines: physicochemical, color, volatile, and sensory insights

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Keywords: color profile, dealcoholization, sensory profile, volatile compound, vacuum evaporation

ABSTRACT

The global non-alcoholic wine market is projected to grow from USD 2.7 billion in 2024 to USD 6.97 billion by 2034, driven by health awareness, lifestyle shifts, and religious factors [1-3]. Consequently, the removal of alcohol can significantly alter the key quality parameters of wine. This study examines the effects of dealcoholization on key wine quality characteristics, including physicochemical parameters, color profile, volatile component composition, and sensory attributes. The study was conducted on three wine types: Merlot red wine (vinified in a 220 L oak barrel for 7 months, 13.15% v/v), Pinot Noir rosé wine (vinified in stainless steel, 12.92% v/v), and Riesling white wine (vinified in stainless steel, 13.13% v/v), all from the 2022 vintage. For each samples two replicated were done. Vacuum evaporation was used to produce both partially dealcoholized (6% v/v) and dealcoholized (<0.5% v/v) wine. Immediately after dealcoholization, the wines were bottled using a heat exchanger in brown glass bottles (without headspace to limit/minimize oxidation) under screw cap closures and stored in a cellar at a temperature of 18–20 °C. The basic wine parameters were assessed via FTIR [4], color profiles were analyzed using a PhotoLab 7600 UV-VIS instrument, the volatile profile was evaluated using GC-MS [5], and wine tasting was conducted by experienced/trained panellists. The results indicated that density, total extract, acidity, and glycerin generally increased with dealcoholization, possibly due to the concentration effect caused by the removal of ethanol. While reducing sugars, pH, and organic acid profiles varied depending on the wine type. Dealcoholization led to a higher color intensity and chroma values, with noticeable differences in lightness (L), redness (a^*), and yellowness (b^*) parameters. Color differences (ΔE) was more pronounced in rosé and red wines compared to white wines. The total volatile compounds significantly ($p < 0.05$) decreased by 89.36%, 91.15%, and 93.74% in dealcoholized white, rosé, and red wines, respectively, compared to the original wine. Furthermore, sensory profile results revealed that the overall acceptability score for partially dealcoholized and dealcoholized white and red wines were similar to that of the respective original wines, while partially dealcoholized and dealcoholized rosé wines were scored lower compared to the original wine. Specifically, the intensity scores for fresh floral, fresh fruity, body/fullness, sweetness, and hotness decreased for all types of dealcoholized wines, while the intensity scores for cooked vegetable, color intensity, and acidity were higher for partially dealcoholized and dealcoholized wines compared to the respective original wines. The experimental findings expand the knowledge of the critical changes induced by dealcoholization and provide insights into maintaining the sensory and chemical integrity of wines during the process.

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ORAL

Understanding aroma loss during partial wine dealcoholization by vacuum distillation

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Keywords: partial dealcoholization, vacuum distillation, aromas, esters, higher alcohols

ABSTRACT

Dealcoholization of wine has gained increasing attention as consumer preferences shift toward lower-alcohol or alcohol-free beverages. This process meets key demands, including health-conscious lifestyles, regulatory compliance, and the expanding non-alcoholic market [1-3]. While traditional winemaking naturally produces alcohol, dealcoholization techniques reduce its content while preserving wine's sensory and chemical integrity. Various methods, such as membrane processes, reverse osmosis, spinning cone column technology, and thermal distillation [4], offer different advantages and challenges, particularly regarding wine volume loss, aroma retention, and overall quality. Among these, vacuum distillation (VD) is promising for partial or complete dealcoholization by operating at lower pressures and temperatures.

This study investigates VD for partial dealcoholization (~2°). First, in a model wine, we analyze the impact of VD parameters—including number of columns, column packing type, and pressure—on aroma variation. Second, we evaluate VD's effect on the chemical composition and sensory profile of white, rosé, and red wines using a selected VD setup.

The analysis of VD in model wine shows that higher alcohols are partially lost in the distillate (59–78% v/v ethanol), with 35% reduction for 2-methylpropanol and 3-methylbutanol, while methanol loss remains minimal (~2%). Aldehydes exhibit higher loss rates, with 60% loss for ethanal and 80% for ethyl acetate. Esters show 74–99% loss, depending on type. Results indicate that pressure significantly impacts aroma retention: lowering the pressure from 150 mbar to 50 mbar enhances ester retention, while 150 mbar increases higher alcohol and aldehyde removal.

In wines, partial dealcoholization (~2°) extracts mostly ethyl acetate (~90%), small amounts of methanol (1–10%), and 20–40% of higher alcohols. Larger esters (C8+ and cyclic esters) are less affected by VD, suggesting their lower volatility helps retain them in the wine, preserving some aromatic complexity. However, 80–100% of short-chain (C2–C4) and medium-chain (up to C6) esters are lost in the distillate, significantly altering the wine's aroma. These esters exhibit high Henry's law constants, explaining their volatility and major impact on wine aroma.

To conclude, even at the early stages of dealcoholization (~2° reduction), most wine aromas are lost in the first distillate fraction, highlighting the challenge of preserving fruity notes while separating them from ethanol.

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ORAL

HPLC-based quantification of elemental sulfur in grape juice

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Keywords: elemental sulfur, HPLC, grape juice, acetone extraction

ABSTRACT

Elemental sulfur is commonly used in vineyards as a fungicide to prevent diseases and protect grapevines.[1] The challenges of climate change are intensifying disease pressure, further increasing the reliance on sulfur use. Understanding the range of potential impacts of residual sulfur during the winemaking process is becoming increasingly important. For example, it is thought that sulfur residues can contribute to the formation of undesirable volatile sulfur compounds (VSCs) such as hydrogen sulfide (H_2S), and methanethiol (MeSH), which negatively affect wine quality.[2,3] Existing analytical methods to measure elemental sulfur in grape and wine samples are laborious and often require large volumes of samples. This study has developed a straightforward HPLC-DAD method for measuring elemental sulfur following a small-scale solvent-based extraction process. The method was subsequently employed in a study investigating the impact of residual elemental sulfur in grape juice, under low and high nitrogen conditions, on the formation of VSCs during fermentation and ageing.

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ORAL

First large-scale study of thiol precursor distribution in red grape berry compartments and implications for thiol-type red wine production

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Keywords: thiol precursors, varietal thiols, red grapes, vinification

ABSTRACT

Climate change and the growing need to reduce the use of phytosanitary products demand the exploration of disease-resistant grape varieties and/or adapted to drought conditions. Integrating data corresponding to red wine quality markers, such as aromas, as early as possible in the varietal selection process, and understanding the extraction and production mechanisms of these molecules of interest, is a major challenge for the wine industry, in order to select varieties with interesting oenological properties. Varietal thiols, namely 3-sulfanylhexan-1-ol (3SH), its acetate (3SHA) and 4-sulfanyl-4-methylpentan-2-one (4SMP) are an important group of aroma compounds responsible for grapefruit, goyava or blackcurrant bud notes in wines respectively. In berries, varietal thiols occurred as odorless S-conjugate precursors to cysteine, glutathione or dipeptide derivatives. Lots of studies have been conducted on thiol precursors of white grapes [1, 2] but data dealing for red grapes are still scarce and even more in the case of interspecific hybrid varieties [3, 4]. The "thiol potential" which refers to 6 thiol precursors (cysteinylated and glutathionylated precursors of 3SH and 4SMP as well as dipeptidic forms for 3SH only) was characterized for 32 red grape varieties cultivated in Occitanie (south of France) in different berry compartments (skin, pulp and seeds) and musts. Finally, the thiol concentration (3SH and 3SHA) was measured in wines produced with those varieties.

In berries, significant differences in the precursor content were observed between the different varieties from 1.1 µg/kg for Xinomavro to 117.9 µg/kg for Pinot Noir. The precursor content was analyzed in the different berry compartments (skin, flesh and seeds) and balanced regarding the relative proportion of each in a whole berry. As for white varieties, the most abundant thiol precursor in berries and must is G3SH for all red studied grapes, independently of the cultivar category (Vitis vinifera, interspecific hybrid). During standardized micro-scale fermentations, thiol precursors are quickly consumed during the first 2 days of AF and corresponding thiols are formed concomitantly. Levels of varietal thiols can pick up to 1556 ng/L for 3176N Bouquet variety to dramatically decrease to levels below to 18 ng/L for Cinsault in all the final wines, highlighting potential trapping of thiols with electrophile species.

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ORAL

Investigating perceptual interactions of fruity aromas in Bordeaux red wines through addition and reconstitution sensory studies

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Keywords: perceptual interactions, red wine, aroma compounds, reconstitution

ABSTRACT

Fruity aromas, characterized by red and black fruit descriptors, are central to the identity of Bordeaux red wines [1,2]. Despite extensive research focused on identifying and quantifying volatile compounds that contribute to fruity aromas in wine, the mechanisms underlying their interactions and sensory perception remain poorly understood [3]. Wine contains more than a thousand volatile compounds from varied origins, which interact within the wine matrix to modify, enhance, or suppress aromatic qualities [1-3]. Consequently, a gap exists in our scientific understanding of these complex sensory phenomena, and this study aims to progress our understanding of perceptual interactions affecting fruity aromas in red wines.

In the first phase, five representative Bordeaux wines from the 2022 vintage were selected for volatile compound supplementations. Individual volatile compounds or families of compounds were added to wines to reach minimum, mean, and maximum concentrations identified in a previous profile of twenty representative Bordeaux red wines. Sensory discrimination was first evaluated by triangular tests using a trained panel, and subsequent evaluations, including descriptive analysis and categorization tasks (e.g., check-all-that-apply), will be carried out to characterize specific olfactory changes.

In the second phase, reconstitution studies further explore perceptual interactions among volatile compounds. Since both volatile and non-volatile components of the wine matrix are known to directly impact sensory perception [1,4,5], dearomatized wine was used as the reconstitution medium rather than hydroalcoholic solutions. Two methods of dearomatization–vacuum distillation and supercritical carbon dioxide extraction–will be compared for their suitability in preserving matrix composition. Then, aromatic reconstitutions involving supplementation and omission tests aim to clarify the role of individual compounds and their interactions related to fruity qualities.

Preliminary results indicate that both the addition and concentration of specific volatile compounds influence wine aroma. Matrix effects are an important factor, contributing to perceptual variations in some wines treated with the same supplementation. Additionally, the perception of racemic linalool compared to R-(-)-linalool differed in several wines but aligned in others, highlighting that both chirality and matrix composition can modulate aroma impact. These findings emphasize the complexity of perceptual interactions in wine and contribute to our understanding of aroma perception.

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ORAL

The capacity of spectrofluorometric fingerprints to discern changes of wine composition: applications in classifying wine additives and tracking red wine maturation and ageing

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Keywords: molecular fingerprint, fluorophore, wine evolution, machine learning modelling

ABSTRACT

Fluorescence spectroscopy combined with chemometrics has shown advantages in wine analysis due to being rapid, sensitive, and selective to fluorescent molecules. Especially due to the abundant phenolic compounds [1], the molecular fingerprints afforded by fluorescence spectroscopy can potentially be used to discern and track the change of wine composition, with two innovative investigations having been implemented.

Processes and additives can be used during winemaking for different purposes, with the overall goal of controlling composition and quality. Regulatory frameworks are imposed but analytical methods are needed to determine aspects such as permitted use of additives, abuse of illegal processes or adulteration, and false label claims [2]. Fluorescence spectroscopy combined with chemometrics is being tested for this purpose, with an investigation of additives and processes. Initial results reveal high classification accuracies of Chardonnay wine treated with nine additives (96.4%) at three levels (95.5%) based on spectrofluorometric datasets and machine learning modelling.

Maturation and bottle ageing are crucial dynamic stages associated with the quality and commercial value of red wine. The capacity of fluorescence spectroscopy to track wines through production [3] or changes in red wine compositions during fermentation [4] have been studied. As a further innovation, the molecular fingerprints afforded by fluorescence spectroscopy have been investigated for monitoring long-term ageing and tracking the dynamic change of red wine to enable the prediction of red wine evolution. To this end, a number of monovarietal red wines have been periodically analysed by fluorescence spectroscopy during maturation and various bottled wines are being regularly studied. Changes in colour, phenolic composition, and sensory properties are also being determined and used for machine learning modelling with the spectrofluorometric datasets to provide understanding that may guide decisions during winemaking and storage.

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ORAL

Impact of yeast strain and aging time on the secondary metabolites, macromolecule composition, and sensory attributes of sparkling wines elaborated by the traditional method

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Keywords: polysaccharides, proteins, volatile compounds, foam quality, sparkling wines

ABSTRACT

The occurrence of aroma and macromolecule constituents in sparkling wines, directly influencing their organoleptic characteristics, is affected by several factors, including the grape cultivar, base-wine particularities, inoculated yeasts, the aging time, and winemaking practices [1]. This study reports the influence of yeast strain and aging time on the chemical profiles and sensory attributes of sparkling wines elaborated by the traditional method over a period of three and twelve months of contact with lees. Two commercial and four selected indigenous *S. cerevisiae* yeast strains were evaluated for their contribution to the correspondent sparkling wines regarding proteins, polysaccharides, and mannoproteins release, foam properties, and volatile composition. Triplicate fermentations were carried out under 13±1°C. HRSEC-RID-DAD was used for macromolecule quantification of the experimental wines, GC-MS was used to evaluate their volatile fraction while foamability and foam stability were determined by the Mosalux method [2-3]. Moreover, the sensory profiles obtained using different yeast strains for secondary fermentation were characterized through the descriptive sensory analysis method by evaluating ten visual, aroma, and in-mouth attributes from an internal trained panel of fifteen experienced judges (aged 25-60 years old) [3-4]. According to the results, autochthonous strains led to a greater release of polysaccharides, proteins, and mannoproteins after twelve months of aging, in comparison with the wines produced by commercial yeasts. Furthermore, the enrichment of the autochthonous ferments in these compounds promoted their foam characteristics, exhibiting the highest foamability and persistence of the foam collar. Data showed a key impact on the concentration of the volatile constituents ($p < 0.05$), depending on the type of inoculated yeast for the second in-bottle fermentation. The three native strains differed from the commercial ones presenting complex volatile profiles in the corresponding sparkling wines, due to the abundance of secondary metabolites after twelve months of aging, especially alcohols and esters. Regarding the sensory analysis results, important differences were observed between the aroma characteristics of wines from the different strains with the indigenous fermented wines exhibiting intense floral and toasty aromas, achieving higher sensory quality. The findings highlight the great potential of indigenous yeast strains to promote the physical, chemical, and sensorial properties of sparkling wines.

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ORAL

Highlighting a link between the structure of mannoproteins and their foaming properties in sparkling wines

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Keywords: mannoproteins, characterisation, foam, bubbles, sparkling wines

ABSTRACT

Effervescence and foaming properties are the main visual characteristics assessed by the consumer during sparkling wine tasting[1]. Moreover, by bringing gas-phase CO_2 and volatile organic compounds in the headspace above glasses, and by bursting in the oral cavity, the myriads of bubbles influence taste, mouthfeel, as well as the perception of sparkling wine aromas during tasting[2]. When the second in-bottle fermentation is achieved, traditional method sparkling wines age on lees for several months up to several decades for the most prestigious cuvees. During aging, traditional method sparkling wines develop desirable organoleptic properties attributed to the proteolytic processes of yeast autolysis[3–5] which may also influence the wine's foaming properties[6]. Due to their structure and composition which favour their adsorption at the gas-liquid interface, mannoproteins released by yeasts during fermentation and aging on lees are well-known foam-active compounds[5–7].

Here, the structure of mannoproteins was characterized, including their protein and amino acid composition, polysaccharides, molecular weight, and charge. In parallel, an innovative carbonation method was developed to assess the foaming properties of a single family of molecules in model sparkling wine solutions. The characterisation of effervescence and foam was carried out, under real tasting conditions, by monitoring several key parameters, including: dissolved CO_2 concentrations (in the sealed bottle and in the glass after serving), collar stability, collar bubble size, degassing kinetics and wine viscosity[2,8]. Finally, the aromatic profile of wines was investigated using measurements of odorous compounds (SPME-GC-MS; esters, DMS, N,S-heterocycles, terpenes)[9] and their precursors, mainly amino acids (HPLC-FLD)[10], complemented by sensory analysis. This combined approach, which consists of determining the structure of mannoproteins, their foaming and effervescent properties, as well as their aromatic characteristics in solutions, aims to offer tailor-made solutions to sparkling wine producers to improve the overall quality and attractiveness of their wines.

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ORAL

Untargeted metabolomics reveals the impact of cork oxygen transfer on non-volatile compounds during red wine ageing

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Keywords: polyphenols, ageing, metabolomics analysis cork OTR

ABSTRACT

During red wine aging, numerous chemical reactions occur, contributing to the modification and enhancement of the wine sensory parameters over time [1]. For non-volatile composition, initial grape or yeast related compounds (*i.e* polyphenols, peptides) decrease during aging as they undergo oxidative and non-oxidative reactions with other wine components to form new compounds [2]. The oxygen transfer through the cork stopper is an important factor that may influence the chemical formation and, thus the evolution of red wines.

The aim of this study was to investigate the change in untargeted non-volatile compounds during the aging of experimental Syrah red wines. These wines were bottled with 4 micro-agglomerated cork stoppers with increasing oxygen transfer rates (OTR) and were stored for a period of 24 months at 17°C in a cellar. Subsequently, an untargeted metabolomic analysis based on high-resolution mass spectrometry (UHPLC-Q-Orbitrap-HRMS) was carried out on the non-aged wines and after the 24 months of ageing [3]. Mass spectral data processing and multivariate statistical methods (PCA, volcano plot) were conducted for classification of samples and identification of discriminant features between young and aged wines.

Unsupervised PCA et discriminant analysis by volcano plot distinguished molecular ions across wine types and ageing times, highlighting CHO and CHON compounds in non-aged wines and increased CHO, CHONS, and CHOS compounds with ageing, especially sulfonated molecules. Polyphenols derivate like pyranoanthocyanins (CHO), emerged as key markers of wine evolution. Our metabolomics analysis highlighted the potential role of specific chemical markers in the impact of cork oxygen transfer rate (OTR) on wine ageing

This research provides us with new insight into the complex chemical changes in the non-volatile fraction (polyphenols, peptides) that occur during the ageing of red wine and highlights the potential impact of cork OTR on wine composition.

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ORAL

Insight on Lugana flavor with a new LC-MS method for the detection of polyfunctional thiols

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Keywords: thiols, ebselen, 96-wells SPE, LC-MS/MS, Lugana

ABSTRACT

The analysis of polyfunctional thiols in wine is challenging due to their low abundance and instability within a complex matrix. However, volatile thiols are highly aroma-active, making their accurate quantification in wine at low concentrations crucial [1].

This work aimed to develop and validate a modern, high-throughput analytical method for detecting the most important thiols reported in literature. This led to a rapid preparative process involving the derivatization of a low amount of wine, followed by Solid Phase Extraction (SPE) to yield a purified and concentrated sample. 2-Phenyl-1,2-benzisoselenazol-3(2H)-one, known as "Ebselen,", was chosen for derivatization due to its high reactivity and selectivity with mercapto functional groups, its retention on a reverse phase column, and its ability to ionize readily in both polarities. This method quantifies the three main varietal thiols, and 12 other compounds related to less-represented aromas or off-flavors.

We present a case study of 41 Lugana wines from various wineries. The most studied varietal thiols 3-mercaptohexan-1-ol (3MH), 3-mercaptohexan-1-ol acetate (3MHA), and 4-mercapto-4-methylpentan-2-one (4MMP) were analyzed using the QuEChERS method of Carlin et al. [2] and compared with the new SPE method validated in this study.

In addition to the already cited varietal thiols, the method allowed straightforward quantification of other important mercapto compounds, including ethyl-2-mercaptopropionate (fruity), ethyl-3-mercaptopropionate, 2-furanmethanethiol, and benzyl mercaptan (burnt, roasted). Other compounds contributing vegetal notes included 3-mercapto-2-methylbutanol and 3-mercapto-3-methylbutanol, while citrus and grapefruit aromas were linked to 4-mercapto-4-methylpentan-2-ol, 3-mercaptopentanol, and 3-mercapto-1-heptanol. Additionally, off-flavors like ethanethiol and 3-mercapto-2-methylpropan-1-ol and 3-methyl-2-buten-1-thiol were included.

All analytes demonstrated good linearity, with determination coefficients > 0.99 and recovery rates between 70% and 130%, and half reached a limit of quantification of 1 ng/L. 3MH and 3MHA were present in all analyzed wines, while high 4MMP was unexpectedly found in five wines, raising questions about its origin. Ethyl-3-mercaptoproprionate, 2-furanmethanethiol, and benzyl mercaptan occasionally exceeded the perception threshold, contributing empyreumatic flavors to some Lugana wines, whereas the other analytes remained below perception threshold.

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ORAL

Understanding novel germplasm solutions: sensory, chemical and preliminary hedonic insights of wines made from Australian first-generation mildew resistant cultivars

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Keywords: 1st generational wines, RATA, sensory profiling, disease resistance

ABSTRACT

One of the major issues for wine production in Australia is the management and eradication of powdery and downy mildews and the associated yield losses they present, costing Australian grape growers upwards of AUD$160M per annum [1]. One solution is the development of resistant varieties such as pilzwiderstandsfähig (PIWI) or fungal-resistant varietals. PIWI varieties see acceptance by some consumers in European countries (e.g., Germany, France) when informed of their environmental benefits [2, 3], yet wines continuously display negative sensory and chemical properties, affecting wine quality and requiring specific procedures to rectify these defects [4-6]. These issues may discourage Australian consumers due to established preferences for wine products [7]. CSIRO has also developed new wine cultivars with mildew resistance [1]. These First-Generation Disease-Resistant (FGDR) grapevines contain ~99% *Vitis vinifera* DNA[8, 9], possibly alleviating the challenges associated with PIWI varietal flavour profiles. This study aims to evaluate the sensory and chemical properties of FGDR grapevines developed in Australia. The study uses wine made from 8 white and red FGDR varieties, developed using six different pollen donors (Frontignac, Verdelho, Muscat Gordo Blanc, Riesling, Dunkelfelder, and Tannat), across three vintages (2019-21). Varieties were grown on the same plot in Irymple, Victoria, undergoing identical, small-batch winemaking protocols. Control wines (Chardonnay, Riesling, Shiraz and Cabernet Sauvignon) also came from the same plot. Rate-All-That-Apply was conducted on wines to generate sensory profiles, using consumers between 18 and 65 who regularly consume white and red wines. Fifty participants individually assessed wines randomly: rating liking on a 9-point scale followed by intensity of applicable sensory attributes. Untargeted volatile chemical analysis of each wine was conducted in triplicate using GCMS, semi-quantifying compounds by relative peak area using an internal standard. Two-way ANOVA helped determine key wine sensory drivers, visualised using PCA. Preliminary hedonics suggest that Australian consumers significantly preferred FGDR wines compared to controls, with results identifying sensory and chemical drivers of liking. Wines of the same parentages tended to group together in the PCA, indicating consistency in flavour profiles across vintages in most cases. CVA showed that the wines have different flavour profiles that would suit varying consumer tastes.

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ORAL

Evolution of acetaldehyde concentration during wine alcoholic fermentation: online monitoring for production balances

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Keywords: acetaldehyde, online monitoring, alcoholic fermentation, production balance

ABSTRACT

During alcoholic fermentation, acetaldehyde is the carbonyl compound quantitatively the most produced by yeasts after ethanol. The dynamics of acetaldehyde production can be divided into 3 phases. Early formation of this compound is observed during the lag phase at the beginning of fermentation before any detectable growth [1]. Acetaldehyde accumulation continues during the growth phase. Finally, the concentration decreases during the stationary phase until the end of alcoholic fermentation [2], [3], [4]. Accumulation of acetaldehyde differs according to yeast species and strains, ranging from 0.5 for the least productive to more than 700 mg/L for the most productive [5]. At low concentrations, acetaldehyde is a pleasant and fruity aroma while at high levels, its odor becomes irritating and pungent which depreciates the organoleptic qualities of wines for consumers. The primary objective of this study was to describe and understand the evolution of acetaldehyde concentration during wine alcoholic fermentation and to shed light on the impact of temperature, the main parameter that manages fermentation kinetics but also acetaldehyde dynamics synthesis. One recurrent question persisted on the kinetics of acetaldehyde production from biological and/or physical aspects: did the temperature impact on the metabolism of production of the molecule by the yeast or on the contrary, did it favor its evaporation, or did it impact of both mechanisms? Indeed, although contradictory, studies agree to consider the fermentation temperature as a key point of acetaldehyde production: for some authors, the fermentation temperature affects little the final acetaldehyde content, while others correlate the increase in acetaldehyde content with increasing fermentation temperature [6].

In the present work, thanks to new online monitoring approaches and associated mathematical methods for data treatment, complete acetaldehyde production balances during fermentation allow biological consumption to be dissociated from physical evaporation in order to answer many of the questions posed.

First of all, from a biological point of view, high fermentation temperatures lead to an important production of acetaldehyde at the end of the growth phase, but also favor a better consumption of the molecule by the yeast during stationary phase, leading to a low residual acetaldehyde content at the end of the fermentation. Additionally, physical evaporation is even more important at high temperatures due to the boiling point of the molecule, reinforcing the final decrease of the acetaldehyde concentration. On the other hand, thanks to the use of production balance, it was possible to determine that the decrease of acetaldehyde concentration during the stationary phase is mainly due to the yeast consumption than to the physical effect of evaporation. These different observations were further corroborated by the use of anisothermal temperature profiles. Finally, the consumption part being the most important in the decrease of the acetaldehyde concentration during the second part of the process, metabolic links were revealed between acetaldehyde and markers of metabolism such as organic acids.

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ORAL

Characterization of resistant varieties produced in the context of a search for regional typicality

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Keywords: resistant varieties, typicality, micro-vinification, sensory analysis

ABSTRACT

Planted between 2018 and 2019, the 'New Vine' system is a vineplot, comprising 169 individuals genotypes (5 vines/individual), located on a gravelous soil, in the INRAE Grande-Ferrade site (Villenave d'Ornon, France). These individuals are grapevine genotypes resulting from crosses between Petit Verdot or Cabernet Franc and resistant varieties containing the following pairs of resistance genes: Rpv1+Rpv3 or Rpv1+Rpv10 for downy mildew resistance and Run1+Ren3.2 for powdery mildew resistance [1]. More than 99% of the genome of these genotypes is derived from Vitis vinifera and contains two pairs of resistance genes. Over the last three vintages (2022, 2023, 2024), these varieties have been qualified from a phenotypic, chemical-components and sensory point of view. The aim was to identify the best suited genotypes to Bordeaux vineyards from an agronomic and oenological point of view. The phenological stages and agronomic performances (yield, berry size, etc.) were graded each year up to the harvest date of each individual variety. At maturity, oenological parameters were measured (pH, total acidity, sugars, assimilable nitrogen, acids) using a sequential analyzer (Y400, Byosystems). After harvesting, each individual genotype was vinified in 2 to 3 liters containers following a validated protocol. After a few months of ageing, the volatile compounds in these wines were measured after extraction by GC-MS and GC-MS/MS protocols in order to obtain a fairly broad identity card of their aromatic profiles [2; 3]. Then, these wines were subjected to a sensory analysis combining categorization evaluation process (typicity and quality by orthonasal evaluation) and CATA. The purpose was to assess the typicality of these wines in relation to Bordeaux wines, as described by Ballester et al. [4]. The CATA allows a rapid, non-exhaustive description of the dominant olfactory and gustatory characteristics of these wines. After three vintages, we have already removed 30% of the individuals in the vine-plot. The results of the sensory analysis in particular, coupled with the agronomic performance and oenological data for these varieties, have enabled us to highlight potential good candidates for future planting in the vineyard, having sensory characteristics and chemical components abundancy compatible with Bordeaux wines expectations. These results shall be confirmed during future vintages and on a larger scale plantations.

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ORAL

Field performance of red and white "pilzwiderstandsfähige" (PIWI) cultivars in the south of Uruguay

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Keywords: *Vitis* hybrids, PIWI, risks and benefits

ABSTRACT

As knowledge about the oenological potential of disease-tolerant grape varieties (PIWI) continues to grow and consumer demand for product safety and sustainable production increases, more governments worldwide are permitting the cultivation of these varieties [1]. The Uruguayan wine sector is deeply engaged in this evolving landscape, where the country's wine regulatory body, the National Institute of Vitiviniculture (INAVI), is now considering amending the law that currently prohibits the production of wines from hybrid varieties. This growing interest is primarily due to the substantial reduction in the use of fungicides, fuel, machinery, and labor required for controlling Peronospora *(Plasmopara viticola*) and Oidium (*Erysiphe necator*). Additional advantages include the effectiveness of biological treatments, the ease of producing low-intervention wines, and the alignment with internationally recognized certification standards [2].

This study aims to evaluate the vegetative and productive performance, as well as the maturation process, of PIWI varieties cultivated in Uruguay. The experiment was conducted in an experimental vineyard at the INIA-Las Brujas Research Station (Canelones, Uruguay; 34°40' S, 56°20' W; 32 m.a.s.l.), where advanced selections and cultivars with resistance to fungal diseases are being assessed. The varieties studied—Fleurtai, Sauvignon Kretos, Sauvignon Nepis, Sauvignon Rytos, Soreli, Cabernet Volos, and Julius—were introduced through an agreement between Vivai Cooperativi Rauscedo (VCR) and INIA Las Brujas. Productive performance was evaluated based on the number of clusters per plant, average cluster weight, total production per plant, yield, and the Ravaz index. Technological and phenolic maturation parameters included pH, soluble solids, total acidity, and total polyphenols.

Microvinifications were carried out, followed by both sensory and chemical analyses to assess the presence of undesirable compounds. The results indicated that certain white varieties demonstrated strong oenological potential for young wines under Uruguayan conditions. Additionally, the anthocyanin profile of the red varieties was analysed to establish criteria for distinguishing PIWI varieties with winemaking potential from other hybrids lacking quality attributes.

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ORAL

From varietal and terroir expression to off-odors: chemical background of wine aroma evolution during aging

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Keywords: wine aging chemistry, terroir expression, light-struck defects, wine longevity and stress resistance

ABSTRACT

Expression of sensory attributes that reflect the varietal and geographical origin of wines (aka terroir) is central to perceived wine quality and reputation of wine producing regions. In wines from neutral varieties, this expression in the young wines is in part masked by the high content of fermentative aromas reflecting largely the technology of production. Conversely, after a period of aging, the concomitant decline of fermentative aromas such as esters and formation of novel aromas from different precursors can support the expression of terroir attributes. At the same time, during aging, the occurrence of chemical reactions involving specific precursors can also lead to the development of undesirable off-odors.

We have conducted a series of studies using both commercial and experimental wines, aimed at defining, for specific varietal models such as Lugana, Soave, Valpolicella, Amarone, Durello, i) the nature of the precursors supporting expression of both terroir features and off-odors; ii) the chemical factors modulating the extent of the underlying chemical reactions, and iii) key vinification operations suitable for their management.

Expression of terroir features during aging is linked, in these wines, to the presence of certain precursors in the grapes. Among these, glycosidic precursors of monoterpene alcohols determine monoterpene content of young and aged wines. However, other terpenoid precursors play a key role, in particular free forms of cyclic terpenes leading to the formation of the potent odorants 1,4- and 1,8-cineole. For both these compounds, a clear connection with grape geographical origin has been shown, allowing to define specific temperature and soil combinations most suitable for their occurrence, with pH also exerting an influence. Dimethyl sulfide is another compound associated with terroir expression, with grape nitrogen content playing a central role in its development during aging. Surprisingly, a very strong association was observed between vineyard geographical location and fermentation esters, supporting the notion that pure fermentation-derived aromas also contribute to expression of terroir features.

Concerning off-odor, accumulation of compounds with cooked vegetables off-odors such as methane thiol and dimethyl disulfide in white wines is triggered by light and temperature exposure. The chemical background determining the occurrence of these compounds is however strongly shaped by fermentation variables such as yeast strain and available nutrients. These results highlight once again the central role of fermentation in determining the future life of wine.

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ORAL

Evaluation of shelf life of white wines in aluminium bottle: a modelling approach

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Keywords: aluminium bottle, mathematical modelling, wine sustainability, shelf-life

ABSTRACT

Aluminum is a particularly interesting material for packaging because it is environmentally sustainable, lighter than standard glass bottles, and protective against light radiation [1]. However, some interactions related to the use of aluminum containers are not fully understood, and further studies are needed to understand the effect of this material on the chemical-physical and sensory characteristics of wines [2]. The shelf-life of white wines bottled in aluminum bottles was studied in comparison to that of wines bottled in glass bottles. Three different wines of cv. Inzolia were used for this experiment. The shelf-life evaluation considered several compositional aspects of the wines, such as the volatile component (studied using GC-MS), the phenolic component (studied using HPLC-DAD and UV-Vis spectrophotometry), the metal concentration (studied through atomic absorption), the concentration of sulfur species with +4 oxidation state (via iodometric titration) and the sensory aspects (evaluated through sensory analysis) [3]. Tests were conducted at 20 °C and 40 °C, to simulate accelerated shelf-life, and wine samples were analyzed at three-month intervals. To obtain models useful for both evaluating the type of bottle and predicting the qualitative characteristics of the wines over time, various chemo-physical models were applied, such as chemical kinetics and empirical power-law models [4]. The results obtained after 191 days of testing allowed the observed kinetics to be described as pseudo-first-order for acetate esters, pseudo zero-order for the evolution of flavan compounds reactive to p-dimethylaminocinnamaldehyde, and pseudo-second-order for the evolution of sulfur species with an oxidation state of +4. Regarding the kinetic behavior of these compounds, no differences were observed in terms of half-lives. However, wines stored in aluminum tended to exhibit a more pronounced yellowing, as indicated by the CIELAB b* coordinate. Overall, aluminum proved to be a container comparable to traditional glass bottle.

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ORAL

METAPIWI: unveiling the role of microbial communities in PIWI grapes for sustainable winemaking

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Keywords: PIWI, fermentation, non-*saccharomyces*, sustainability

ABSTRACT

The METAPIWI project advances viticulture research by examining microbial communities in PIWI (fungus-resistant) grapevines compared to traditional *Vitis vinifera*. It investigates how these microbes influence spontaneous fermentation and the production of distinct metabolites and aromas. PIWI grapevines, resistant to fungal and oomycete diseases, host specific microbial communities, particularly on berry pruina, crucial for fermentation dynamics and wine aroma profiles [1,2,3].

The project employs chemical analysis, metagenomics, metabolomics, and culturomics to elucidate microbial metabolic pathways contributing to aromatic compound formation during fermentation with indigenous microorganisms [4]. Culturomics enables the isolation and characterization of cultivable microbes, enhancing knowledge of their metabolic potential. Additionally, the development of predictive biomarkers aims to optimize wine quality and fermentation processes, aligning with modern wine science trends emphasizing microbial contributions [1,2].

Preliminary findings from must and fermenting wine samples of conventional and PIWI grapevines (*Chardonnay blanc – Resistant Chardonnay; Pinot noir – Prior; Riesling weiss – Sauvignon gris; Cabernet sauvignon – Cabernet carbon*) reveal notable differences. Except for *Pinot noir – Prior*, PIWI varieties generally show a higher yeast load and greater diversity of non-*Saccharomyces* yeasts (*Starmerella bacillaris, Metschnikowia pulcherrima,* and *Hanseniaspora uvarum*). This diversity correlates with enhanced fermentative vigor, highlighting PIWI's potential for sustainable viticulture [1,2,3,5].

These findings suggest that PIWI grapevines can produce wines with unique sensory attributes shaped by their distinct microbial communities. The research underscores the role of microbial terroir in defining wine characteristics [1,2,3].

In conclusion, the METAPIWI project pioneers the study of microbial-grapevine interactions, particularly in fermentation and aroma production. By integrating advanced metagenomics and metabolomics, it contributes to sustainable winemaking and positions itself at the forefront of viticultural science.

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ORAL

Circular economy strategies to reintegrate grape pomace from cv. Lagrein into the food chain

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Keywords: grape pomace flour, functional foods, antioxidants, sustainability

ABSTRACT

The project REALISM (regionality and circular economy in food products to counteract the Metabolic Syndrome (M.S.)) was initiated to develop antioxidant-rich food products with the ability to reduce the risk of developing the M.S. The M.S. summarizes comorbidities like high blood pressure, elevated blood sugar and a large waist circumference, which increase the risk of developing cardiovascular diseases or type 2 diabetes and can probably be prevented by a healthy diet with a high content of bioactive compounds such as antioxidants [1]. In accordance with the principles of the circular economy, grape pomace and apple peels were identified as optimal locally sourced raw materials.

Lagrein, an autochthonous red wine cultivar from South Tyrol, Italy, is a rich source of antioxidants, including polyphenols and anthocyanins [2]. Grape pomace from cv. Lagrein was collected from local organic producers before and after fermentation and processed into a fine flour: the drying and milling processes were optimized to preserve the nutraceutical content of the grape pomace. Antioxidant degradation during the processes was monitored with the following methods: the total polyphenol content was determined by using the Folin-Ciocalteu assay [3], total anthocyanins by using the pH-differential protocol [4] and total antioxidant capacity was measured as ferric reducing antioxidant power [5]. More than 80% of the antioxidants were preserved during the processing of grape pomace, resulting in a flour with a high antioxidant content.

New gluten-free baked goods, namely breadsticks, cookies and focaccia, were developed using grape pomace alongside other functional ingredients like apple peel flour, beta-glucan-rich oats and flaxseeds, which provided omega-3 and omega-6 fatty acids. Backed goods enriched with 5% grape pomace flour and 3-10% apple peel flour showed an increase in bioactive compounds compared to control products: polyphenols increased 3.0 -7.3 fold, anthocyanins 6.0-17 fold and the antioxidant capacity 2.8-12 fold.

Our findings indicate that the antioxidant content of grape pomace remains almost unaffected after processing it into a flour. Adding grape pomace flour and apple peel flour to baked goods has significantly enhanced their nutritional value. Further studies will be needed to validate the effects of these products for the dietary managements of the M.S. This approach provides a sustainable way to utilize industry by-products, supporting the circular economy while also creating new revenue streams for food producers and healthier food options for consumers.

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ORAL

Influence of protective colloids on tartrate stability, polysaccharide contents and volatile compound profile of a white wine

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Keywords: wine colloids, wine additives, stabilization, hydroxytyrosol, chemical composition

ABSTRACT

The tartaric salts precipitation is one of the main issues regarding wine instability [1]. In addition to the well-known and deeply studied phenomena of potassium hydrogentartrate precipitation (KHT), the last decade has been increased the phenomena of calcium tartrate (CaT) precipitation, that is a concern for the wine industry [2]. Extractive and additive methods have been proposed to address the tartrate salts instability of wines [3], although the additive methods are more favourable from an energetical and environmental point of views. This study aimed to check the effectiveness of employing different protective colloids (metatartaric acid [MTA], carboxymethylcellulose [CMC], potassium polyaspartate [KPA], mannoproteins [MP] and Arabic gum [AG]) over the KHT and CaT wine stabilities of a Chilean white wine. Furthermore, the side effects of the colloid addition on the soluble polysaccharides, volatile compound profiles, and sensory perception were checked. The instable bulk wine was used to fill 18 jugs (3 L), where the different treatments were applied in triplicate besides a control (untreated triplicate). One week after treatments, the wines were bottled and stored in a dark cellar (18 °C) until analysis. The wine stability regarding both KHT and CaT salts were checked as reported [4]. General parameters and colour features of wines were analysed according to the methods recommended by the International Organization of Vine and Wine. The colloidal profile of treated and untreated wines was recorded by HRSEC-RID after precipitation with cold acidified ethanol [2]. Moreover, the volatile compound profile was recorded by means of HS-SPME-GC-MS. The results highlight that the applied protective colloids can protect against the KHT precipitation, but they are poorly effective against the CaT precipitation. Slight effects were observed in wine colour among treatments, pointing that the colloids can exert a differential protective effect against phenolic compounds oxidation. As previously reported [2], the addition of AG greatly modifies the soluble polysaccharides profile but also increased the wine turbidity compared to the other conditions. Regarding the volatile compound profile, the wines treated with CMC and KPA showed the higher contents of esters, carbonyl compounds, and alcohols. Thus, the addition of colloids such as CMC and KPA do not have a negative impact on the volatile composition of white wines.

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ORAL

Unveiling the secrets of catechin: insights from NMR spectroscopy

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Keywords: catechins, NMR, sparsely populated states, kinetic model

ABSTRACT

Catechins, a class of flavonoids found in foods and beverages such as wine and tea, exhibit potent antioxidant properties that contribute to various health benefits.[1] Self-association of catechins, occurring through both transient and covalent mechanisms, plays a critical role in determining their stability, bioavailability, and biological activity.[2][3] This ability to form supramolecular complexes may modulate their absorption and effectiveness, with important implications for optimizing catechin-rich foods and developing novel functional foods and nutraceuticals.

In this study, we present a quantitative analysis of the hydrogen-deuterium (H/D) exchange kinetics of the C6 and C8 hydrogens in (+)-catechin, monitored using ^{1}H NMR spectroscopy. While the presence of heavy water is not significant in natural systems, it serves as an instrumental tool to investigate the exchange mechanisms in this model system. At low concentrations, the exchange follows a two-step mechanism with pseudo-first-order rate constants ($k1$, $k2$), showing a slight preference for deuterium incorporation at C6 over C8 at 298 K and pD 6.[4] Despite theoretical prediction, increasing (+)-catechin concentration accelerates the observed H/D exchange, suggesting a concentration-dependent mechanism. This effect is not attributed to pD changes but rather to (+)-catechin self-association. NMR chemical shift perturbations coupled with relaxation-based and diffusion NMR experiments reveal a monomer-dimer equilibrium, where dimerization alters the local environment of exchangeable protons, facilitating faster H/D exchange.

Based on these findings, we propose a comprehensive kinetic model that integrates both deuteration and self-association of (+)-catechin, aligning with the growing interest in H/D exchange at carbon centers in polyphenolic compounds.[5] Furthermore, complementary LC-MS data provide insights into how reversible self-association influences irreversible oligomerization, leading to changes in dimeric procyanidins profiles, in terms of conversion rate and stereochemical preference.

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ORAL

α-Terpinyl ethyl ether: stereoselective GC × GC confirmation and identification of its precursors in wine

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Keywords: enantioselective-GC × GC, α-terpinyl ethyl ether, terpenes, olfactory attributes

ABSTRACT

Wines exhibit profound chemical complexity which arise from a diverse array of compounds that contribute to its sensory profile. Among these are the terpenes, which are a class of volatile compounds that play a key role in imparting floral, fruity and resinous, aromas in wine, and can undergo complex chemical reactions even after fermentation [1,2]. One of such compounds is α-terpinyl ethyl ether (CAS number: 27153-54-4), which remains poorly characterized with limited hypotheses on its formation, precursors or enantiomeric preference in wine. This study thus presents the analytical confirmation and profiling of α-terpinyl ethyl ether enantiomers in single varietal wines. Reference analytical standards of α-terpinyl ethyl ether enantiomers were prepared *in house* by an *ad hoc* synthetic protocol, designed to prevent any possible loss of configuration of the reagent (α-terpineol) into the product (α-terpinyl ethyl ether). The enantiomerically pure, isolated, and purified α-terpinyl ethyl ether isomers were then successfully characterized and identified through flow injection APCI-HRMS, e-GCxGC-EI-MS, and NMR, to confirm their structures and purities [3,4]. To this aim, an enantioselective method based on a γ-cyclodextrins-derivatized GC primary separation phase was optimized. The quantitative method was thoroughly validated for linearity, limit of quantitation, recovery, matrix effect, and robustness. Then, single varietal wines were analysed to determine the concentrations of the enantiomers, along with other closely related terpene enantiomeric species (linalool, α-terpineol, and limonene). The study aimed also at identifying potential direct precursors of α-terpinyl ethyl ether, by preparing stock solutions of pure *R*-linalool, *R*-α-terpineol, and *R*-limonene in a model wine solution. The results showed that α-terpineol in wine undergoes a reversible and slow conversion to α-terpinyl ethyl ether without loss of the initial chiral configuration. On the other hand, linalool is irretrievably converted to both α-terpineol and α-terpinyl ethyl ether, with a predominant loss of the initial chiral configuration. This observed distinction highlights the different chemical behaviour of these terpene compounds and their significance in the wine aroma, particularly over prolonged time. Finally, qualitative sensory analysis further elucidated the distinct olfactory profiles of the enantiomers. Overall, the study contributes to a deeper understanding of α-terpinyl ethyl ether origin in wine.

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ORAL

Closure permeability: A key parameter for modulating the aroma of monovarietal white wines during bottle ageing

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Keywords: closures, oxygen transfer rate, sensory analysis, aroma

ABSTRACT

Bottle aging is crucial for wine quality, influencing its chemical and sensory properties [1]. Ideally, a phase of qualitative ageing enhances sensory attributes before a decline in quality occurs. Understanding the impact of oenological variables on these phases is a key challenge in modern winemaking. Oxygen plays a significant role in modulating reactions involving volatile and non-volatile compounds, affecting aroma evolution during storage [2]. Oxygen exposure during bottle aging is regulated by closure permeability, defined by the Oxygen Transmission Rate (OTR) and the Oxygen Initial Release (OIR), which contribute to the total oxygen supply [3].

From a sensory perspective, excessive oxygen exposure can lead to a loss of fruity and varietal aromas, causing oxidative spoilage. Conversely, insufficient oxygen ingress may result in the development of reduction characters over time [1]. Predicting a wine's response to oxygen is complex due to various chemical and physical interactions. Generally, red wines require more oxygen during ageing, whereas white wines are more prone to oxidation. Micro-agglomerated cork stoppers with different OTRs offer a precise means of regulating oxygen ingress, but understanding how different wines respond to oxygen exposure is crucial for optimizing closure selection.

In 2020, a study was launched to examine the aging of four monovarietal white wines (Falanghina, Greco, Fiano, and Chardonnay) with closures featuring OTRs between 0.3 and 0.6 mg O_2/year. Sensory analysis was conducted yearly, including free sorting tasks, liking tests, reduction/oxidation ratings, and odor profiling via the Rate-All-That-Apply (RATA) method. Additionally, free and total SO_2 and total acetaldehyde levels were monitored.

Despite small OTR differences, results showed distinct sensory evolutions across wines. Over three years, no oxidative spoilage was observed. Higher OTRs enhanced fruitiness and liking, while lower OTRs intensified reduction characters, with significant differences among varieties. These findings highlight closures as a powerful tool to modulate wine aroma, tailored not only to the type of wine but also to the intended consumption timing.

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ORAL

The impact of ethyl esters, monoterpenes and volatile thiols to the perception of tropical fruit aromas in white wines

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Keywords: aroma intensity, discriminant analysis, causation, wine consumers

ABSTRACT

Many varietal white wines have aroma qualities that incorporate various tropical fruit aromas. These tropical fruit aromas are found to be considered positive qualities of the wines with consumers having positive emotional responses [1]. In previous work, it has been found that combinations of ethyl esters, ethyl esters and thiols and monoterpenes, can cause tropical fruit aromas in white wines [2,3,4]. However, it is unknown if these aromas are similar or if they correspond to different tropical fruit characteristics. This work aimed to determine if the perceived aromas from these different chemical combinations resulted in various tropical fruit aromas. It is also known that individuals with greater exposure to specific aromatics can discern and evaluate them better than those with limited exposure. Therefore, this work also looked to compare consumers based on their exposure and familiarity with different tropical fruits. Reconstitution studies of different combinations and concentrations of the compounds of interest, ethyl esters, monoterpenes and volatile thiols were created in a base Pinot gris wine. Descriptive analyses were conducted on two groups of wine consumers: those with great exposure to tropical fruits and the ability to differentiate and identify various kinds of tropical fruits, and those without such exposure and ability. Results showed that these compound combinations did result in different tropical fruit aromas, although not all treatments were perceived differently and that the consumer groups were different in their description of the wines. This work builds on understanding the causation of aromas in wine, which in turn can help with production decision-making and the choice of processing to obtain specific wine styles.

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ORAL

First disclosure of eugenol precursors in *Vitis* genus: analytical development and quantification

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Keywords: geoside, glycoconjugates, grape berry, citrusin C, Armagnac

ABSTRACT

The main aim of this work was to develop an analytical method to disclosure the molecular form of eugenol precursor. Indeed eugenol is an important contributor to Armagnac spirits typicity made with Baco blanc. Moreover the high content of eugenol found in Baco blanc may be one of the reasons why this variety is tolerant, thereby requiring fewer phytosanitary treatments overall compared with Ugni blanc or Folle blanche. Prior to our work, the eugenol potential was estimated after enzymatic release using unspecific glycosidase enzyme preparations. However, the chemical structure of the actual eugenol glycoconjugates precursors had never been fully elucidated. To reveal the identity of eugenol precursors, an innovative specific methodology was developed and applied to berry skin extracts. This EPIQ strategy (Extraction-Purification-Identification-Quantification), involved HS–SPME, GC–MSguided LC fractionation, use of specific enzymatic hydrolyses, as well as LC–MS/MS and LC–HRMS analyses. We identified geoside (eugenyl-6-O-α-L-arabinopyranosylb-D-glucopyranoside) as the major eugenol precursor, and confirmed this identification with commercially available standards. To the best of our knowledge, this is the first study to identify geoside in grapevine. Additionally, three minor eugenol precursors were detected, including the monoglucoside citrusin C (eugenyl b-Dglucopyranoside).

An LC-MS/MS (MRM) quantification method was then established and validated based on linearity, inter-day and intra-day precision. LC–MS/MS quantifications confirmed that geoside is present in greater amount in Baco blanc than in *Vitis vinifera* grape varieties such as Ugni blanc, Folle blanche and Plant de Graisse. Moreover, we studied the synthesis of geoside during fruit development and found that in Baco blanc, geoside reached its highest concentration in berry skins at veraison. Finally these quantifications performed on various *Vitis* species and their hybrids demonstrated that geoside is specific to certain grapevine hybrids, particularly Baco blanc.

The strategy developed in this study could be easily applied for the exploration of other aroma precursors in different grape compartments and varieties.

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ORAL

Study of the fruity aroma of red wines through perceptual interactions among volatile compounds in the context of climate change for the Bordeaux vineyard

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Keywords: red wine, climate change, fruity aroma, perceptual interactions

ABSTRACT

The fruity aroma of red wines is described by a wide range of descriptors, ranging from fresh fruits to ripe and jammy fruits, to candied fruits and prunes notes [1]. The fruity quality of a red wine is characterized by notes of fresh and jammy red- and black-berry fruits. Although many sensory attributes are mentioned in the literature, knowledge regarding the qualitative fruity aroma of red wines in relation to their chemical composition still requires further investigation. However, at least one component of this fruity expression reflects perceptual interactions primarily involving esters, as well as other families of aromatic molecules [2,3]. In recent years, changes in the fruity expression of Bordeaux red wines, characterized by the emergence of notes of cooked and dried fruits, have been reported and correlated with climate change [4]. Thus, technicians in the wine industry and scientists emphasize the need to take precautions to preserve the fresh fruity aroma of Bordeaux red wines. One adaptation strategy involves introducing late-ripening grape varieties selected for their potentially suitable vegetative cycle under future climatic conditions into Bordeaux vineyard. This study proposes a better understanding of the fruity aroma of red wines derived from Bordeaux grape varieties, as well as those cultivated around the Mediterranean basin. Through sensory approaches, it has been demonstrated that Bordeaux red wines exhibit similarities with red wines derived from grape varieties grown around the Mediterranean in terms of their fruity character. A detailed characterization of the contribution of volatile compounds of interest in the perception of fruity notes has been conducted. Perceptual interactions between compounds from the monoterpenic, C13-norisoprenoid and C6 alcohols families, mixed with esters, have revealed the importance of these compounds in the perception of fruity notes. Finally, the addition of these volatile compounds to a red wine shows a decrease in cooked fruit notes and an increase in fresh black-berry fruits notes. This research opens up new perspectives in oenology, such as controlling the levels of these different aromatic families of interest through various practices, as well as the potential introduction of "new" grape varieties into Bordeaux wine blends.

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ORAL

Early development of potential wine styles for PIWI varieties in grapevine breeding

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Keywords: PIWIs, Napping®, RATA, quality potential

ABSTRACT

In a framework in which climate change is increasingly recognized as a critical global challenge, traditional viticulture must be reconsidered in order to provide better solutions for future needs [1]. Grapevine breeding plays a key role by developing new varieties that combine high wine quality potential with resistance to fungal diseases and better adaptation to the changing climatic conditions. In this context, resistant grapevine cultivars, so-called PIWIs (from the German word *"Pilzwiderstandsfähig"*), represent a promising solution to new challenges posed by climate change. While the successful introduction of disease resistance in PIWIs is already detectable few weeks after germination via marker-assisted selection (MAS), the assessment of a breeding strain to deliver grapes suitable for the production of high quality wines lasts decades. Standardized micro-vinification allows exploring the basic of wine quality potential from new variety candidates [2]. Consequently, this study aims to investigate the sensory wine profiles from new PIWIs by determining key sensory traits and evaluating their response to different winemaking techniques. Hereby, potential wine styles for new cultivars are identified in the later steps of the breeding program when sufficient grape material becomes available. Based on this, recommendations for pioneering winemakers can be provided to assist their market introduction. Three recently released white wine PIWIs: Calardis Musqué, Calardis Blanc and Calardis Soleil developed from the Julius Kuehn Institute were investigated. Small-scale experimental vinifications were carried out in 30 L steel tanks, with different winemaking processes that varied in skin contact time, fermentation temperature and fermentative yeast strains. Three different sensory evaluations were conducted using a panel of 20 trained tasters; first, a triangle test to establish discrimination among the wines, followed by two rapid and cost-effective methods: sorting and Napping® [3] and RATA (Rate-All-That-Apply) [4]. This study reveals first potential wine stylistics for the investigated PIWIs and show their sensory characteristics and plasticity induced by the different oenological treatments. This highlights their potential to produce high quality wines with various sensory profiles. Establishing such studies in the breeding process for promising candidate varieties will support the final breeding decision and provide an initial understanding of potential wine styles to support their introduction to the market.

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ORAL

Oenological performances of new white grape varieties

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Keywords: resistant grape varieties, oenological parameters, aroma compounds, phenolic compounds

ABSTRACT

The wine industry works to minimize pesticides and adapt to climate change. Breeding programs have developed disease-resistant grape varieties, particularly against downy and powdery mildew, to minimize pesticide applications [1]. However, their enological potential remains underexplored. This study compares disease-resistant white grape varieties with traditional cultivars by evaluating various enological parameters. Ten musts were prepared from seven grape varieties, including resistant (Voltis, Souvignier Gris, Sauvignac, and Floreal) and traditional (Chardonnay, Sauvignon, and Viognier) varieties, from Atlantic and Mediterranean climates. Fermentation was conducted at laboratory scale with online CO_2 monitoring and two yeast strains: Zymaflore X5 and Anchor Alchemy II. Wines were analyzed for metabolites from central carbon metabolism (MCCM), varietal thiols (3SH, A3SH), fermentative aromas (ethyl esters, acetate esters and higher alcohols), and phenolic compounds (hydroxybenzoic acids, hydroxycinnamic acids, flavanols and flavonols) using HPLC-UV-IR, UHPLC-MS/MS [2], GC-MS [3], and UHPLC-HRMS [4], respectively. Multivariate statistical analysis was applied. For the principal component analysis (PCA) of all variables, the PC1 axis (32.7%) primarily drove varietal differentiation, influenced mainly by phenolic compounds, while the PC2 (14.5%) reflected the yeast effect, driven by aromas, MCCM, varietal thiols, and fermentation kinetics. Souvignier Gris grouped with Sauvignon samples partly due to its higher abundance in varietal thiols, suggesting enological similarities possibly linked to genetic proximity. Sauvignac, Voltis, and a Floreal sample showed some proximity to Souvignier Gris, with the first influenced by ethyl esters and the others by varietal thiols. In contrast, the second Floreal sample exhibited opposite behavior to that of the first, possibly due to differences in their geographic origins. PCA of aromas and varietal thiols (PC1: 37.7%, PC2: 17.8%) showed a sample separation trend based on grape varieties and yeast strains. Regardless of the yeast strain, Souvignier Gris exhibited the same clustering behavior with Sauvignon samples as in the global analysis, influenced by 3SH and ethyl lactate. The other samples showed a more dispersed behavior. The heat map of 19 phenolic compounds showed clear clustering of each wine sample, independent of yeast strain. Sauvignac (genetically related to Sauvignon) and, to a lesser extent, Souvignier Gris, clustered with Sauvignon samples, and these varieties were the least abundant in phenolic compounds. Conversely, the Floreal samples clustered together but were separated from Voltis, despite their genetic similarity. They also had higher levels of many compounds, belonging to the different phenolic families, than Voltis. This work highlights the enological potential of disease-resistant white grape varieties. It identified key enological criteria (phenolic and aroma compounds) for assessing these varieties. Souvignier Gris and Sauvignac emerged as potential alternatives to Sauvignon, while Floreal and Voltis may still offer valuable attributes. Further research with a larger sample set is necessary, and this approach can aid breeding programs by integrating enological performance with genetic and agronomic criteria.

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ORAL

Revealing the aroma profile of Greek wines from indigenous grape cultivars

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Keywords: wine aroma, volatile composition, sensory analysis

ABSTRACT

The indigenous Greek grape varieties Assyrtiko, Malagousia, Moschofilero and Roditis are used to produce white wines that are attracting the interest of wine producers and consumers due to their aromatic characteristics [1]. In addition, the Agiorgitiko and Xinomavro varieties are Greece's most prominent red grape varieties. However, there are few studies that focus on the unique wine characteristics of each variety and the relationship between the composition of volatile compounds and sensory properties. Monovarietal wines (2018 vintage) were evaluated by a trained sensory panel using the frequency of attribute citation methodology [1,2], and volatile compounds were identified and quantified using gas-chromatography-mass spectrometry [3]. Multivariate statistical analyses were used to investigate correlations between volatiles and sensory attributes. For the white wines, the results showed that the most potent aroma compounds were a group of terpenes, isoamyl acetate and phenylethyl acetate. Terpenes such as geraniol, α-terpineol, linalool and cis-rose oxide correlated with floral notes, especially in Moschofilero wines. In addition, isoamyl acetate contributed to the aroma of tropical fruits, especially banana, in the Roditis wines, while phenylethyl acetate correlated with rose, vanilla and fruity notes in both the Moschofilero and Roditis samples. The Assyrtiko wines and the Malagousia wines were mainly associated with compounds such as cis-3-hexen-1-ol and cis- and trans-furan linalool oxides, which may enhance fresh fruit and citrus aromas through synergistic effects. As for the red wines, Agiorgitiko wines exhibited a common background blackberry aroma and were also characterized by dried fruit (prune, fig) and earthy (mushroom, grassy) notes. On the other hand, Xinomavro wines displayed, overall, a tomato paste aroma. Additionally, they exhibited olive, floral, fruity, and spicy aromas. Xinomavro wines contained higher levels of terpenes than Agiorgitiko wines, contributing to their vegetative and floral-fruity character. In contrast, Agiorgitiko wines exhibited higher concentrations of β-damascenone, β-ionone, and ethyl butyrate, associated with blackberry and dried fruit aromas, as well as higher amounts of cis-3-hexen-1-ol related to earthy notes. Our findings highlight the aromatic distinctiveness of these varieties and the value of combining sensory analysis with chemical profiling to define aroma typicity, which will help producers develop targeted wine styles and will be useful for boosting the global recognition of Greek wines.

Finally, this research will assist professionals in making highly focused viticultural and winemaking decisions to enhance desirable characteristics while reducing undesirable ones, and thus, be useful for consumer promotion purposes.

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ORAL

Sensory quality of wines as a trait in MAS grape vine breeding – sensory insights from multiple vintages in a F1 breeding population

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Keywords: grapevine breeding, sensory quality, marker-assisted selection (MAS), predictive modelling

ABSTRACT

In the context of the three global crises of global warming, loss of biodiversity and environmental pollution, current agricultural practices need to be reconsidered [1]. Viticulture in particular can contribute to this by optimising plant protection [2]. Grapevine breeding addresses this issue by producing new grape varieties with resistance to pests, thereby reducing the use of plant protection products and their impact on biodiversity and environmental pollution. Since the resulting product wine is a traditional product with established sensory wine styles, the acceptance of new grape varieties strongly depends on its sensory quality. To make the breeding process more efficient in terms of market acceptance of these new wines, the sensory quality trait of wine should be considered in marker-assisted selection (MAS) [3]. In the current multidisciplinary project, two identical segregating F1 populations of 'Calardis Musqué' x 'Villard Blanc' crosses, comprising a total of 150 selected individual genotypes and two geographical locations, were characterised by a high-density genetic map using a 'genotyping by sequencing' approach [4]. Around 1,300 individual wines were vinified over eight vintages and comprehensively characterised using sensory analyses. For this purpose, we combined elements from the evaluation scheme of the International Organisation of Vine and Wine (OIV) [5] with an intensity evaluation of selected aroma and flavour attributes. This scheme not only allowed the assessment of a large number of wines, but also provided comparable results over the years with a strong sensory differentiation of the sensory characteristics and their qualitative evaluation. A predictive model was developed using descriptive and qualitative results of wines from one geographical location to predict the quality classification of wines from a second geographical location. The analysis revealed that the vintage effect accounted for a significant proportion of misclassified wines. The findings underline the necessity for multiple vintages and a robust sensory evaluation methodology to ensure the incorporation of sensory quality in a MAS-based breeding programme.

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ORAL

Smoke exposure effects on red wines: how much is too much?

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Keywords: red wine, smoke exposure, volatile phenol threshold levels, descriptive analysis

ABSTRACT

Increasing wildfire frequency in the United States has led to the indirect impact of smoke in vineyards, affecting grape quality and wine sensory attributes, commonly called "smoke taint".[1] During a smoke event, grapes absorb volatile phenolic compounds, which are subsequently glycosylated, leading to potential negative sensory impacts in the resulting wines.[2] During the 2024 harvests, Vitis *vinifera L. cv.* Cabernet Sauvignon, Barbera, and Zinfandel grapes were intentionally exposed to various levels of smoke to establish threshold levels of free and bound volatile phenols in grapes that lead to noticeable changes in the sensory characteristics of their vinified wines. The wines were made using commercial practices at the UCD winery and stored until a complete sensory descriptive analysis (DA)[3] and chemical analysis. All wines are analyzed for volatile phenols and their glycoconjugates concurrently using GC-MS/MS and LC-MS/MS, respectively.[4,5] Previously, in 2023, a DA panel evaluated Cabernet Sauvignon grapes. Judges rated highly smoked exposed grape (HE) samples higher for "astringency" and "vicious" mouthfeel as well as "smoky," "cooked meat," and "rubber" aroma, which correlated with significantly elevated levels of all volatile phenols analyzed compared to other treatments. However, HE grape samples were rated lower for "fresh and fruity" aromas than all other treatments, indicating that smoke suppresses fruit aromas in grape samples. The low (LE) and medium (ME) exposed grapes were not able to be sensorial differentiated from the control grape samples, even though ME grape and wine samples were significantly higher in all volatile phenols. For the wines, the trained DA sensory panel evaluated aroma orthonsal and the five "smoke taint" retronasal, in addition to tastes and mouthfeels. ME wines showed higher levels of "smoky," "meaty," "cigar box," "wood," and "old ashtray" aromas than LE and CE wines, with HE wines most affected. Preliminary results indicate high smoke exposure causes distinct sensory differences in grapes and wines. Similarly to 2023 wines, the presented project investigates three 2024 vintage red varietal wines. It shows the possible sensory profiles in response to different smoke levels in an experimental system that exposes grapes to various smoke levels. The aim is to develop threshold levels in common wine varietals of free and bound volatile phenols that can lead to unfavorable sensory attributes in the final wines.

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ORAL

Investigating winemaking techniques for resistant varieties: the impact of prefermentative steps on must quality

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Keywords: disease resistant *Vitis*, interspecific hybrid, sustainable wine production

ABSTRACT

Resistant grape varieties are gaining interest in viticulture due to their resistance to diseases, allowing to drastically reduces pesticides in viticulture [1]. However, their adoption by the industry is hampered by concerns about the quality of their wines, which meets particular challenges due to specific biochemical traits of their berries, including high levels of proteins, high acidity and low levels of aromas [1-5].

Prefermentation treatments such as partial-grape drying and cryomaceration have been found to increase the level of thiol precursors, a group of natural grape aromas that contributes fruity and exotic notes to wine, in *V. vinifera* berries, prior alcoholic fermentation. Although the presence of those precursors has been reported in resistant varieties, the impact of prefermentation approaches on their concentration in musts before fermentation has not been studied.

Thus, this study examines the effect of gas maceration (CO_2, N_2) at two temperature (10 days at 25°C ; 4 days at 30 °C), partial grape drying (10 days at 25 °C), and cryomaceration (down to -20 °C using liquid nitrogen) compared to traditional skin maceration (control) on the level of thiol precursors in berries from the resistant *Vitis* varieties Vidal and Frontenac gris. Musts were sampled immediately after the end of treatments and after *debourbage*. Thiol precursors were analyzed by LC-MS/MS Orbitrap, using parallel reaction monitoring of exact masses of molecular and fragments ions, and were semi-quantified against an internal standard. An analysis of variance followed by Tuckey's honest difference test were used to compare means while principal component analyses were conducted to evaluate the global impact of treatments on each variety.

Results showed that partial grape drying significantly increased (up to five times) the content of thiol precursors in both varieties. Gas macerations had variable effects and cryomaceration had a limited impact. In Vidal, partial grape drying specifically increased the concentration in gluthation-3-mercaptohexanol (G3MH), a precursor of grapefruit, citrus, and exotic fruits notes in wine, and glutathione-4-mercapto-4-methylpentanone (G4MMP), associated with aromas of boxwood in wine.

These results suggest that partial grape drying may contribute to improve the quality of wine made from disease resistant varieties. Further development in this project will involve the analyses of free thiols in wines made from these trials, to trace a full portrait of how prefermentative steps may contribute to improve the quality of disease-resistant wines.

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ORAL

Quantification of newly identified C8 aroma compounds in musts and wines as an analytical tool for the early detection of Fresh Mushroom Off-Flavor

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Keywords: fresh mushroom off-flavor, octane-1,3-diol, 1-hydroxyoctan-3-one, must, wine, LC-MS/MS

ABSTRACT

The Fresh Mushroom Off-Flavor (FMOff) is a concerning undesirable aroma in wine specific of certain vintages, characterized by a typical button mushroom aroma. The appearance of this off-flavor is linked to the presence of certain fungus on the grape [1-3]. One of the main problems of the defect is that it is not sensory perceived in the musts and appears only at the end of alcoholic fermentation [4]. Consequently, the use of must with potential FMOff in blending can lead to the spoilage of large amount of wine.

Today, fresh mushroom aroma compounds are well documented: they are saturated and unsaturated C7, C8 and C9 compounds, the most common and sought-after compounds being 8 carbon-compounds, such as 1-octen-3-ol, 3-octanone,or1-octen-3-one [2, 5, 6] and more recently, 1-hydroxyoctan-3-one [7]. However, these compounds can be difficult to measure notably in the case of 1-octen-3-one and do not fully explain this defect appearance during winemaking. The aim of this work was to identify reliable FMOff compounds in both musts and wines and to propose a high-throughput analytical method to discriminate samples of different quality as early as possible.

First, experimental altered musts were made from grapes with a natural apparent alteration by grey mold. Untargeted GC-MS analysis of the musts allowed to identified two compounds correlating well with the development of FMOff in the wines: 1-hydroxyoctan-3-one and octane-1,3-diol, the latter being identified for the first time in an oenological sample. Their concentrations, measured using a rapid analytical method developed by SIDA-LC-MS/MS, ranged from some µg/L to mg/L with a clear correlation with the FMOff intensity (sensory perception) ($R^2 = 0.95$ and $^2 = 0.89$, respectively).

Then, 82 samples (62 base wines and 20 musts used to make these wines) were collected in the Champagne region during the 2023's harvest. Based on sensory analysis results, 33 wines developed a FMOff and 29 were considered as control samples (no FMOff detected). Both 1-hydroxyoctan-3-one and octane-1,3-diol were quantified in these samples. The quantification of both compounds allowed a clear discrimination of FMOff wines from control samples ($p<0.0001$), confirming the reliability of 1-hydroxyoctan-3-one and octane-1,3-diol as FMOff markers in base wines. More interestingly, 1-hydroxyoctan-3-one was quantified in 90% of the musts giving a wine with a FMOff character. Octane-1,3-diol was quantifiable in 100 % of the musts from the FMOff group and detected at lower concentrations in the control musts. Thus, the quantification of these two markers in the musts allowed the identification of future wines with FMOff potential, thus providing a rapid and reliable tool to segment the quality of must before fermentation.

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POSTERS AND FLASH TALKS SESSION

FLASH TALK

Revisiting esters hydrolysis in young white wines

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Keywords: esters, metal ions, hydrolysis, matrix effect

ABSTRACT

Esters play an essential role in the young white wines' fruity expression, particularly the groups of ethyl esters of fatty acids (EEFAs) and higher alcohol acetates (HAAs) [1]. However, generally, these groups of esters decrease relatively fast during the first two years of ageing [1, 2]. Ester hydrolysis naturally occurs during wine maturation and bottle ageing [3]. Some authors suggested that the rate of esters hydrolysis could be affected by other factors such as the presence of metal ions or antioxidants [4, 5]. However, in wine, this has been poorly reported.

Thirty-three one-year-old commercial white wines, made from Chardonnay and Welschriesling varieties from different Eastern European countries, were subjected to accelerated ageing, all the samples in triplicate. Basic wine parameters were characterised and 17 esters were quantified by HS-SPME-GCMS before and after the forced ageing process. Additionally, the metal ion content (K, Ca, Na, Mg, Cr, Mn, Fe, Co, Ni, Cu and Zn) was measured using ICP-MS. EEFAs and HAAs concentration decreased with ageing as reported in the literature [1, 2]. However, an important matrix effect on the hydrolysis rate was observed between wines, particularly in the case of HAAs. Contrary to our expectations, there was no link between the hydrolysis rate and the initial concentration of esters. Interestingly, iron concentration was positively correlated (Spearman's correlation) with the loss of HAAs and EEFAs with the longest carbon chains (C10 and C12), suggesting that in real wine conditions metal ions could potentially favour ester hydrolysis. Additionally, K and Mg have shown an impact on HAAs of these wines through a PLS-R model. In parallel, a previous study performed on white wines artificially spiked with metal ions and esters showed that iron, manganese and copper increased the loss of esters during forced ageing irrespective of oxygen level [6]. The difference between both studies suggests that the role of metal ions in ester hydrolysis is matrix-specific. The present work demonstrated that ester hydrolysis is significantly affected by wine chemical components that differ from initial ester concentration and pH which were so far known as the most influential chemical factors on ester hydrolysis. Metal ions particularly iron can potentially favour faster ester hydrolysis but the important matrix effect on the ester hydrolysis rate observed in this study is overall driven by other factors, excluding pH, that still need to be investigated.

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POSTER

Effect of elicitors and ripening moment on the phenolic composition of Monastrell

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Keywords: maturity grade, nethyl jasmonate, marc grape extract, phenolic compounds

ABSTRACT

Grapevine (*Vitis vinifera* L.) is a globally cultivated crop and economically significant, particularly in the wine industry (Varela et al., 2024). Climate change is already affecting vineyards and is expected to worsen (Averbeck et al., 2019; Dupuis and Knoepfel, 2011). Wine quality relies on the berry's chemical composition, which depends on various metabolites and the synchronization of skin, seed, and pulp ripening. Strategies to enhance grape quality and address the uncoupling of technological and phenolic maturity include using elicitors, which induce secondary metabolite accumulation in response to stress signals (D'Onofrio et al., 2018). Numerous studies have explored the effects of different elicitors on grape phenolic compositions, but information on the impact of methyl jasmonate (MeJA) and grape marc extract on grape ripening is lacking. This research aims to provide insights into how elicitation affects the phenolic composition of grapes and wines, reducing the decoupling between phenolic and technological maturity.

This study was performed over two growing seasons (2022 and 2023) with Monastrell *Vitis vinifera* L.cvon Richter 110 rootstock, which were 7 and 10 years old and planted 2.5 x 3m in an experimental field located in Cehegín (Murcia, Spain). Three treatments were carried out, each in triplicate, at veraison and one week later, with 10 vines per replicate: (i) control (water), (ii) MeJA (10 mM), and (iii) grape marc extract (10 g/L). Grapes were harvested at two ripening moments when they reached 21ºBrix and 23ºBrix, respectively. Different chemical and chromatographic analyses were carried out to evaluate the quality of grapes and wines at harvest and at the end of alcoholic fermentation, respectively.

The results showed how the degree of maturity influenced the different parameters measured. Total anthocyanin content in grapes was higher for all the factors studied—treatment, degree of ripening, and vintage—at 23ºBrix, not showing differences among treatments at 21ºBrix; however, at 23ºBrix, the highest total anthocyanin content was observed in MeJA-treated grapes, and the lowest in marc-treated grapes. Regarding the results obtained for anthocyanins in wines, the differences found were much smaller than in grapes. With respect to flavonols in grapes, treatments did not have any effect, although the highest flavonol content was obtained in control grapes matured at 23ºBrix. However, in wines, the results for flavonols were more pronounced than in grapes, with significant differences found between treatments, maturity, and season.

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FLASH TALK

Cross analytical and sensory differentiation of monovarietal white wines from four autochthonous grape varieties: focus on macromolecules

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Keywords: Asymmetrical Flow Field-Flow Fractionation, flash profile, macromolecules, white wine

ABSTRACT

White wines contain macromolecules such as proteins, phenolic compounds and polysaccharides. On a sensory level, these compounds contribute to the 'mouthfeel' that differentiates the white wines worldwide [1]. Separation methods such as Size Exclusion Chromatography (SEC) or High-Performance Liquid Chromatography (HPLC) are commonly used to analyse the macromolecular composition of wines [2,3]; However, macromolecular complexes can be denatured with these techniques, a barrier to evaluate precisely the contribution of macromolecules to wine properties. Asymmetrical Flow Field-Flow Fractionation (AF4) is an alternative promising separation technique to study wine macromolecules since it allows sample compounds separation by size with no stationary phase. Collected fractions integrity is thus preserved [4].

In France, 10 varieties of *Vitis vinifera*, out of around 250 listed, represent 75% of the national wine production [5]. French Southwest region has a real singularity with nearly 120 autochthonous varieties. In this study, 69 monovarietal white wines from four indigenous varieties (Colombard, Gros Manseng, Mauzac and Len de l'El) renowned for their specific taste properties were selected in different wineries from Tarn and Gers. Wines were analysed by Fourier Transform Infrared Spectroscopy to determine the conventional oenological parameters (alcohol content, titratable acidity, assimilable nitrogen, pH, residual sugars…). Then, their macromolecular profile was studied using AF4.

After statistical analysis, 3 wines were selected for each variety. A sensory Flash Profile test was set up using a trained panel to differentiate the 12 white wines according to their mouthfeel. Wines that stood out from the other wines on account of their sensory characteristics were analysed with the AF4. More specifically, the bitter flavour perception for Mauzac and Colombard wines differed strongly. The AF4 results highlighted different macromolecular profiles for these two varieties in terms of proteins, polysaccharides, and phenolic compounds. An SDS-page gel electrophoresis confirmed the observations for proteins, mannoproteins and polysaccharides.

Finally, the wines from Colombard and Mauzac were ultrafiltered at three different cut-off thresholds (100 kDa, 50 kDa and 30 kDa). The three collected fractions were tasted by the sensory panel and analysed thanks to the AF4. The expert panel could identify differences between the fractions for each variety, these results providing a new insight on the impact of macromolecules on white wines gustative properties.

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POSTER

Managing extraction of colour, tannin and methoxypyrazines in Pinot noir grapes treated by leaf removal

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Keywords: grape tissues, mDP, Pinot noir, tannin extractability

ABSTRACT

Managing extraction of tannins and green aroma compounds attributed from methoxypyrazines in winemaking is crucial for producing high quality Pinot noir wine. This study[1] investigated the impact of leaf removal on concentrations of anthocyanins, tannins, and methoxypyrazines in Pinot noir grapes and resultant wines. Leaf removal was conducted at 7 days (LR7), 30 days (LR30), and 60 days (LR60) after flowering, and the no leaf was removed in the control treatment (LRC). Leaf removal could significantly increase the concentration of anthocyanins in Pinot noir grapes and reduce the concentration of methoxypyrazines, especially in grape stems, in comparison with the control treatment. Early leaf removal (LR7 and LR30) showed greater effect on enhancing the colour density, polymeric pigments, and tannin concentration in the resultant wines. LR7 treatment showed significantly higher proportion of skin-derived tannins in resultant wine, compared to LRC. Although the aroma analysis of resultant wines showed significant differences between treatments, the impact of leaf removal on the aroma profiles was not evident by the sensory evaluation. These findings offer valuable insights for managing the extraction of colour, tannin and methoxypyrazines in Pinot noir wines, enabling winemakers to optimize quality through targeted viticultural and winemaking practices.

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POSTER

Free and bound terpene profile of recovered minority white grape varieties by GC × GC-TOFMS

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Keywords: grape aroma potential, recovered cultivars, water regime, two-dimensional gas chromatography

ABSTRACT

Climate change presents a significant challenge for actual viticulture. In this context, recovering minority grape varieties can be a crucial strategy to ensure resilience, particularly those capable of maintaining quality and aromatic complexity under water stress. Many of these varieties have characteristics and specific adaptations to their environment, offering an opportunity to diversify vineyards and secure high-quality wine production in the future. In Castilla-La Mancha, the Spanish region with the largest vineyard area, research is underway white minority varieties with promising potential, such as Azargón, Maquías, and Montonera.

The aroma potential of grapes is key to a wine's aromatic identity, being terpenes one of the most important groups that define this component are terpenes. These are characterized by a low olfactory perception thresholds and pleasant floral aroma and they can exist in two forms: as non-odorous precursors bound to sugar molecules and as volatiles in their free forms. During winemaking and aging, bound terpenes gradually release from the sugar molecules, influencing the wine's aromatic profile. Grape terpene composition is known for its remarkable diversity, complexity, and structural similarities, where even minor molecular differences can lead to significantly distinct aroma profiles. As a result, the use of precise analytical methods, such as the comprehensive two-dimensional chromatography GCxGC-TOFMS, is essential to investigate and understand the role of terpenes.

Therefore, the objective of this work has focused on these three recovered white viniferas, to determine how two different water regimes, drought with survival irrigation and deficit irrigation (20% ETo), affect their terpene composition in both, free and bound forms. To analyze this, GCxGC-TOFMS was used in combination with enzymatic hydrolysis to release terpenes from their precursor compounds[1].

A total of 80 different terpenes were identified, including myrtenol,β-cyclocitral or β-copaene, among others, with significant variations among grape cultivars and water regimes. In general, a higher concentration was found under the drought regime, suggesting a good adaptability of these cultivars in terms of terpene composition to future climate scenarios. Consequently, this study highlights that these recovered minority grape varieties could be promising candidates for cultivation in semiarid regions, where water availability is limited. This approach would support the sustainability of the wine industry while maintaining the aromatic quality of the wines.

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POSTER

Physical-chemical characterization of Moscatel de Setúbal fortified wines from different vintages

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Keywords: Moscatel de Setúbal fortified wine, winemaking, phenolic composition, chromatic characteristics

ABSTRACT

Moscatel de Setúbal is a Portuguese fortified wine with Protected Designation of Origin (PDO Setúbal), made from Moscatel de Setúbal grape variety (Muscat of Alexandria) [1]. The particular winemaking process of this white wine comprises fortification with wine spirit or vinous alcohol after a short period of alcoholic fermentation, followed by a prolonged maceration stage (commonly 5 months) with the skins and grape seeds. After that, traditionally the mixture of free-running wine and press wine is aged in used wooden oak barrels, for a minimum of 18 months [1]. Although highly recognized for its quality, only scarce scientific knowledge is available on this wine. This study aimed to characterize Moscatel de Setúbal wines from different vintages, in terms of general physical-chemical composition, phenolic composition and chromatic characteristics. For that, twenty-seven Moscatel de Setúbal fortified wines from different vintages (1985 and from 1995 to 2020), collected in May 2023, from the corresponding barrels where they are ageing, were analysed regarding chromatic characteristics [Absorbance at 420 nm, CIELab (L*, a*, b*, C, h)], turbidity [2] tanning power [3], and phenolic composition (total phenols [4], monomeric flavanols and proanthocyanidins according to the degree of polymerization [5] [6]). All analytical determinations were performed in triplicate and the data results were subjected to one-way analysis of variance (ANOVA). Whenever a significant effect ($p<0.05$) of the year of production was observed, the Fisher's minimum significant difference test was used to compare the wines. For the parameters for which there was a significant effect of the vintage year, principal component analysis (PCA) was performed. As expected, it was found that the longer the barrel ageing time, the more intense the colour of these wines. Higher values of total phenols content were observed in the older wines and, simultaneously, the tanning power was higher in wines with longer ageing period. In the older wines, the oligomeric proanthocyanidins and flavanol monomers were found in higher proportion than the polymeric proanthocyanidins. Therefore, two profiles of wines were identified: a first one in which flavanol monomers predominate (vintages from 1985 and 1995 to 2001, except 1997), and a second one with predominance of polymeric proanthocyanidins (vintages from 1997 and 2003 to 2020). The results obtained confirm that the ageing step influences the chromatic characteristics and phenolic profile of this fortified wine. Finally, this study enlarges the very limited knowledge on Moscatel the Setúbal fortified wines.

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POSTER

Effects of urea and nano-urea foliar treatments on the aromatic profile of Monastrell wines

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Keywords: fertilizer, vineyard, nanotechnology, grape

ABSTRACT

Foliar application of urea has proven to be an effective method for increasing the amino acid content in grapes, especially when the vineyard has additional nitrogen needs. These treatments can prevent problems of stucking fermentation during winemaking. Furthermore, the synthesis of different aromatic compounds in wine is partially related to the content of different amino acids in must.

In this work, the effect over wine aromatic profile of foliar treatments with urea and nano-urea in Monastrell vineyards during two vintages, 2020 and 2021, was studied. Foliar treatments were applied at veraison and one week later: i) Control (water), ii) urea and iii) nano-urea. The aromatic profile of wines was analysed by solid phase microextraction (SPME) coupled to a gas chromatograph, using the methodology of Moreno-Olivares [1]. An organoleptic analysis was carried out in order to check whether there were organoleptic differences between control wines and those from the treatments.

Regarding to the results, in 2020 there was no clear effect of the treatments on the aromatic composition of wines, with a decrease in total aromatic concentration with respect to control wine in both treatments, being 14% for urea and 6% for nano-urea. This fall was mainly due to the lower values found in the alcohol family. In contrast, fruity esters were not affected in the urea treatment and increased in the nano-treatment by 12%. On the other hand, 3-methyl-thio-1-propanol was lower for the urea treatment by 17% and unchanged for the nano-treatment.

In 2021 for urea treatment, the effects were opposite to previous year, total aromas were increased by 24%, mainly due to the increment in alcohol family. Moreover, fruity esters were also increased. However, the behaviour of wines from grapes treated with nano-urea was very similar to that obtained in 2020, showing a 5% decrease in total aromatic composition. Both treatments presented a reduction in 3-methyl-thio-1-propanol compared to control wine, being 16% for urea and 51% for nano-urea treatment.

Finally, during the two years of the study, the organoleptic analysis showed no significant differences between the control wines and the wines from the treated grapes.

In conclusion, the aromatic profile of wines from grapes treated with urea and nano-urea revealed small changes, these variations were dependent on both vintage and treatment, also the sensory characteristics of wines were not modified.

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POSTER

Simultaneous determination of ethanol and methanol in wines using FTIR and PLS regression

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Keywords: alcohol profiling, chemometric modelling, spectroscopy, FTIR

ABSTRACT

Wine is a complex hydroalcoholic solution, with ethanol levels serving as a critical quality parameter. Produced by yeast during the fermentation of hexose sugars, namely glucose and fructose, ethanol not only contributes to the sensory attributes of wine but also plays a vital role in influencing interactions with other components, such as tannins and volatile compounds [1]. Methanol, a naturally occurring component in wine, is primarily produced during alcoholic fermentation through the enzymatic breakdown of pectic polysaccharides in grape skins [2]. While methanol levels in wine are typically low and pose minimal toxicological risk, the International Organisation of Vine and Wine (OIV) has established maximum acceptable limits of 400 mg/L for red wines and 250 mg/L for white and rosé wines. Traditional methods for measuring ethanol and methanol include electronic densimetry and gas chromatography with flame ionization detection (GC-FID). While accurate, these methods are time- and labor-intensive, prompting the adoption of more efficient, non-destructive analytical techniques. FTIR is recognized for its rapid, automated, and non-invasive capabilities, making it a valuable tool for modern wineries and laboratories. This study explores the potential of FTIR spectroscopy, enhanced by chemometric approaches, to accurately quantify simultaneously methanol and ethanol in wine samples. To quantify ethanol and methanol in wine samples standard solutions of ethanol in water, methanol in water, and various combinations of both, were used. Duplicate FTIR measurements took place in transmission mode with the use of a Perkin Elmer LQATM 300 FT-IR wine analyzer. A mathematical model was developed using Partial Least Squares (PLS) regression. For external validation purposes, the predicted ethanol and methanol concentrations of 20 wine samples were compared to electronic densimetry for ethanol determination and GC-FID for methanol determination. The developed FTIR model demonstrated the feasibility of simultaneous ethanol and methanol quantification in wine samples, offering the potential for quality control in wine production. Future improvements should include expanding the dataset with samples from diverse wine types, grapevine cultivars, and winemaking techniques across various wineries. To enhance methanol prediction accuracy, samples with higher and varied methanol levels should also be incorporated [3].

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POSTER

^{137}Cs analysis by gamma spectrometry and its potential for dating Portuguese old wines

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Keywords: ^{137}Cs analysis, radioactivity, dating, prestigious vintages, authenticity

ABSTRACT

Analytical methods for dating wines often rely on assessing anthropogenic and cosmogenic radionuclides, including ^{14}C and ^{137}Cs [1,2]. Measurements of ^{137}Cs for dating can be implemented through either a destructive approach involving radiochemical separation or via a non-destructive approach utilizing direct gamma-spectrometry [3]. Given the rarity and historical and commercial value of aged wines, this study explores non-destructive ^{137}Cs detection in bottled wines. The methodology is based on measuring gamma-emitting radionuclides within the energy range of 46.5keV–1836 keV, using Hyper Pure Germanium (HPGe) detectors. A unique calibration system was designed for horizontally positioned wine bottles inside the detector. The method was optimized and validated using model wines after the addition of known levels of ^{137}Cs, confirming the accuracy of the approach. Furthermore, an interlaboratory comparison, employing a Broad Energy Germanium (BEGe) detector demonstrated consistent trends in radioactivity measurements, further corroborating the reliability of the approach. The study represents the first application of ^{137}Cs dating to Portuguese wines, both fortified and non-fortified, from vintages spanning 1947 to 1970. The findings highlighted variations, depending on the region and type of wine. No detectable radioactivity was found in wines produced before 1950 or after 1969. Interestingly, fortified wines exhibited lower ^{137}Cs levels than non-fortified wines, likely due to differences in winemaking practices. This non-destructive and non-invasive method proves effective for distinguishing between wines made before and after the anthropogenic release of radionuclides in the 1950s. It offers additional valuable information to resolve ambiguities in wine dating while maintaining the integrity of the bottled wine.

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FLASH TALK

Exploiting the diversity in spent yeast for its valorisation towards producing yeast-derived processing aids

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Keywords: side stream valorisation, spent yeast, mannoprotein, yeast beta-glucan

ABSTRACT

In view of sustainability and zero-waste initiatives, the valorisation of sidestreams is a key emerging topic in the wine industry. Spent yeast (SY), usually found in the fermentation lees, is the second largest sidestream in wineries, accounting for approximately 25% of the total sidestreams, amounting to approximately 2.5 million tonnes worldwide[1,2]. Today, SY is mainly either processed as waste, which is associated with a high cost, or used for low-value applications such as bioenergy or compost[1,3]. However, several high-value applications are on the rise where specific yeast-derived components are used for functional purposes in food or feed. Within the wine industry, several of these yeast-derived products are already used to improve wine quality. For example, mannoprotein isolates can be used to protect against tartrate precipitations or protein haze and to accelerate the effects on on-lees ageing[1,4]. However, these products are usually derived from baker's yeast instead of using the spent yeast already available. To accommodate the use of SY for such high-value applications, it is important to understand yeast properties to allow for an efficient production of these yeast-derived components. Therefore, we set out to investigate the effect of fermentation on yeast by examining a wide variety of SY samples to evaluate their potential for valorisation towards functional yeast-derived components.

To achieve this, 32 spent yeast samples were collected from various wineries and breweries. These samples were analysed for a set of chemical (e.g. cell wall composition, protein content, polyphenol content) and physiological characteristics (e.g. cell size, cell wall hydrophobicity, cell surface charge). In these samples, a large variability in cell wall compounds (β-glucan 7-18% and mannoprotein 6-23%) was observed. To investigate the impact of this variability on the isolation of yeast-derived components, SY was autolysed and the amount of cell wall material in the isolates was determined, which varied between 22 and 87%. In addition, the assimilable nitrogen content in yeast extracts varied by a factor of 5 depending on the specific SY sample. Results from this work can be used to assess the suitability of an SY stream for valorisation purposes, which will increase the value of these streams and provide winemakers with an additional stream of revenue.

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POSTER

Study of the volatile aroma profile of five Italian grape varieties submitted to controlled postharvest withering

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Keywords: postharvest dehydration, Italian grapes, aroma compounds, straw wines, withering

ABSTRACT

Wines made with grapes submitted to postharvest dehydration are often referred to as "passito" or "straw wines." This distinct style of winemaking consists of a process of water loss that allows the berries to undergo a mild water stress and senescence process [1]. Several factors can influence the dehydration kinetics of grapes, some related to the environmental conditions (temperature and relative humidity) and others to the grape characteristics (surface area/volume ratio, skin thickness) [2]. Postharvest dehydration introduces important physicochemical changes and stress to the cell, triggering modifications of genes involved in the formation pathways of many volatile compounds and their precursors [3].

This work aimed to evaluate the aromatic evolution of five Italian grapes varieties ('Aleatico,' 'Corvina,' 'Moscato di Scanzo,' 'Nebbiolo,' and 'Sagrantino') subjected to controlled postharvest dehydration (T 14-15 °C, RH 40-50%). Grapes at different stages of dehydration (0%-fresh, 10%, 20%, and 30% weight loss) were macerated in a hydroalcoholic solution to extract volatile compounds. Analyses were carried out by GC-MS and SPE/SPME for the identification and quantification of free and glycosidically bound compounds belonging to terpenes, norisoprenoids, volatile phenols, and C_6 alcohol classes. Results were normalized according to weight loss in order to eliminate a concentration effect. A variety-dependent behavior was found in terms of both accumulation/degradation of aroma compounds and dehydration kinetic. For Sagrantino, the highest levels of terpenes were observed at 30%, while for norisoprenoids and volatile phenols, at 10%. For Nebbiolo, high levels were found for free and bound norisoprenoids (0% and 20%) and for free and bound C_6 alcohols (10% and 30%). For cv. Corvina and Moscato di Scanzo, the highest levels of free compounds were found in fresh grapes; regarding the bound compounds, a similar behavior was observed with a maximum accumulation at 10% and 20%. In Aleatico, the highest levels were found in free and bound norisoprenoids (10%) and free volatile phenols (10%). In conclusion, postharvest dehydration can be an important factor modulating the aroma profile of grapes. This effect is complex and varies depending on the degree of dehydration and the class of compounds. In most of the cases, free compounds decreased at 30%, indicating that at this level, compounds can start to degrade. Instead, glycosidically bound compounds accumulate at 10 and 20%, which can be a source of aroma potential that later can be released during fermentation and aging.

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POSTER

Development of a new lab-scale carbonation method for applications to sparkling wines

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Keywords: carbonation, CO_2 solubility, dissolution, sparkling wines

ABSTRACT

Carbon dioxide (CO_2) is the gaseous species responsible for the sparkle in all sparkling wines, influencing their visual appearance, aromas and mouthfeel[1]. Behind the industrial-scale production of sparkling wines (and sparkling drinks in general) lies a simple law, known as Henry's equilibrium, which states that the concentration C_L of dissolved CO_2 in the liquid phase is proportional to the pressure of gas-phase CO_2 in a sealed container according to $C_L = k_H P_{CO2}$ (with k_H being the Henry's constant of CO_2 in the liquid phase, and P_{CO2} being the partial pressure of gas-phase CO_2 in the sealed container)[2]. However, precise knowledge of the Henry's constant of CO_2 in complex water/ethanol mixtures such as sparkling wines remains challenging due to the high variability of the multitude of compounds present (such as ethanol, sugars and myriads of small or macromolecules[3,4]).

In the present work, an accurate and reproducible carbonation method for measuring the solubility and dissolution kinetics of CO_2 in model wines was developed. A lab-scale carbonator has been designed to inject gaseous CO_2 in a controlled manner up to concentrations of around 10-12 g/L in standard 75 cL "Champenoise" bottles sealed with crown caps. Various tests were performed with variations in the temperature (at 1, 12 and 19°C), ethanol concentration (at 0, 12 and 40% vol.), and pH (3 and 7) of the model wine solutions. Moreover, increasing addition of yeast cell wall products were also performed (with 10, 20 and 100 cL hL^{-1}, respectively). Preliminary results show that the solubility of CO_2 increases at low temperatures and with moderate ethanol concentrations, while the presence of yeast cell wall products does not significantly impact its solubility, but improved mass transfer up to a threshold where viscosity becomes limiting. This brand-new carbonation method makes it possible to study the effects of the compounds of interest on the quality of sparkling wines (and sparkling drinks in a broader sense), in relation to their foam and effervescence for example. Future perspectives include an in-depth analysis of the impact of various compounds on olfactory and organoleptic properties, indeed crucial to the consumer experience. In short, this method is a powerful tool for analysing production parameters and optimizing the sensory qualities of sparkling beverages. Ultimately, this approach could be extended to other complex carbonated matrices, thus contributing to the development of new formulations of sparkling drinks.

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FLASH TALK

Unraveling the role of grape cell wall in shaping the fermentation rate, the polyphenolic profile and quality of red wines from disease-resistant and drought-tolerant grapes in Occitanie varietal selection

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Keywords: extractibility, polysaccharides, polyphenols, varietal selection

ABSTRACT

Climate change and an evolving environmental and societal context call for the exploration of disease-resistant and/or drought-adapted grape varieties that meet the demands of consumers and society. Integrating data on red wine quality markers (polyphenols and aromas) earlier in the varietal selection process and understanding their extraction and production are major challenges for the wine industry. These efforts aim to identify varieties with desirable oenological properties. Polyphenols are one of the most abundant and important compounds in red wines, since anthocyanins are their main pigments and tannins bring astringency and mouthfeel. Lots of studies have been conducted on polyphenol profile in red wines from interspecific varieties but also in their associated grapes [1]. Recent studies have demonstrated that the polyphenolic characterization isn't the perfect reflection of the final wine composition [2][3]. They have explained these differences by the difference of extraction, the numerous interactions between polyphenols but also with cell-wall polysaccharides [4]. However, the data on polyphenol composition and extraction through cell-walls in red interspecific grapes and wines has not yet been compared to traditional Vitis vinifera varieties. Moreover, their cell-wall composition and their impact on polyphenol extraction is not fully understood yet and seems to have an significative impact on the wine final quality and needs to be elucidated. On this study, the tannins, anthocyanins and polysaccharides of 32 red grape varieties including 14 *Vitis vinifera* and 18 interspecific hybrids were analysed, as well as in their wines produced by a standard microvinification process. Significant differences have been observed between varieties in anthocyanin content (p-value < 0.05) and polysaccharides composition in both grapes and wines (p-value < 0.05 for both wines and berry skins). The repartition of anthocyanins into the different families as well as tannin distributions profiles have been characterized in grapes and wines and demonstrate a difference in extraction. Plus, PCA demonstrates a positive link between fermentation rate and polysaccharide composition and a negative relation with polyphenol content. Such results could be explained by the difference in cell-wall compositions and their ability to interact with polyphenolic compounds.

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POSTER

Two dimensions, one mission: unlocking grape composition by GC × GC

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Keywords: GC × GC-ToFMS, volatile composition, free compounds, white varieties

ABSTRACT

Aroma is one of the most important attributes that determine consumer's perception of the sensory quality of wine and varietal typicity. The aroma of grapes consists of big diversity of volatile compounds, including esters, terpenic compounds, C_{13} norisoprenoids, C_6 compounds, benzene derivatives, alcohols, aldehydes, among others. Given the complexity of the grape volatile profile and the trace concentrations of these compounds, employing advanced analytical techniques such as GC×GC-ToFMS is essential. This method enables efficient separation and precise detection of volatile compounds within the intricate grape matrix [1, 2].

This work aims to analyze the volatile composition of three different Portuguese white grape varieties (Terrantez, Encruzado and Malvasia Fina) using HS-SPME-GC×GC-ToFMS. To increase the efficiency of the SPME technique, a detailed optimization of all the steps of the sample preparation technique was carried out. The optimized conditions were 4 g of grapes, 2 g of NaCl, and 2 mL of H_2O. Additionally, the extraction conditions using a carboxen/divinylbenzene/polydimethylsiloxane fiber were also optimized and performing the extraction for 40 minutes at 60 ºC allow to identify more volatile compounds.

As a result, it was possible to identify sixty free compounds, including four C_6 compounds, three benzenoids, twenty-four monoterpenes, twenty-four sesquiterpenes and five C_{13} norisoprenoids. The results showed that there are some compounds in only one variety, for example, β-copaene is only present in the Encruzado variety, as well as *trans*- pyran linalool oxide in the Malvasia Fina variety and, finally, in the Encruzado variety, α-thujone. Compounds such as D-verbenone, δ-elemene, cis-thujopsene, α-muurolene, cubenol, α-cadinene and δ-selinene were only found in the Terrantez and Encruzado varieties, while the compound 5-hexen-2-ol was only found in the Malvasia Fina and Terrantez varieties. Comparing the varieties, Malvasia Fina showed the highest relative total area of C_6 compounds, while Terrantez showed the highest relative total area for benzenoids. In addition, Encruzado revealed the highest relative total area for monoterpenes. Linear discriminant analysis (LDA) further revealed clear differences in the volatile composition between the studied white varieties.

HS-SPME combined with GC×GC-ToFMS provides a suitable and sustainable approach for determining the volatile signature of grapes from different varieties.

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POSTER

Adapting Portuguese vineyards to climate change: impact of different irrigation regimes on phenolic composition

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Keywords: HPLC-DAD, phenolic profile, irrigation regimes, autochthonous varieties

ABSTRACT

Climate change has led to increased extreme weather events, such as severe droughts and intense rainfall, with regions like Alentejo and Algarve in Portugal, being particularly affected. Some grape varieties are better suited to these conditions due to their ability to close stomata under water stress, reducing water loss through evapotranspiration from the leaves, and potentially leading to increased synthesis of phenolic compounds [1, 2]. Understanding the influence of water availability in concentrating phenolic compounds in autochthonous varieties can be an important tool to adapt to water scarcity while preserving wine typicity and water resources.

This work has been carried out, to analyze the profile of phenolic compounds in four Portuguese red grape varieties: Tinta Gorda, Tinta Miúda, Tinta Caiada, and Moreto. These varieties were cultivated in Reguengos de Monsaraz (Alentejo), under three irrigation regimes (water comfort, moderate water deficit and rainfed) and harvested in 2024. The water comfort regime applied 2686 m³/ha of water, moderate water deficit applied 1343 m³/ha, while the rainfed regime relies solely on natural precipitation. The grape varieties studied are cultivated under organic production practices. The phenolic compounds from the grapes were extracted after 1 hour of maceration with ethanol and analyzed using high-performance liquid chromatography coupled diode array detector (HPLC-DAD).

Nineteen phenolic compounds were identified and quantified in the studied varieties, including anthocyanins, flavanols, flavonols, phenolic acids and stilbenes. In Tinta Gorda, no significant differences were observed between the moderate water deficit and rainfed regimes, although both significantly differed from water comfort. This variety exhibited higher phenolic concentrations under moderate water deficit and rainfed conditions, highlighting its adaptability to water scarcity. Tinta Miúda was the only variety to display significant differences in total phenolic concentrations in all irrigation regimes, with phenolic levels increasing as water availability decreased. Tinta Caiada showed no significant differences between water comfort and moderate water deficit but had the highest phenolic concentration under rainfed conditions, which was statistically distinct from the other irrigation regimes. Moreto exhibited a similar pattern to Tinta Gorda, but its phenolic concentrations decreased with reduced irrigation, likely due to lower grape ripeness under water-scarce conditions.

In summary, the results reveal that Tinta Gorda, Tinta Miúda, and Tinta Caiada varieties exhibit higher concentrations of phenolic compounds under rainfed conditions. Among these, Tinta Miúda and Tinta Caiada stand out as the most statistically promising varieties in terms of adaptability to water scarcity.

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POSTER

Evolution of grapeseed composition during maturation and characterization of its impact on wine compound using molecular networks

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Keywords: grapeberry ripening, grapeseed, wine, non-targeted metabolomics and molecular networks

ABSTRACT

Usually the winemaker consider the grapeberry maturity as an actor of the wine quality. Grape seed are frequently used as a marker to assess the grape maturity. The first aim of this study is to obtain a better understanding of the impact of grape seed maturity on the grape seed and grape berry composition. Furthermore, due to the lack of knowledge regarding grape seeds and the need for new maturity markers, part of this work aims to enhance the current methods of assessing grape seed maturity to help winegrowers determine the best harvest time. A second goal of this study is to characterize the effect of grape seed maturity on wine and to identify new compound in wine derived from grape seed.

Data for this study were collected from grape seeds picked at different maturity stages (from bunch closure to 2 weeks after harvest) and wines made at three harvest time (underripe, ripe and overripe) in 2024. Each grape seed sample was frozen until analysis and then samples were ground and extracted during 24H in methanol. They were then filtered and dried. The wine samples were directly filtered and dried without any prior extraction. Then they were diluted to the same concentration (1 mg/mL) and analyzed by HPLC MS/MS. All the results were used to construct a molecular network using the fragmentation pattern and retention time of the molecules[1]. The different results were analyzed using the software MetGem[2]. MetGem or personal annotation were used to annotate the molecules in the molecular network that were not found in the database but still appeared promising. With the grouping capability of molecular networks, families of molecules were identified (polyphenol, AA, nitrogen compounds). Even in the well-known family of molecules (polyphenols), recently discovered molecule (epicatechin vanillate[3]) and potential new molecules were annotated. Not all molecule can be classified into family through molecular networking. Even so, molecules might be studied using semi (SQ) and quantitative approaches to validate markers of ripening evolution in grape seeds and to confirm their involvement in grapeberry ripening evaluation as well as in winemaking processes. For example, amino acid found in grapeseed could contribute to wine aroma[4]. Additionally, the quantity of catechin glucoside (found in red wine[5]) appear to increase (SQ approach) in grape seed during maturity, potentially being a good grape seed maturity marker. Finally, this work has enabled us to combine the molecular network approach and a semi-quantitative method to deepen our knowledge of grape seed ripening driven by specific markers.

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FLASH TALK

Effect of pre-fermentative cold soaking and use of different enzymes on the chemical and sensory properties of Catarratto wines

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Keywords: grape maturity, polysaccharides, enzymes, wine quality

ABSTRACT

The wine industry widely recognizes that early-harvested grapes or those with uneven ripeness at harvest can produce wines with an "unripe fruit" mouthfeel [1,2]. Despite this, it is still unknown which compounds cause these sensory flaws or the most effective winemaking techniques to address them. This study evaluates the impact of pre-fermentative cold soaking (PCS) and the addition of enzymes during must fermentation on the chemical composition and sensory characteristics of *Catarratto* wine, a variety frequently linked to these issues, when early harvested [2]. The research hypothesis suggested that grape polysaccharides released during PCS, along with yeast polysaccharides released during alcoholic fermentation, would result in smoother wines by the end of fermentation [3]. Two winemaking approaches were compared: non-prefermentative cold soaked (NPCS) wines followed traditional white winemaking, while PCS wines underwent a 48-hour skin contact at 4°C. Five trials were conducted for each group, including a control, three pectolytic enzymes with secondary activities, and a β-glucanase enzyme inoculated with fermenting yeast. Alcoholic fermentation kinetics, chemical-physical parameters, volatile organic compounds, and sensory profiles were analyzed. PCS treatment increased grape polysaccharide release, doubling total colloids, and the wine's volatile profile improved, increasing aromatic complexity. Enzyme treatments further enriched yeast-derived polysaccharides, with β-glucanase showing the greatest effect, raising mannose levels. Addition of enzymes before alcoholic fermentation boosted yeast polysaccharide levels without altering sugar fermentation kinetics. Sensory analysis confirmed that enzyme-treated wines reduced "unripe fruit" flavors and enhanced smoothness by the end of the fermentation. These findings demonstrate for the first time the potential of these techniques to refine the overall quality of *Catarratto* wines from early harvested grapes.

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POSTER

From bush to glass: unlocking the potential of indigenous microbes in Australian wines

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Keywords: bioprospecting, *Eucalyptus gunnii*, novel yeast strains, sugar utilisation

ABSTRACT

Global trends in the wine industry are changing, which is caused by consumer demands for aroma and flavour innovation. Producers in Australia, the sixth globally ranked wine producing country, are embracing this trend by exploring non-conventional yeast species to improve sensory qualities and achieve fermentation advantages. Bioprospecting in the Australian Bush is a novel approach to domesticate favourable environmental microorganisms for use in industry. Australia has over 24,000 unique plant species in which lie potential niches for novel microbes. One of these is *Eucalyptus gunnii*, commonly known as the Cider Gum tree. Historically, the tree sap was used by Aboriginal Australians to produce a sweet, naturally fermented drink called *way-a-linah*, and which is an excellent place to search for novel yeast strains. We collected samples from *E. gunnii* and have begun to isolate and identify yeast species using ITS profiling. Fermentations of isolates in 96-well plates were performed using a Chemically Defined Grape Juice (CDGJM), where growth and sugar utilisation were measured. Isolates with efficient sugar utilisation capabilities were screened on a larger scale, and their secondary metabolites and volatile compounds were analysed using HPLC and GC-MS. Out of the more than 550 isolates identified, the most abundant genera found were *Hanseniaspora*, *Kregervanrija* and *Zygosaccharomyces*. Out of all the screened isolates, 54% were able to use more than 90% of sugars in CDGJM. We expect this project will result in the identification and characterisation of novel yeast unique to Australia, suitable for wine fermentation.

FLASH TALK

Prototype development for the recovery of wine aromas from fermentation gases

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Keywords: fermentation gas, wine aromas, dealcoholised wines, icy shower

ABSTRACT

Dealcoholised beverages are trendy. But this market segment is slowed down by flavour losses during dealcoholisation and by the reduced perception of flavours in the absence of alcohol.

Adding foreign flavours distorts the product. One alternative is to add wine aromas that are already lost during alcoholic fermentation through evaporation. They represent a raw material with no additional costs and which is available in abundance. The recovery of volatile wine aromas from the fermentation gases is difficult because tiny amounts of the substance are present in a very large excess of carbon dioxide. Simply cooling the fermentation gases is not enough. In addition, the predominantly lipophilic aromas must be absorbed in a lipophilic, food-grade liquid. This is achieved by 'gas scrubbing' with cold ethanol. The process has been protected by a German [1] and a European [2] patent since 2022. In 2023, the process was published [3] and presented orally at the OIV congress.

In 2024, a first prototype was developed with modest means, which was designed for a must volume of 100 litres. The volatile aromas were captured at approx. -25°C in 100-200 ml of ethanol (96%), which was circulated. A Vigreux column with a mirrored vacuum jacket was used. The alcoholic concentrates obtained show aroma profiles typical of the grape variety, with particularly intense sweet primary aromas. The residual gas escaping from the apparatus is almost odourless. Wine aromas can only be smelled if the flow rate is too high (over 1 l/min). Towards the end of the fermentation, some acetaldehyde can also be detected.

The separation of the aromas from the ethanol used is crucial for the application in dealcoholised wines. A new technique, which is eligible for another patent, was used for this.

In addition to the improvement of dealcoholized wines, other applications are also being considered, such as fortified wines and distilling mashes. If a normal wine is fermented at a reduced pressure, large quantities of aromas and alcohol evaporate. The aromas are recovered using the technology presented, while the alcohol is removed. This is an elegant way to reduce excessive alcohol content. In any case, a valuable additional product is obtained: food-grade carbon dioxide that can be used in the beverage industry.

The process is being developed to market maturity as part of a Franco-German project under the brand 'Montclair Tech'. It is supported by Bernard Magrez Start-Up Win (Strasbourg) and Triathlon, the entrepreneurship ecosystem of Saarland University.

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FLASH TALK

Dimethyl sulfide transfer through wine closures during bottle aging: implications for wine aroma management

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Keywords: permeation, closure, dimethylsulfide, aroma transfer

ABSTRACT

Dimethyl sulfide (DMS) is a volatile sulfur compound with a complex role in wine aroma, contributing both desirable and undesirable sensory characteristics depending on its concentration (1). While DMS is known to accumulate during bottle aging through the degradation of precursors such as S-methylmethionine (SMM) (2), this study provides the first demonstration that DMS can also be lost through wine closures *via* permeation mechanism. This phenomenon, previously unreported, highlights the critical role of closure permeability in shaping the aromatic profile of aged wines.

In practice, we used 3 different experimental designs:

- Set 1: model wines spiked with DMS (n=3) and unspiked ones (n=3, control) were bottled and sealed with same micro-agglomerated closures. Bottles were then equipped with ®Tenax tubes to capture volatiles at the top of the bottles after vertically ageing at 35°C.
- Set 2: model wines were spiked with synthetic SMM, bottled and sealed with 4 closures of varying oxygen transfer rates (OTR). Accelerated aging experiments were conducted at 35°C for 4 months and corresponding wines were analysed in terms of SMM and DMS at t4months.
- Set 3: To validate findings, similar analyses were performed on Syrah wines aged 2 years in standard cellar conditions with closures of varying OTR. These wines were analysed at t0, t12 months and t24 months in terms of SMM and DMS.

The results obtained in the set 1 demonstrated the phenomenon of DMS permeation through closures, as DMS was detected only in ®Tenax tube placed on the top of the bottles containing the spiked solution. In the set 2, accelerated aging experiments revealed that up to 12% of DMS in model wine was lost through micro-agglomerated closures. Finally, in Syrah wines, DMS concentrations increased during bottle aging due to SMM degradation. However, wines sealed with higher-permeability closures showed reduced DMS levels compared to those with low-permeability closures, corroborating findings from model wine studies.

This study highlights the dual role of closures in managing oxygen ingress and volatile compound retention. Low-permeability closures can help preserve DMS in wines where it enhances aromatic complexity, while higher-permeability closures might mitigate reductive off-flavors in wines prone to sulfur compounds. These findings may account for the reductive notes empirically observed in red wines sealed with highly impermeable closures compared to those bottled with more permeable alternatives. The latter could be advantageous by facilitating the permeation of light volatile sulfur compounds, such as H_2S, MeSH, or EtSH.

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POSTER

Influence of social interaction levels on panel effectiveness in developing wine sensory profiles using consensus method

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Keywords: sensory profiles, consensus method, social interactions, descriptive analysis

ABSTRACT

The development of sensory profiles is crucial for quality control and innovation in the wine industry. If quantitative descriptive analysis is the most commonly used method for establishing sensory profiles due to its robustness, it presents significant limitations. Specifically, this approach requires 12 to 15 trained panelists, which can pose logistical challenges. Additionally, the statistical analyses involved are often complex. Alternative methods exist, such as the consensus methodology, which requires only 4 to 6 panelists. Unlike conventional profiling, which relies on individual assessments aggregated statistically, consensus profiling involves collective discussions among panelists to agree on sensory descriptors and intensities (Chambers, 2018). This results in a unique sensory profile, avoiding laborious statistical analyses of individual profiles. This method offers advantages, including faster evaluations and fewer participants (Chambers, 2018), enabling efficient wine assessments by a small panel while providing scientifically robust results.

However, social interaction within the panel can influence the quality and consistency of these profiles. Since exchanges are inherent to this methodology, they introduce bias, as social dynamics can affect judgments and compromise objectivity (Syarief et al., 1985; Meilgaard, 1991). To explore this, six panels of four participants evaluated three white wines, each presented twice, under three interaction modalities. In the first modality, participants engaged in face-to-face discussions. In the second, they interacted verbally without visual contact. In the third, they communicated in writing without seeing one another.

The results demonstrate that each of the studied approaches has its own advantages and limitations depending on the study objectives, which will be further discussed. The findings highlight the potential for optimizing consensus methodologies, a robust tool for wine industries to achieve more reliable and precise wine evaluations.

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FLASH TALK

New use of natural silk fiber as a fining agent in wines

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Keywords: silk fibre, wine, colour, oxidized compounds, fining

ABSTRACT

Undesirable compounds in wine, like OTA, biogenic amines, and pesticide residues, can negatively affect its quality and pose health risks to consumers. In addition, an excess of tannins can lead to an unpleasant rise in astringency and bitterness, which makes tannins another target of reduction. The primary method used by winemakers to lower these undesirable compounds is fining. However, some commonly used fining agents can trigger allergies or even increase the protein content in the wine, which can increase turbidity. To prevent these issues, the use of plant fibers, such as those from grape pomace, might be a viable alternative[1]. Trying to find other alternatives, the objective of this work was to explore the effect of a natural fiber, the silk fibers obtained from the *Bombyx mori* cocoons, in the reduction of undesirable compounds and in the chromatic profile of a young red wine and an oxidazed white wine. Indeed, this natural biopolymer is not only abundant, due to the large-scale cultivation of silkworms for the textile industry, but also sustainable and can be obtained at reasonable low cost as textile by-product. A fining trial was conducted with the silk fibroin fibres, both in shredded and raw state, at the maximum concentration allowed by OIV (2 g/L) in the wines previously doped with histamine, OTA and several pesticides. After 48 h of contact, wine chromatic parameters and phenolic compound content were measured, along with the concentration of the undesirable compounds in the treated wines. The results obtained showed that the silk fibers were successful at reducing oxidized phenolic compounds in white wine and tannins in red wine, and able to significantly reduce some of the tested pesticides, histamine and OTA, affecting minimally the wine colour in red wine. For that, this fibre may be a very good alternative for obtaining safer and high quality wines.

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FLASH TALK

Exploring the inhibitor effect of different commercial chitosan-based preparations on malolactic fermentation in rosé wine

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Keywords: chitosan, rosé wine, sulphurous, malolactic fermentation

ABSTRACT

Chitosan is a natural polymer of β-D-linked N-acetyl-D-glucosamine units (1,2), that has only recently been approved by OIV for its use in winemaking to help with microbial control, metal chelation, clarification, and reducing contaminants[1]. Beyond wine, it has also been shown to exhibit other beneficial properties, such as antioxidant and antiradical effects, in various foods. However, the full extent of its actions in must and wine has yet to be thoroughly explored. For microbial control, sulphurous is usually used in wine industry, but this compound has some risks and inconveniences that make it necessary to look for alternatives to its use, even though it is cheap and very practical. The main issue with sulphites is that they are allergenic compounds that can cause severe reactions in sensitive populations or in high concentrations they modify the sensory properties of the wine[2].

In this study, we aimed to test four commercial chitosan-based preparations to inhibit malolactic fermentation in a rosé wine produced in our experimental winery and compared them to sulphurous treatment. Microbiological analysis of lactic and acetic bacteria, together with the determination of malic, lactic and acetic acid concentrations were carried out in the wine for 45 days. Furthermore, the composition of the chitosan samples was analysed by mass spectrometry. The results showed that only two of the quitosan treatments were able to effectively inhibit the malolactic fermentation, while the other treatments, including the sulphurous treatment, were only capable of delaying it. Among the chitosan treatments that inhibit the fermentation, one, which managed to reduce the CFU/mL to zero in only seven days, was a preparation that also contained small amounts of fumaric acid in the formulation, while the other treatment, where the formulation was composed only of a yeast extract and chitosan reduced the CFU/mL more slowly until after about 30 days reached zero. These results allow us to correlate the composition of the different chitosan preparations with their effectiveness, as well as to show that certain chitosan combinations can inhibit malolactic fermentation more effectively than a sulphurous treatment.

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POSTER

Unveiling the chemical headspace of sparkling wine glasses by laser spectroscopy

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Keywords: sparkling wines, Champagne, gaseous ethanol, CO_2, spectroscopy, interband cascade laser

ABSTRACT

Right after serving a sparkling wine into a glass, thousands of rising and bursting bubbles convey gas-phase CO_2 and volatile organic compounds (VOCs) in the headspace above the champagne surface, thus progressively modifying the gaseous chemical space perceived by the consumer [1]. Champagne and other traditional method sparkling wines being complex water/ethanol mixtures (with typically 12-13% ethanol by volume), gaseous ethanol is therefore undoubtedly the most abundant VOC in the glass headspace [1]. Yet, both gaseous ethanol and CO_2 are known to have a multimodal influence on wine's perception [2]. As their abundance increases, these two gaseous species stimulate the human trigeminal system, leading to the so-called carbonic bite (induced by excess gaseous CO_2), while gaseous ethanol results in a tingling/burning sensation [2,3]. Monitoring simultaneously gaseous CO_2 and ethanol (in space and time) in the headspace of sparkling wine glasses is therefore crucial to better understand the neuro-physicochemical mechanisms responsible for aroma release and flavour perception during sparkling wine tasting.

Over the past decade, a diode laser infrared spectrometer has been developed and progressively upgraded in our group to accurately monitor gaseous CO_2 through the headspace of champagne glasses [4]. After the addition of a multipath system dedicated to the mapping of CO_2 throughout the glass headspace [5,6], and the design of an optomechanical prototype dedicated to the replication of the human gesture of swirling wine [7], the spectrometer has recently been once again upgraded to monitor gaseous ethanol thanks to the recent interband cascade laser (ICL) technology [8]. From the start of sparkling wine serving, and during the next minutes following, kind of spatial-, temperature-, and glass shape-dependent gas-phase CO_2 and ethanol footprints were revealed in the headspace of glasses. It is noteworthy to mention that accurately quantifying gaseous ethanol in the headspace of wine glasses is a first step towards quantifying the myriads of VOCs responsible for the wine's bouquet, which also paves the way for a better understanding of the role of the glass and overall tasting conditions in the world of wine and spirits in the broad sense.

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FLASH TALK

Identification of novel aromatic precursors in winemaking grapes using an optimized fractionation and UHPLC-MS analysis

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Keywords: aroma precursors, acid hydrolysis, phenolic aromatic fraction, glycosides

ABSTRACT

Winemaking grapes contain a diverse array of non-volatile precursors that become noticeable only after hydrolysis reactions or molecular rearrangements, during which aroma compounds are generated and released [1]. Among these, glycosidic precursors are the most abundant and play a key role in the development of wine aroma [2]. Although direct determination of these molecules is possible using UHPLC-MS [3], it remains challenging due to the lack of commercial standards, the wide variety of precursors associated with the same aroma, and their typically low concentrations. A deeper understanding of the nature and behaviour of these molecules during the different stages of the winemaking process would allow for the optimisation of certain stages, such as maceration time or enzyme addition, among others. This study aims to identify the largest possible number of aroma precursors through an optimized fractionation approach [4], involving a sequence of semi-preparative chromatographies, first by size exclusion and then by normal phase fractionation. This method is designed to reduce the excessive complexity of grape samples in UHPLC-MS analyses, thereby facilitating precursor identification.

For this purpose, a phenolic-aromatic fraction from Garnacha grapes was subjected to silica gel fractionation, improving a previously established protocol by increasing the sample size and adjusting the polarity of the mobile phases. A total of 96 fractions were obtained, 92 of which released aroma upon hydrolysis. These fractions were analysed using SPME-GC-MS to identify where the precursors of key varietal aromas -such as terpenes, norisoprenoids, phenols, vanillins, and cinnamates- were located. The hydrolysates from 55 of these fractions contained aroma molecules of interest and were subsequently analysed by UHPLC-MS to detect potential precursors. The identification process was based on three criteria: a) the expected molecular mass of the precursor, b) the presence of fragments in the MS/MS spectrum that were consistent with the precursor's structure, and c) the correlation between the precursor signal in UHPLC-MS and the corresponding aroma signal in GC-MS for the same fractions.

As a result, 175 precursors were identified, including 67 novel compounds not previously reported in the literature. Among these, 54 precursors were confirmed based on all the three identification criteria. The majority of the identified precursors were disaccharides (79) and monosaccharides (63), with a smaller proportion of trisaccharides (33). Noteworthy among them were 54 terpene precursors, 24 phenol precursors, 22 vanillin derivatives, and 14 cinnamate derivatives. This represents both a quantitative and qualitative advancement in the evaluation of the potential aromatic quality of winemaking grapes using UHPLC-MS. Furthermore, this approach would be useful for proposing new winemaking techniques or for developing new grape-derived products. It will also be essential for optimising grape quality and mitigating some effects of climate change.

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POSTER

Enhancing Monastrell wine quality in a climate change scenario: the role of cation exchange resins in addressing acidity challenges

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Keywords: titratable acidity, pH, cationic exchange, climate change, wine color

ABSTRACT

Climate change significantly impacts vine and grape physiology, leading to changes in wine composition, including reduced titratable acidity, elevated ethanol content, and higher pH levels [1]. These effects are particularly problematic in arid and semi-arid regions such as the Mediterranean areas, where high summer temperatures and low rainfall accelerate the degradation of grape acids [2]. This results in wines lacking sufficient acidity to maintain the desired level of freshness and quality. To address this issue, the wine industry employs various techniques to reduce pH and enhance acidity, such as acid addition, ion exchange, blending with high-acidity wines, and biological methods. Among these, cation exchange resins stands out as one of the most widely used and effective approaches. For that, this study explores the effect of treating must with cation exchange resins on the composition and quality of Monastrell red wines, comparing them with wines adjusted to the same pH with tartaric acid and untreated control wines. The results showed that treating part of the must with cation exchange resins (20% and 30%) significantly lowed pH values and increased total acidity compared to the control must. This trend was also observed in wines treated with tartaric acid. The resulting wines showed no significant differences on the concentration of phenolic compounds but must acidification favored the color quality associated to an increase of the color intensity and a decrease in the tone values. Moreover, sensory analysis showed tasters preferred treated wines, particularly those made with must acidified with cation exchange resins, which were perceived as fresher in the mouth. Therefore, must treatment with cation exchange resins may be a good method for lowering the pH and increasing the acidity of Monastrell red wines solving the problem of the significant decrease in acidity that grapes are suffering due to the temperature increase in the semi-arid regions associated to climate change.

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POSTER

Lactic acid bacteria: A possible aid to the remediation of smoke taint?

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Keywords: glycosidase, smoke taint, volatile phenols, lactic acid bacteria

ABSTRACT

With climate change, the occurrence of wildfires has increased in several viticultural regions of the world. Subsequently, smoke taint has become a major issue, threatening the sustainability of the wine industry. Indeed, following smoke exposure, ripening grapes absorb volatile phenols (VPs) arising from the burning of lignified plant material and store them as odourless glycosylated compounds. During the winemaking process, these precursors can be liberated through acidic hydrolysis or through the glycosidase activities of yeasts and lactic acid bacteria (LAB), thereby leading to undesirable odours such as ash tray, burnt, and smoky. Various remediation strategies have been proposed, including spraying kaolin on grapes to prevent absorption of VPs by grapes or various wine treatments by reverse osmosis or carbon addition to remove introduced VPs in wine, but these are currently employed with moderate success. LAB, including *Oenococcus oeni*, possess glycosidase enzymes, but studies have mainly been limited to the breakdown of artificial substrates such as *p*-nitrophenyl-β-glycosides, and their efficacy against smoke-derived VP glycoconjugates in real grape juice has never been truly assessed. Therefore, this study aimed to investigate the ability of a large number of wine-related LAB species to release VPs in real smoke-exposed grape juice. Indeed, the use of LAB with strong glycosidase activity could be used to ameliorate smoke taint, when combined with already proposed remediation strategies that are more effective on free VPs than on glycosylated VPs.

Forty-two LAB isolates were screened for glycosidase activity in sterile smoke-exposed Pinotage grape juice. Volatile phenols were quantified using Gas Chromatography - Mass Spectrometry. All isolates were found capable of releasing free-VPs to various extents. Four LAB isolates, namely *Lactiplantibacillus pentosus* 65.1, *Latilactobacillus sakei* 115, *Lentilactobacillus hilgardii* 87.2 and *O. oeni* 192, released more overall VPs than other investigated isolates in smoked Pinotage juice. Amongst the VPs quantified, isolates of *Lac. plantarum* and *Lac. pentosus* were found to release high levels of 4-ethyl phenol (4-EP), which was then demonstrated to originate not only from the release of smoke-derived glycosylated 4-EP, but also from *de novo* intracellular production. Overall, the study showed that selected LAB isolates secrete glycosidases, with good potential to release free-VPs prior to their removal using agents such as charcoal.

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POSTER

Geographical indication "Brandy Italiano": study on the influence of wood barrel toasting and natural seasoning on endogenous and wood-derived compounds of aged distillates

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Keywords: Brandy Italiano, wood toasting, wood seasoning, volatile compounds

ABSTRACT

The European geographical indication (GI) *Brandy Italiano* is exclusively reserved to brandy obtained in Italy from the distillation of wine from grapes grown and vinified in the national territory [1]. The product specification regulating the production of this geographical indication establishes a minimum ageing period of 6 months in oak casks with a capacity of less than 1000-L to consider *Brandy Italiano* as marketable [2]. The characteristics of the final product can be influenced by the various treatments that the oak wood undergoes during the cooperage process [3]. This study aimed to assess the influence of different wood toasting levels and natural seasoning duration on the volatile profile of this Italian GI, including wood-related compounds, varietal and fermentative volatiles. The research was conducted on brandies produced from wines obtained from cv. *Trebbiano Romagnolo* grapes, distilled by a two-step discontinuous method and aged in 350-litre oak barrels. Woods for cooperage were naturally seasoned for two different periods of time (24 and 36 months) and were toasted at two different degrees (light and heavy toasting). The brandies were aged for 8 months, i.e. 2 months more than the minimum ageing time required for the GI. The products were analysed by SPE-GC-MS and HPLC-DAD-FLD to determine their volatile composition and to evaluate the main wood-derived compounds according to the EU reference method of analysis of wood compounds in spirit drinks [4]. A two-way analysis of variance (ANOVA) was performed to study effects and interactions for each variable and level. Results demonstrated that the degree of toasting and the duration of seasoning influenced both the release of some aromatic compounds from the wood and the profile of some endogenous compounds. Wood seasoning, in particular, was found to have an impact on the content of individual phenolics and the ratio between lactones while toasting degree affected almost all compounds derived from lignin degradation. The presence of certain endogenous volatiles such as terpenes and esters was also discussed in light of the analytical results.

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POSTER

Towards 2D mapping of gaseous ethanol in the headspace of wine glasses by infrared laser spectrometry

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Keywords: wine tasting, water/ethanol mixtures, gaseous ethanol, sensor

ABSTRACT

Under standard wine tasting conditions, volatile organic compounds (VOCs) responsible for the wine's bouquet progressively invade the chemical space perceived by the consumer in the glass headspace. With usually 7-15% ethanol by volume in wines, gaseous ethanol is thus the most abundant VOC in the headspace of still wine glasses (but after gaseous CO_2 which has already been shown to be the predominant species in the glass headspace throughout the tasting of champagne and other sparkling wines [1,2]). However, gaseous ethanol plays a multimodal role in the perception of the wine bouquet via the ortho-nasal route [3]. Moreover, as a function of its abundance in the headspace of a wine glass, gaseous ethanol can induce an unpleasant tingling/burning sensation after triggering the human trigeminal system [3,4]. Monitoring gaseous ethanol in the headspace of wine glasses is therefore crucial to better understand the neuro-physicochemical mechanisms responsible for aroma release and flavor perception throughout wine tasting.

Gaseous ethanol was monitored for the first time in the headspace of champagne glasses by micro-gas chromatography (μGC), but with a very low time-resolution and at a single point in the glass headspace [5]. More recently, a sniffer-camera for visualizing ethanol vapors above a wine glass has been developed by using chemiluminescence from an enzyme-immobilized mesh [6]. These two series of works highlighted an inhomogeneous spatial distribution of ethanol in the headspace of glasses, with higher ethanol concentrations near the rim compared to the center of the wine glass, which could be attributed to the presence of wine tears along the walls of the glass. Even more recently, thanks to the recent interband cascade laser (ICL) technology, a brand-new sensor dedicated to monitoring gaseous ethanol in the headspace of wine glasses was developed and validated [7]. In the present work, this brand-new ethanol sensor was used to better apprehend how the concentration of liquid phase ethanol rules the overall evaporation of ethanol in the headspace above glasses. Real-time monitoring of gaseous ethanol was performed in the headspace of glasses dispensed with water/ethanol mixtures showing increasing concentrations of ethanol (from 0% to 100% vol.). Moreover, real-time monitoring of gaseous ethanol was also performed in the headspace of still wine and sparkling wine glasses. From the start of wine serving, and during the next minutes following, a kind of spatial- and temperature-dependent gaseous ethanol footprint was revealed in the headspace of glasses. Accordingly, the 2D mapping of gaseous ethanol was performed in the headspace of glasses, which was discussed based on the vapor-liquid equilibrium of the water/ethanol mixture combined with a diffusive 2D-model.

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POSTER

Understanding colloidal instability in white wine model solutions: A study focused on the effect of polysaccharides and salts onto bentonite efficiency

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Keywords: polysaccharides, protein, bentonite, colloidal instability

ABSTRACT

A white wine model solution (12% v/v ethanol, 4 g/L tartaric acid, pH 3.2) was used to assess wine colloidal instability as well as the influence of several wine components on bentonite performance in protein removal. BSA was used at a maximum concentration of 500 mg/L [1] as a protein standard, and sodium-activated bentonite was chosen due to its high efficiency demonstrated in previous studies [2]. For all tests, samples were let to react for 24 hours, protein content was measured using the Bradford assay [2], while polysaccharide content was measured using the phenol-sulfuric method [3]. Adsorption curves with increasing levels of bentonite showed that 100 g/hL of bentonite was required for the total removal of protein. The influence of polysaccharides was also tested. To achieve this, naturally occurring polysaccharides were added to the model solution at concentrations equivalent to the sum of their monosaccharides [2]: arabinogalactans (gum arabic), mannoproteins, and pectin. With the addition of polysaccharides, bentonite efficiency decreased at lower concentrations (20, 40, and 60 g/hL) due to polysaccharide/bentonite interactions that occupied bentonite adsorption sites. Additionally, arabinogalactans and pectin showed protein interactions by themselves, as evidenced by the reduction in protein content to 350 and 287 mg/L, respectively, compared to 436 mg/L in the control. This, combing with the fact that polysaccharide content dropped near 0, showed that this interaction was likely due to surface charge interactions. To further characterize the adsorption process, adsorption isotherm models were performed by maintaining a fixed bentonite concentration (20 g/hL) while varying the concentration of each polysaccharide and protein from 500 to 1 mg/L. Except for pectin, Freundlich isotherm models were applicable in all cases, indicating that adsorption occurred on a heterogeneous surface with interactions between adsorbed molecules [4]. Furthermore, arabinogalactan, mannoprotein, and BSA had 1/n values of 0.9460, 1.0997, and 0.7943, respectively, suggesting that BSA had the most favourable adsorption ($1/n < 1$) onto bentonite, whereas both polysaccharides exhibited (near) irreversible adsorption ($n \approx 1$). Pectin showed no adsorption capacity onto bentonite, which was expected due to its neutral nature. On the other hand, the addition of both KCl and K_2SO_4 (at the maximum authorized concentrations by IVV of Cl^- and SO_4^{2-}, respectively) reduced the efficiency of bentonite. Based on particle size measurements obtained via DLS [5], the addition of KCl and, at higher levels, K_2SO_4 induces protein aggregation, which makes protein/bentonite absorption more difficult. These results reveal a complex colloidal system, shedding light on the interactions among major wine components and explaining the variability in bentonite efficiency observed in the industry.

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POSTER

Modulation of the tannic structure of Tannat wines through maceration techniques: cross analytical and sensory study

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Keywords: Asymmetrical Flow Field-Flow Fractionation, macromolecules, red wine, astringency, TCATA

ABSTRACT

The Tannat grape, native to the foothills of the Pyrenees in France, is known for producing wines with intense colour, exceptional tannic structure, and remarkable aging potential. These distinctive characteristics are attributed to its unique genome, making Tannat one of the grape varieties with the highest tannins concentration. While this contributes to the variety's uniqueness, it also presents a challenge for winemakers, who must carefully manage maceration processes to avoid producing wines with excessively harsh tannic structures.

In response to this challenge, a study was conducted in Madiran during the 2024 harvest focusing on the vinification of a Tannat plot. The experiment was designed at the 4,6 hl scale, with three distinct maceration protocols (72h pre-fermentation maceration at 17°C (PFM), 5 days maceration at 20°C (MRac) and conventional 14 days maceration at 20°C (MT)). Throughout the vinification process, these three modalities were closely monitored, and physicochemical parameters were measured using standard methods. The Total Polyphenol Index value (TPI) was used as the determining factor to stop maceration for the three processes (20, 40, and 60 for PFM, MRac, and MT, respectively).

Following vinification, the macromolecular structure of the wines was analysed using Asymmetrical Flow Field-Flow Fractionation (AF4) [1]. The resulting fractograms clearly revealed distinct profiles corresponding to each maceration treatment, with a notable correlation between the spectra and TPI values [2]. A sensory analysis based on the TCATA method [3], allowed an expert panel to successfully differentiate the three treatments based on their astringency levels and to identify specific descriptors that characterized the perception of astringency for each modality.

These initial findings form the basis for a broader study on the macromolecules responsible for astringency. To better manage their tannic structure, the next phase of this research will explore the relationship between grape quality, vinification techniques, and the molecular compounds that contribute to the astringency of Tannat wines from Madiran.

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POSTER

Effect of bleaching with different agents on protein hydrolysate characteristics

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Keywords: bleaching, protein hydrolysate, grape seed meal, CIELAB colorimetric parameters

ABSTRACT

High temperatures can reduce the phenolic content of grapes, especially anthocyanins and copigments involved in colour stabilisation of red wines [1]. This could make it difficult to maintain stable colour during storage [2]. To address this, protein hydrolysates added to red wines during the stabilisation process could preserve colour by forming a protective protein-phenolic complex [3]. However, protein hydrolysates exhibit a brown tonality, which may not be ideal as a colour stabiliser in wine due to the possible undesirable coloration. This study evaluates the effect of different bleaching agents on protein hydrolysate characteristics. The colour has been determined by CIELAB colorimetric parameters (L^*, C^*_{ab}, h_{ab}), the antioxidant activity by DPPH and ABTS, and the protein content by Kjeldahl. First, the defatted grape seed meal was dephenolised to remove phenolic compounds and discard their influence on the colour of the hydrolysates. The hydrolysate from enzymatic hydrolysis was subjected to bleaching using activated carbon (1 g/L, 5 g/L), PVPP (30 g/hL, 150 g/hL), and resin (25%, 50%). It was observed that protein hydrolysates submitted to a higher concentration of each bleaching agent presented a higher colour reduction. In terms of colour, all samples exhibited brown tonalities (h_{ab}, 62-78), except those treated with the combination of 50% resin:5 g/L activated carbon, which displayed the yellowish one (h_{ab}, 84). The lightest samples were those treated with 50% resin (L^*, 63), while the use of 150 g/hL PVPP led to darkest samples (L^*, 30), even more than the control (without bleaching). Additionally, the samples treated with the combination of 50% resin:5 g/L activated carbon, exhibited the lowest chroma value (C^*_{ab}, 12), resulting in a more greyish appearance, which makes it more suitable for not imparting colour to the wine. In addition, protein percentage did not show a significantly ($p > 0.05$) reduction in the treated samples, except for 50% resin and the combination of 50% resin:5 g/L activated carbon, which showed around 20% of reduction. However, the antioxidant activity, by both DPPH and ABTS methods, of almost all samples displayed a significant ($p < 0.05$) decrease, even more for the combination of 50% resin:5 g/L activated carbon and 50% resin. In conclusion, the 50 % resin and its combination with 5 g/L activated carbon proved to be the most effective in terms of colour reduction, and although the antioxidant activity and protein percentage decrease, the values are considered acceptable compared to the loss of colour involved.

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POSTER

Wine chemical markers assess nitrogen levels in original grape juice

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Keywords: nitrogen deficiency, chemical markers, prediction model

ABSTRACT

Nitrogen (N) nutrition of the vineyard plays a crucial role in the composition of must and wine, impacting fermentation, as well as the aroma and taste of the final product. N-deficient grape juice can result in increased astringency and bitterness, and a decrease in pleasant aromas in the wine. N management in vineyards is continually evolving, influenced by climate change and emerging trends in cover crop management. These factors can affect the availability of N to the vines. Yeast-assimilable nitrogen (YAN) in grape juice is a reliable indicator of the N status of vines. Ideally, YAN should be measured at harvest to identify deficiency (YAN < 140 mg/L). However, this practice is not widely adopted, and once the wine is produced, the original YAN levels in the must cannot be determined.

This study proposes a methodology to estimate YAN concentrations in the original grape juice by analysing the wine. Several chemical markers found in wine have been identified as potential indicators of N deficiency in the grape must for the Chasselas cultivar [1]. We suggest using a predictive model based on four of these markers: proline, succinic acid, 2-phenylethanol (PhEtOH), and 2,3-methylbutanol. These markers are known to be present in all grape varieties and remain stable during wine aging.

The study builds several predictive models: a linear model as a baseline, a generalized additive model to handle non-linear relationships, and a random forest model (a flexible machine learning algorithm). We assess their predictive power using a test set (data not used in the training process). The dataset includes results from grape juice and wine analyses of 447 wines from 16 grape varieties grown in Switzerland by Agroscope between 2014 and 2023. The model provides an acceptable estimation of YAN deficiency across all grape varieties. When a single grape variety with a reasonable sample size (129) is considered, the estimation is improved to reach a median relative absolute error of 8.6% (meaning that 50 % of predictions fall within an interval of the observed value ± 8.6 %). The predictive analyses suggest that the markers with highest predictive power are the proline and PhEtOH.

This methodology has the potential to help winegrowers monitor N status post-fermentation and adjust vineyard practices accordingly, leading to improvements in wine quality. In the future, a possible web app' allowing winemakers to make one's own prediction is envisioned.

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POSTER

Gas Chromatography-Olfactometry (GCO) screening of odorant compounds associated with the tails-off flavour in wine distillates

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Keywords: wine distillate, GCO, tails distillation fraction, odorant compounds

ABSTRACT

The development of off-flavours in wine distillates, particularly those associated with the tails fraction, is a key issue in the production of high-quality spirits. The traditional distillation of wine to obtain wine spirit is carried out discontinuously in a still, requiring the precise separation of the distillation fractions: heads, hearts, and tails, each with a distinct chemical composition [1]. The final fraction, known as the «tails,» is typically separated due to its heavy and unpleasant aroma, which is identified in the sensory evaluation of wine spirits [2] and is negatively correlated with overall wine spirit quality [3]. However, the specific compound or compounds responsible for this tails-off flavour have yet to be identified.

Therefore, this study aims to identify and characterize the volatile compounds responsible for the «tails-off» flavour in certain wine distillate tails fractions using Gas Chromatography-Olfactometry (GCO), an analytical technique that combines gas chromatography/flame ionization detector (GC-FID) with human olfactory detection, allowing for the direct identification of odorant compounds in complex matrices like wine distillates. A frequency detection method was applied using nine sniffers to evaluate the detected odour notes while the compounds were simultaneously eluted in the FID detector. This approach aids in identifying compounds with «tails» odour notes. In parallel, gas chromatography/mass spectrometry (GC-MS) was used to determine the exact identity of the compounds.

The initial results of this study reveal the presence of compounds with both pleasant and unpleasant odour notes in the tails fraction, originating from different chemical families. For example, the sniffers detected the presence of diacetyl, which imparts butter, caramel, and vanilla notes, as well as isovaleric acid, which has cheese and foot odour notes. However, no compound was detected in the analysed tails fraction with a distinct «tails» odour. Most of the compounds with heavy and unpleasant aromas belonged to the fatty acid family.

By identifying the specific odorant compounds responsible for the tails-off flavour, this research lays the groundwork for potential strategies in distillation process optimization, aimed at reducing off-flavour development and improving the overall sensory quality of wine-based distillates.

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POSTER

Sensory and chemical effects of postharvest grape cooling on wine quality

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Keywords: Sauvignon blanc, Gewürztraminer, Pinot noir, winemaking practice

ABSTRACT

Wine cellars are affected by seasonally fluctuating workloads and face challenges especially in the harvest period connected to the required timely processing of the harvested grapes. In particular, wine varieties such as Sauvignon blanc white wine and Pinot noir red wine might increase these challenges due to their elevated cultivated amounts worldwide. In addition, specific regions produce considerable amounts of autochthonous grapes, for example Gewürztraminer in South Tyrol, Italy, which during harvest creates elevated workload for the local cellars. Storing the grapes for a short period of time after harvest might decrease the need for direct processing of the grapes, flattening the workload peak. Our experiments aimed to determine the influence of grape cooling applied after harvest on the sensory and chemical aroma profile of Sauvignon blanc, Gewürztraminer and Pinot noir wines. While Pinot noir wine mainly changes its aroma profile upon storing the grapes for two days at 20 °C, Sauvignon blanc and Gewürztraminer wine aroma is also influenced when the grapes are stored at lower temperatures of between 4 and 12 °C for two or three days. An additional cold maceration step at 8 °C for 16 hours (Sauvignon blanc) or 5 to 7 days (Pinot noir) shows less influence, especially in the red wine, and might depict an alternative to the storage of the intact grapes. Our study presents a detailed investigation of changes in sensory properties and volatile organic compound concentrations in the wines upon grape cooling and/or maceration of the grapes.

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FLASH TALK

How can yeast modulate Divona's aromatic profile?

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Keywords: resistant grape variety, yeast, thiol, aromatic profile

ABSTRACT

Volatile thiols play a key role in the aromatic expression of white wines, contributing to notes such as passion fruit, grapefruit, and herbal nuances [1]. These compounds, present as non-volatile precursors in grapes, require enzymatic activation to be released and realize their aromatic potential. The enzymatic activity of yeast during fermentation influences the release and transformation of thiol precursors, thereby modulating their final concentration in wine [2]. Divona is a new Swiss grape variety with quantitative trait loci for resistance to fungi: R*pv*10, R*pv* 3.3 (mildew), *Ren*3, *Ren*9 (powdery mildew), *Rgb*1 (black rot) and average susceptibility to grey rot (*Botrytis cinerea*) [3]. It produces wines with a fruity bouquet of exotic fruit and citrus, with occasional floral and mineral notes. The aim of this work is to see how the use of thiol-releasing yeasts can influence the composition and aromatic profile of Divona wines. In 2020, 2 thiol- revealing yeasts were compared with a control yeast on a Divona must from the experimental vineyard in Pully, VD, Switzerland. The presence of aromatic precursors in the must was measured by LC-MS. The wines were vinified at the Changins experimental winery, VD, Switzerland. Classical wine parameters were analysed by WineScan©, FOSS, thiols were measured by UHPLC-MS/MS and terpenes by GC-MS. The wines were also subjected to a sensory profile analysis. The results obtained with Divona were compared with similar trials on Sauvignon blanc carried out at the Wädenswil experimental estate. The results show that the Divona grape variety has thiol precursors in the must and the use of special yeasts can influence the final quantity of 3MH. The quantity of 4MMP is very low compared with the quantities found in Sauvignon blanc wines. Terpene concentrations are below the perception threshold. The sensory analyses showed that the general appreciation is not linked solely to the quantity of 3MH in the wine and takes into account the overall balance of the wine. The use of such thiol-releasing yeasts can influence the aromatic expression of the new Divona grape variety. Improving our knowledge of resistant grape varieties such as Divona will help to integrate them into the wine industry.

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POSTER

Evaluation of the composition of pomace from grapes grown in the slopes of the Popocatépetl volcano (Puebla, Mexico). Feasibility of its application for obtaining functional foods

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Keywords: grape pomace, composition, safety, functional food

ABSTRACT

Grape pomace is the main byproduct generated during wine production and is primarily composed of skins and seeds, which are obtained after the pressing stage [1]. This byproduct retains a significant amount of nutrients, such as fiber, phenolic compounds, unsaturated fatty acids, vitamins, and minerals. After being dehydrated and micronized, grape pomace has been incorporated into various foods, such as bread [2], pasta [3], cookies [4], yogurts [5], candy [6], and dressings [7], to enrich them with fiber and phenolic compounds. To determine whether this byproduct is safe for functional food production, this study evaluated Syrah grape pomace from the 2023 and 2024 harvests in the Puebla region, Mexico, whose vineyards are located near the Popocatépetl volcano, active since 1994. Its chemical composition was analyzed using bromatological analysis, and the mineral and heavy metal content was determined using atomic absorption spectroscopy. The results showed no significant differences in protein, total fat, or ash content between the pomace samples from both harvests. However, the 2023 pomace had a significantly higher insoluble fiber content. Regarding the composition of skins and seeds in the pomace samples, significant differences were observed only in fat content. The predominant minerals in all samples were potassium, calcium, and magnesium, with higher concentrations in the skins. Heavy metals, such as lead, mercury, and arsenic, were also detected in the pomace samples from both harvests, exceeding the maximum permissible limits for dietary supplements or powdered products [8]. Therefore, these findings highlight that grape pomace from the Puebla region, Mexico, has the potential to be used as a functional ingredient to enrich foods with fiber and essential minerals like potassium, calcium, and magnesium. However, its addition should be moderated due to the high concentration of heavy metals.

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FLASH TALK

Metabolomic fingerprint changes during the alcoholic fermentation at industrial level of Muscat of Alexandria grape must

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Keywords: metabolomics, grape must, Muscat of Alexandria, alcoholic fermentation

ABSTRACT

Muscat of Alexandria is one of the oldest cultivars still existing, globally recognized for its distinctive aroma, and the primary grape variety cultivated in the Greek Island of Lemnos, yielding various white wines with designated origins. On the other hand, understating the changes occurring during alcoholic fermentation is of paramount importance in wine science and wine making, and untargeted metabolomics, which enable the registration of thousands of metabolites in a single analysis, could serve as a valuable tool for the comprehensive study of these changes.

The aim of this study was to track the metabolomic profile of Muscat of Alexandria grape must during the industrial-level alcoholic fermentation. For this purpose, numerous samples were collected from eleven tanks originating from three wineries on Lemnos Island across two vintages (2019 and 2020) and analysed using ultra-high pressure liquid chromatography coupled to time-of-flight mass spectrometry in both positive and negative electrospray ionization modes (UPLC-QTOF-MS). The data processing and analysis divided the annotated metabolites into different categories based on the behaviour. Between others, the tentative biomarkers included sugars, organics acids, vitamins, amino acids, peptides, flavonoids, nucleosides and terpene glycosides. Notably, small peptides exhibited analogous trends with amino acids, indicating rapid consumption similar to the amino acids. This peptides consumption potentially elucidated the observed proline increase, which is not preferrable by the yeasts. Additionally, some peptides exhibited increased concentrations towards the end of fermentation. Furthermore, the hydrolysis of terpenes and phenolic glycosidic bonds, alongside the release of nucleic acid building blocks into the must during fermentation, were highlighted. Overall, this comprehensive analysis enhances understanding of how alcoholic fermentation influences wine quality under realistic conditions.

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POSTER

What defines the aging signature of Chasselas wines?

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Keywords: volatilome analysis, olfactometry, Chasselas grape, aging

ABSTRACT

Chasselas is a refined grape variety renowned for its subtlety and its remarkable ability to reflect terroir characteristics [1]. Typically consumed young, it is appreciated for its low acidity and delicate fruity and floral aromas. However, in specific terroirs such as Dézaley and under particular vinification conditions, Chasselas can evolve with aging, developing complex aromatic profiles with notes of dried fruit and honey. Despite its cultural importance, scientific studies on the aging bouquet of Chasselas remain limited, with most existing knowledge being empirical.

This study investigates the aging potential of Chasselas wines from the Dézaley appellation by comparing the 2009 and 2022 vintages from four different estates known for their quality and historical availability of aged wines. The objective is to analyze the differences between young and aged Chasselas wines and to assess the influence of vintage and estate on their characteristics.

To achieve this, gas chromatography coupled with mass spectrometry (GC-MS), olfactometric analysis, and standard wine analyses were conducted to determine the chemical composition of the wines. Sensory evaluations, including napping and sensory profiling, were also performed to characterize the organoleptic properties of aged Chasselas wines. Key compounds were identified as markers of aging: furfural (bready note) in older wines and isoamyl acetate (fruity, banana note) in younger wines, while 3-ethoxy-1-propanol decreased over time. Olfactometric analysis identified 32 aromatic compounds, revealing that younger wines predominantly exhibit fresh, fruity aromas, whereas aged wines develop richer and more complex profiles. Sensory and olfactometric results findings aligned. The analysis of chemical compounds highlighted the complexity of the composition of aged Chasselas wines, emphasizing the importance of integrating sensory, chemical, and standard analyses to better understand their quality and aging potential.

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POSTER

A fast and sensitive method for total tannin determination in wine based on the substoichiometric quenching of silicon-rhodamine conjugates

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Keywords: tannins quantification, fluorescence quenching, rhodamine fluorophore

ABSTRACT

Tannins are chemically diverse polyphenols contributing to important sensory attributes of food and beverages. In wine, their structure and quantity depend on several factors, such as the grape variety, climate, soil, viticultural and enological practices and the wine-aging process. Therefore, their accurate and cost-effective quantification is essential to optimize polyphenols profiles during wine making.

Conventional tannin quantification methods are primarily colorimetric, some of which suffer from a high interference with anthocyanidins and therefore are unsuitable for many emerging disease resistant grape varieties. Even though precipitation-based methods remain a relatively good proxy for astringency they are difficult to scale to large number of samples.

Fluorescence or chemiluminescence-based assays could provide a more practical alternative by offering high sensitivity while minimizing interference artefacts.

We recently discovered a novel fluorescence quenching mechanism of synthetic rhodamine fluorophores with a high selectivity towards tannic acid (TA) and catechin-3-gallate (C3G). Specific chemical conjugates of silicon-rhodamine with alkyl linkers attached to bulky apolar moieties (SiR) had a detection limit near 500 pM and a linear range spanning 5–100 nM for TA.

The technique was applied to quantify condensed tannins present in wine and was compared to a methylcellulose precipitation and acidic butanolysis. We validated the assay on 18 distinct red wine samples, which showed high linearity ($R2 = 0.92$) with methylcellulose precipitation. The variability between the individual measurement points was consistent for SiR-quenching and methylcellulose precipitation for all samples. Additionally, when tested with pure standards, the assay was two orders of magnitude more sensitive towards certain wine catechins than to malvidins, making it suitable for wines with high anthocyanin content like new resistant grape varieties.

In conclusion, a novel assay was developed and validated that allows the sensitive and selective quantification of tannins abundant in food and beverages.

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POSTER

Evolution and sensory contribution of ethyl acetate in sweet wines

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Keywords: ethyl acetate, sweet wines, detection and complexity threshold, HS-SPME-GC/MS

ABSTRACT

Ethyl acetate (EtOAc) is the main ester present in all wines, generally produced by yeasts during alcoholic fermentation and sometimes by bacteria during barrel ageing. Its odor is characterized by solvent notes, which give wines their acescent note [1]. Empirical observations have shown that in sweet wines, this note is often perceptible when tasting in the bottle, whereas it is not present at the end of barrel ageing. The perception of acescence is explained by an increase in EtOAc of the order of 100 to 150 mg/L after bottling in sweet wines. This phenomenon has also been observed in red wines, but its extent remains limited and unexplained [2]. The aim of this study is to establish the concentrations of EtOAc found in sweet wines and to study its sensory influence on their olfactory perception.

To assay the levels of EtOAc in a sensitive and precise way, an HS-SPME-GC/MS method was developed in the laboratory. A quantitative comparison was carried out between samples of wines made from *Botrytis cinerea* and "passerillage". The results revealed great variability in EtOAc, with concentrations ranging from 90 to 300 mg/L, highlighting both an estate effect and a vintage effect. The origin of such high levels compared to other types of wine is unexplained in the literature, and certainly have a non-negligible impact on the sensory space of sweet wines [3]. As EtOAc perception is matrix-dependent, its detection threshold has been determined here at 136 mg/L in a botrytized sweet wine by two different panels. To complement these sensory data and further investigate the contribution of EtOAc, a concept of complexity threshold was introduced and investigated, on the same model as the detection threshold. Samples containing the 95 and 115 mg/L EtOAc additions were judged significantly more complex than the wine with no addition. These results showed that EtOAc can play a role in wine complexity. Both concentrations were infra-threshold, demonstrating that EtOAc has an indirect influence on olfactory perception. When EtOAc was clearly detected, the wine loses complexity and may even be rejected. These results provide a better understanding of the influence of EtOAc on the sensory space of sweet white wines.

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FLASH TALK

Exploring the impact of different closures on tannin evolutions by using metabolomic approach

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Keywords: condensed tannins, oxidation marker, wine closure, metabolomics

ABSTRACT

Condensed tannins (CTs), polymers of flavan-3-ols, are a class of polyphenolic compounds that play a significant role in the organoleptic qualities of red wines, particularly influencing color, astringency and bitterness. These properties are highly dependent on size and structure of these compounds. Moreover, from grape harvest to wine consumption, exposure to oxygen induces diverse molecular reactions such as oxidation, increasing molecular diversity and complexity of wine composition, ultimately affecting wine quality. Particularly during aging process, wine undergoes many compositional changes, making its evolution in the bottle a subject of great interest to ensure consistent quality over time. While wine closures are known to regulate oxygen levels[1], the impact of their oxygen permeability on the structural evolution of CTs during bottle aging has yet to be explored.

In this work, a comprehensive analysis of the profile of red wines aged for 17 years was conducted. The aim was to study the impact of closure type on the evolution of tannin structures and to identify oxidation markers associated with wine aging. Wines were produced under same winemaking conditions but sealed with closures characterized by different oxygen permeability (screw cap, synthetic, traditional and agglomerated corks). To conduct this study, due to the difficulty in precisely characterizing tannins, biological triplicates of wine samples were first fractionated[2] to isolate tannins from the matrix. Chemical depolymerization of tannin fractions was then performed using a thioglycolysis reaction[3]. From these depolymerized tannin fractions, an untargeted UHPLC-Q-Orbitrap metabolomic analysis was performed, which compares the wine profiles to discover specific discriminating markers linked to closure permeability.

The obtained results showed that closure oxygen permeability has a significant influence on the evolution of tannin structures during bottle aging, indicating that the selection of wine closures should be considered in preserving wine profile over time. Furthermore, this study showcased the strong potential of advanced analytical tools in characterizing complex metabolites and open new perspectives for research into wine quality.

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POSTER

Biosynthetic evolution of galloilated polyphenols in Tannat grapes during ripening, potential applications of grape thinning

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Keywords: grape ripening, galloylated flavan-3-ols, Tannat, biosynthesis

ABSTRACT

Galloylated flavan-3-ols are a class of polyphenolic compounds present in various plants, including grape seeds. These compounds are formed through the condensation of flavan-3-ols, such as catechins, although the precise mechanism by which gallic acid is incorporated into the molecule remains unclear. The biosynthesis of galloylated flavan-3-ols in grape seeds is a subject of ongoing debate, reflecting the complexity of the metabolic pathways involved in polyphenolic compound production [1]. Flavan-3-ol gallate transferase (F3'5'GT) is a key enzyme in the biosynthesis of galloylated proanthocyanidins (GPCs), which are naturally occurring compounds found in grape seeds and other plant tissues. Research has demonstrated that the expression of the F3'5'GT gene is significantly higher in the seeds of Vitis vinifera cv. Tannat compared to other grape varieties [2]. This elevated gene expression may explain the higher levels of GPCs observed in Tannat grapes.

In this study, we present a comprehensive analysis of galloylated flavan-3-ol profiles by HPLC-MS/MS across three vintages, combined with an assessment of enzyme gene expression at multiple sampling points throughout the ripening process [4]. Our findings reveal a distinct peak in F3'5'GT expression at veraison, consistent with previous data from our research group. Notably, as ripening progresses, there is a significant decline in both enzyme activity and GPC concentration in grapes.

Furthermore, our investigation highlights the influence of environmental factors, such as temperature and light intensity, on F3'5'GT expression, reinforcing prior indications of their regulatory role. While GPCs are not only found in wine but also available through dietary supplements, our findings have important implications for supplement production [4]. They underscore the potential benefits of extracting GPCs from immature grapes obtained during berry thinning, optimizing their use in nutraceutical applications.

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POSTER

The Albariño route in Uruguay: A clonal selection process to produce quality wines

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Keywords: Albariño, phenotypic differences, wine chemistry, sensory and volatile profile

ABSTRACT

In recent years, Uruguay has embraced the Albariño grape variety (*Vitis vinifera* L.) as one of the most promising for commercial growth. Originally cultivated in Galicia and northern Portugal, Albariño has risen to prominence in the global wine market, driving strong demand and significantly increasing grape prices [1].

Unlike other grape varieties with a longer history of market interest, the systematic selection of Albariño's genetic material is relatively recent, with only a limited number of commercial clones currently available (certified clones of Galician origin [1]. Notably, CSIC-02 and CSIC-07 are exclusively reserved for winegrowers within the Rías Baixas D.O. in Galicia. Additional clones include VN04 (Vitis Navarra nursery), and several clones from the Vivai Rauscedo vineyard (42JBP, 43JBP, 44ISA, and IVCR-33). The latter are the most widely planted certified clones in Galicia today and demonstrated strong agronomic performance in experimental plots at the INIA Las Brujas Experimental Station in Uruguay. However, other commercial clones, such as ENTAV-ENRA 1143 have shown poor agronomic results in vineyards established in Uruguay.

Given the limited understanding of the behavior of different commercial clones and the inconsistent performance observed in local plantations compared to their regions of origin, Uruguayan producers tend to favor planting vineyards derived from local massal selection from which have originated internationally successful wines. However, it remains unclear whether this selection represents a single genetic material or a diverse group of materials.

Due to the absence of genetic analysis, in the 2023/24 season an experiment was conducted to quantify the variability among 435 mother plants from a nursery. The results showed significant phenotypic differences [variations in sprouting date, flowering, technological ripening, fruit yield, average bunch weight, load ratios (Ravaz Index), and fruit composition (soluble solids, acidity, and must pH]. To verify the presence of distinct genetic material, six genetically contrasting individuals were genotyped.

Wines obtained under controlled microvinifications were subjected to sensory analysis [2]. On the sensorially differentiated wines, their volatile profile was studied (HS-SPME-GC/MS) [3].

This paper presents the results obtained at each stage, where the variability obtained is challenging to attribute solely to environmental factors, suggesting potential underlying genetic diversity.

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POSTER

Impact of fining agents on Swiss Pinot noir red wines

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Keywords: fining agent, Pinot noir, astringency, bitterness

ABSTRACT

In the context of climate change, excessive bitterness and astringency in wines have become increasingly prevalent. While variety selection and viticultural practices offer long-term solutions, they require considerable time before yielding practical results. In contrast, fining remains an accessible and immediate tool for winemakers. However, many experienced wine professionals still struggle to fully understand the effects of different fining agents on their wines. Additionally, with new European regulations on wine labeling, there is an urgent need to better comprehend the mechanisms of different fining agents across various wine matrices to ensure informed decision-making in cellar.

Fining is a technique commonly used in winemaking to correct the levels of bitterness and astringency in wines. Various fining agents are employed for this purpose, such as gelatin, egg whites, pea protein, potato protein, casein, etc. Studies in this field have shown that each fining agent has a very different impact on the characteristics of the wine, and their effects also depend on the specific composition of the wine [1-3]. To our knowledge, no study in the literature has reported the impact of different fining agents on Pinot Noir wines.

This study evaluated the impact of four commercial fining agents: gelatin, egg albumin, pea protein, and potato protein, on the phenolic composition and sensory properties of two Pinot Noir wines. At the lowest recommended dosage, gelatin was the most effective in reducing total phenolic compounds, condensed tannins, mean degree of polymerization (mDP), yellowness and astringency. Notably, this is the first study demonstrating that mDP in Pinot Noir wines is significantly affected by fining. Pea protein proved to be the most efficient in reducing bitterness, aligning with empirical observations from Swiss Pinot Noir producers. Our results further highlight the significant influence of phenolic richness and maturation stage on the effectiveness of fining. Wines with lower phenolic content were more strongly affected, emphasizing the need for a tailored approach based on wine composition and aging stage. Additionally, the observed reduction in yellowness suggests that oxidized pigments were partially removed during fining. These findings underscore the importance of carefully selecting fining agents and adjusting their dosages according to the maturation stage and the desired wine style, particularly for delicate varieties such as Pinot Noir.

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FLASH TALK

Characterization of a unique mannan from *Starmerella bacillaris* for protein stabilization in white wine

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Keywords: yeast polysaccharides, *Starmerella bacillaris*, protein stability, cell wall

ABSTRACT

Yeast cell wall components are valuable biotechnological tools with applications in oenology and beyond [1], [2]. *Starmerella bacillaris*, a non-*Saccharomyces* yeast, remains relatively understudied, yet recent discoveries have highlighted distinct metabolic traits among wine yeasts [3] and the promising role of its polysaccharides in winemaking [4]. This study investigated different *S. bacillaris* strains alongside *Saccharomyces cerevisiae* as potential sources of functional yeast derivatives for protein stabilization in white wine.

Yeast biomass was cultivated through aerobic fed-batch propagation and mechanically processed to obtain yeast cell walls. To generate distinct polysaccharidic derivatives, yeast cell walls were subjected to various extraction processes. The physicochemical properties of the obtained macromolecular derivatives were characterized using near-infrared (NIR) spectroscopy, HPLC, SDS-PAGE, and high-resolution size-exclusion chromatography (HRSEC). The stabilization efficacy of the obtained derivatives was assessed in white wine through turbidity analysis, identifying a promising product from *S. bacillaris*. Ultrafiltration was then employed to isolate the active polysaccharide fraction, which underwent further characterization through linkage analysis and nuclear magnetic resonance (NMR) spectroscopy. The fraction was identified as a linear mannan, distinguishing it from the typically branched mannoproteins found in *S. cerevisiae*-derived cell wall extracts [5].

These findings reveal the unique structural features of *S. bacillaris* cell walls and their technological potential for alternative protein stabilization strategies in winemaking.

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POSTER

Studying the redox state of wines under oxidative processes with a multi-parametric analysis

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Keywords: redox state, wine oxidation, electrochemistry

ABSTRACT

The detection of reducing compounds such as phenolic acids, anthocyanins or tannins is of prime importance to decipher on the antioxidant and anti-aging properties of wines. Spectrophotometric methods (ABTS, DPPH) are the reference methods, but their major limitation is their interference with other reducing compounds present in wines.[1] In this context, electrochemical methods are of great interest, as they are fast, easy to use and well selective for such species. Various procedures are described in the literature, based on voltammetric techniques associated with carbon electrodes, in some cases functionalized to improve detection sensitivity and/or increase selectivity towards interfering compounds.[2-4] Approaches based on the use of screen-printed disposable sensors (PolyScan Vinventions) made also possible to obtain a fingerprint and/or classification of certain phenolic compounds, or to study different alternatives to oak wood for the wine industry.[5,6] The research performed by the RedoxWine joint laboratory (CBMN - Biolaffort) is first devoted to the development of analytical protocols based on electrochemical methods to detect some key molecules in wine and define a signature of its redox state in real time. Several electrochemical sensors are developed to study the relationships between reductants, i.e. concentrations of sulfite, phenols and derivatives, and the levels of oxidants, first oxygen and daughter Reactive Oxygen Species (H_2O_2, O_2°-), generated or provided in a controlled manner. We are thus studying wine responses under controlled oxidative stress, starting from normoxic conditions to chemically forced conditions (additions of known concentrations of O_2, H_2O_2 or by direct electrochemical oxidation of the wines) to accelerate matrix ageing processes. The evolution of the wines redox chemistry is eventually studied using a combination of spectroscopic and electrochemical techniques: redox signature, sulfite, dissolved O_2, pH, color (CieLab) and thiols.[7]

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FLASH TALK

Unveiling *Metschnikowia* spp.: mechanisms and impacts of bioprotection in winemaking

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Keywords: wine fermentation, bioprotection, *Metschnikowia*, diversity

ABSTRACT

Bioprotection, leveraging beneficial microorganisms, has emerged as a sustainable approach to modern winemaking, minimizing reliance on chemical preservatives like as sulfur dioxide (SO_2). Among these microorganisms, non-*Saccharomyces* yeasts, particularly *Metschnikowia pulcherrima* (MP), have garnered significant attention. By establishing a favorable microbial environment during the early stages of fermentation, MP reduces the risk of undesirable fermentations and spoilage caused by lactic acid bacteria, *Brettanomyces bruxellensis*, or acetic acid bacteria (AAB). Pulcherriminic acid, an iron-chelating compound responsible for the red pigment, pulcherrimin, has long been considered the key mediator of MP bioprotection through iron deprivation. This yeast species also plays a dual role in shaping microbial dynamics and enhancing wine quality.

This study explored the broader bioprotective potential of *Metschnikowia* species, including those other than MP, against a model AAB. The strains demonstrating the most effective bioprotection (BP) were further assessed for their oenological suitability and the underlying mechanisms supporting their BP activity were investigated.

In a first step, forty-six strains of *Metschnikowia* spp. were co-inoculated with the AAB *Gluconobacter oxydans* (Go), responsible for acetic souring in commercial grape juice. Monitoring bacterial growth over time revealed three distinct yeast BP profiles. Only one strain (*M. reukaufii*) exhibited no BP capacity. The majority of *Metschnikowia* strains (43) significantly delayed Go growth, but resulted in only a modest reduction in bacterial population after 7 days of incubation. Two strains (MP) demonstrated highly effective BP capacity, with minimal bacterial growth observed even after 7 days.

The four MP strains with the highest bioprotective effect were then evaluated for their on *Saccharomyces cerevisiae* fermentation and their bioprotection in Chardonnay must. Their presence had no significantly effect on fermentation duration, though slightly reducing *S. cerevisiae* fermentation rate. Analysis of central carbon metabolism and volatile organic compounds revealed that MP positively interacted with S. cerevisiae in sequential inoculation, with an increase in glycerol and acetate ester content.

In the last phase of the study, we quantified pulcherrimin in the medium by its absorbance (550 nm) and of pulcherriminic acid precursor by LC-MS/MS, and no significant correlation between the presence of these compounds and the BP capacity of *Metschnikowia* strains against Go was detected. To further evaluate alternative mechanisms, we assessed the influence of nutritional limitation (nitrogen sources, sugar, oxygen and iron), inhibitory compounds production and cell-cell contact, using differential bacterial growth media. Interestingly, Go growth was inhibited only in the presence of MP cells, regardless the medium composition, suggesting a key role of cell contact in the BP capacity of MP. These findings provide new insights into the efficient use of *Metschnikowia* as a natural alternative to sulfite addition for controlling specific spoilage microorganisms in winemaking.

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FLASH TALK

Experiments with the use of stems in Pinot noir winemaking

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Keywords: Pinot noir, stems, maceration, tannin

ABSTRACT

Vinification trials were carried out between 2018 and 2021 in the experimental winery at Laimburg Research Centre, Alto Adige, to test the effect of grape stem inclusion during fermentation of Pinot Noir. In 2018 and 2019, grapes were harvested at two different moments during the vintage. In the subsequent two vintages, there was only one moment of harvest. The experimental design compared a fully destemmed control (0% stems) with trials adding 25%, 50%, 100% and 200% stems. In all trials, the presence of stems was observed to have an impact on both the chemical and sensory aspects. With increasing percentage of stems used during maceration, the alcohol and total acidity decreased while pH increased. Anthocyanin concentration remained almost unchanged, whereas dry extract and total polyphenols increased. At tasting, wines with 0-50% stalks retained fruity aromas, harmony and typicity. Beyond this percentage, notes of herbs and leather were more expressed. In addition, bitterness and astringency increased. The presence of stalks (in percentages of 25% and sometimes 50%) made the wines more interesting and appreciated than the control.

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FLASH TALK

Separation and elucidation of ethylidene-bridged catechin oligomers using preparative-HPLC and NMR

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Keywords: acetaldehyde, aging, oxidation, polyphenols

ABSTRACT

During wine aging, small amounts of oxygen are absorbed and initiate a cascade of oxidation reactions. These aging reactions create many products including ethylidene-bridged oligomers and polymers of endogenous polyphenols, like flavan-3ols. This bridging is believed to reduce bitterness and astringency while enhancing color stability in aged wine [1]. The elongation reactions are products of interaction of flavonoids with acetaldehyde, an oxidation product of ethanol. While studies have been conducted confirming the reaction between acetaldehyde and various flavan-3-ols, there has not been research elucidating the structure of individual ethylidene-bridged flavan-3-ols. Previous acetaldehyde-flavan-3-ol nuclear magnetic resonance (NMR) experiments have either been conducted using the entire reaction mixture [2], or of the total amount of precipitates, which would include all of the polymers from the reaction. The goal of this experiment was to isolate various ethylidene-bridged catechin oligomers (dimer, trimer and tetramer) and confirm their proposed structure and yield using NMR. To investigate this, exogenous acetaldehyde and catechin (both 500 mg/L) were added to model wine (12.5% EtOH, pH 3.5), and incubated at 35°C for 7 days to allow for sufficient reaction. Using reverse-phase preparative-high-performance liquid-chromatography (RP-prep-HPLC) affixed with a diode array detector (DAD), the individual ethylidene-bridged catechin oligomers were isolated. Ethylidene-bridged oligomer purity and stability were determined using previously created liquid-chromatography mass-spectrometry (LC-MS) methods. After 10 hours of incubation at 20°C, the signal of the ethylidene bridged dimer was 23.3% of the initial isolate signal, demonstrating degradation after removal from the model solution. Isolates were dried using a freeze-dryer to preserve purity and stability. Interestingly, the ethylidene-bridged oligomers are stable prior to isolation from the reaction mixture. These products could potentially be in equilibrium with the reactants. All isolates (ethylidene-bridged dimer, trimer, tetramer) were redissolved in methanol-d_4 and measured using both ^{1}H and ^{13}C NMR for elucidation of structure. NMR characterization of these compounds has increased our understanding of LC-MS data conducted on actual wine investigating the fate and kinetics of acetaldehyde mediated bridging of flavonoids.

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POSTER

Identification of compounds produced by reactions of flavonoids and acetaldehyde in wine

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Keywords: aging, catechin, mass spectrometry, oxidation

ABSTRACT

During aging, wine consumes small amounts of oxygen. This oxygen intake triggers a series of reactions that lead to flavonoid elongation, which is known to reduce bitterness and astringency while enhancing color stability. The oligomers and polymers formed during aging differ from those produced in the non-aging reactions, as they contain ethylidene-bridges, — a result of acetaldehyde formation, an oxidation product of ethanol [1]. High oxygen ingress can lead to off-flavors, depending on the wine's stability, with excessive exposure potentially resulting in vinegar formation. Acetaldehyde, a key intermediate in this cascade of reactions, could potentially be added exogenously after fermentation to induce aging qualities without the associated risk of high oxidation. To investigate the effect of this, exogenous acetaldehyde was initially added to model wine (12.5% EtOH, 250 mg/l Catechin, pH 3.5) at 0, 50 and 250 mg/l, at two temperatures (4 and 35 °C) and with or without SO_2. Samples were collected over 21 days and analyzed using LC-MS/MS, utilizing multiple-reaction-monitoring for ethylidene bridged catechin oligomers. Higher temperature and acetaldehyde concentration accelerated the formation of ethylidene-bridged products. However, sequential acetaldehyde addition did result in a final difference in product formation. Furthermore, the addition of SO_2 as KMBS at 250 mg/l did not completely inhibit elongation but rather slowed the reaction. To further confirm that the observed products were the result of acetaldehyde bridging, acetaldehyde-d_4 was reacted with catechin using the same solution. Ions with an *m/z* value 4 higher than those in the previous experiment were observed, indicating that acetaldehyde was being consumed in the reaction. Ions resulting from the addition of both acetaldehyde and acetaldehyde-d_4 were identified using a LC-MS metabolomics workflow, demonstrating the formation of multiple products. Combinations of catechin, procyanidin B2, malvidin-3-O-glucoside and acetaldehyde or acetaldehyde-d_4 were reacted in model wine and the predicted ions associated with polymerization via acetaldehyde were detected. Acetaldehyde was also added to Cabernet Sauvignon wine, and MRM methods were used to detect if ions corresponding to ethylidene bridges. Overall, this research could provide winemakers with a new tool for chemically modifying their wines, enhancing desirable aging characteristics while minimizing the risks associated with excessive oxidation.

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FLASH TALK

Exploring aromatic profiles and environmental influences on berry chemistry of *V. vinifera* Riesling and *Vitis* sp. L'Acadie blanc in Quebec and Nova Scotia, Canada

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Keywords: glycosylated aroma precursors, terroir, volatile compounds, cold-climate viticulture

ABSTRACT

Wine quality depends on grape biochemical constituents, including sugars, organic acids, amino acids, and bound and free aroma compounds, which are influenced by vineyard location and environmental factors such as temperature and precipitation [1]. However, the impact of these terroir factors on interspecific *Vitis* varieties in Eastern Canada's cold climate remains largely unexplored [2]. Additionally, the interaction between terroir and grape variety in cold-climate viticulture, including *V. vinifera* and interspecific hybrids, requires further study. To address this gap, we analyzed the effects of vineyard location (Quebec and Nova Scotia), meteorological conditions (temperature and precipitation), and berry maturity stage across two vintages (2019 and 2020) on the aromatic profiles of *Vitis vinifera* Riesling and the interspecific hybrid L'Acadie blanc. Berry samples (EL-36 to EL-38) were collected from commercial vineyards in the Gaspereau Valley, Nova Scotia, and Île d'Orléans, Quebec. Bound volatile compounds were analyzed via solid-phase extraction and gas chromatography-mass spectrometry (SPE-GC-MS) [3]. GC-MS data were processed using MZmine 3, with compound identification performed via NIST MS Search and Kovats indexes, and semi-quantification using 2-octanol as an internal standard. Statistical analyses included ANOVA to assess vineyard location, vintage, and maturity effects. Principal Component Analysis (PCA) explored sample clustering, while Partial Least Squares Regression (PLS) examined relationships between environmental factors and aroma composition. Results showed a significant influence of geographical origin on volatile profiles. Riesling from Nova Scotia exhibited higher concentrations of acids, terpenes, and volatile phenols than Quebec Riesling, while L'Acadie blanc from Quebec contained more alcohols and fewer benzene derivatives than its Nova Scotia counterpart, highlighting terroir-driven variations. PLS regression confirmed strong correlations between meteorological conditions and glycosylated aroma compounds, with temperature and growing degree days (GDD) shaping berry aroma profiles. These findings underscore the role of environmental factors in aroma development, providing insights for viticultural practices in emerging cold-climate wine regions such as Quebec and Nova Scotia and for developing new resistant, cold-hardy *Vitis* varieties.

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POSTER

Metal reducing agents (Fe and Al) as possible agents to measure the dimensions of the hydrogen sulfide (H_2S) pool of precursors in wines

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Keywords: metal reducing agents, off-odors, sulfur compounds, polysulfides

ABSTRACT

Reductive wine fault is characterized by the presence of odors such as rotten eggs or spoiled camembert cheese, originating from hydrogen sulfide (H_2S) and methanethiol (MeSH) [1]. These compounds stabilize in polysulfide forms, creating a complex pool of precursors that will revert to both molecules when the environment becomes anoxic [2]. A recent study [3], confirmed by ongoing research [4], suggests that wines could contain between 1 and >2.6 mg/L of H_2S precursors. However, there are no methods to determine the dimensions of this pool within a reasonable timeframe, as its development through spontaneous reduction takes more than 3 months at 75ºC. The aim of this study was to evaluate whether metallic reducers, such as Fe and Al, could serve as an effective alternative to evaluate the pool of H_2S and MeSH precursors.

Methods: Wines (reals and models) were incubated in containers holding vials with CuCl-based trapping solutions. Traps were analyzed by GC-SCD to determine H_2S and MeSH levels; and replaced by fresh trapping solutions [3]. Effects of wine pH (3 to 5.5), SO_2 (0-150 mg/L), temperature (ambient and 50°C), metal dose (between 8 and 40 cm of Fe wire per 80 mL), and acetaldehyde concentration (1-4 g/L for Fe and 1-10 g/L for Al) were evaluated.

Results: In all cases, SO_2 was a strong interference, as it is reduced to H_2S by both metals. However, its reduction can be partially limited by the addition of acetaldehyde, pH adjustment, and regulating the amount of metal present. Al was particularly sensitive to SO_2 interference, as its production could not be completely avoided even with 10 g/L of acetaldehyde. Additionally, Al was highly inefficient in reducing H_2S precursors, leading to the conclusion that it is not suitable for this assay. Contrary, Fe was significantly more effective, though it was also capable of reducing SO_2. At room temperature, at pH 4.5 with 2 g/L of acetaldehyde, the amount of SO_2 reduced to H_2S was marginal (<0.5 µg/L/day per 10 mg/L of SO_2 present). However, under these conditions, the pool of precursors could not be effectively reduced, yielding no more than 0.4 mg/L of H_2S and 16 µg/L of MeSH after 10 days of incubation. At 50°C, it was necessary to add 4 g/L of acetaldehyde to limit the reduction of SO_2 to H_2S (<2 µg/L/day per 10 mg/L of SO_2 present). Under these conditions the total reduction of the pool of precursors appears to be achieved within 10 days, allowing for a reasonable estimation of the H_2S and MeSH pool of precursors.

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POSTER

South American Creole grapevines: new varieties identified in the Caravelí Valley (Peru) and their aromatic profile

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Keywords: *Terroir*, tradition, *Vitis vinifera*, heritage, phenotypes

ABSTRACT

The valley of Caravelí (Peru) received the first vine plants in colonial times and the tradition of cultivation is maintained thanks to its *terroir* and artisanal techniques. In order to maintain the tradition and pass it on to the next generations, the vines were geo-referenced (1780 m,18 L 678350 8253911), and DNA tests were carried out, where two non-catalogued varieties were identified [1]. The non-catalogued varieties are Jaén (white grape) and Cantarilla (red grape), which had a genetic profile inherited from the varieties Moscatel de Alejandría and Listan Prieto, and it is a heritage from Perú. To test the potential of these varieties for wine production, the researchers made varietal wines from them and a very important attribute that gives quality and character to the wines is the aromatic profile [2]. For the aromatic analysis of these two varieties, the wine samples were injected in triplicate and analysed by HS-SPME/GC-MS. Even if these two varieties are new clones from Listan Prieto and Moscatel de Alejandría, they present different phenotypes, and it can also be evaluated in the aromatic profile of them. Jaén cultivar showed higher amounts of terpenoid compounds (α-terpineol, linalool, β-damascenone, nerol oxide), ethyl esters and their precursors volatile fatty acids (C6, C8, C10, C12), which contributes to the wine of this variety showing aromas of pineapple, manzanilla, pear, peach, variety in which the fruity character (citrus and stone fruit) stands out. On the other hand, the Cantarilla variety presents a lower quantity of these compounds and stands out for its floral aroma, due to the higher quantity of the phenethyl alcohol compound that smells of rose. The attributes of the varietal wines were evaluated by sommelier professionals and the descriptors pointed by them were very similar to the chemical data. Thus, besides additional harvests that should be done to characterize the aroma and phenolic profiles of these varieties, Jaén and Cantarilla varietal wines have a great potential to be produced and marketed by Peruvian winemakers.

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POSTER

Aroma profile evaluation in whole grape juices

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Keywords: table grapes, volatile compounds, GC-MS, methyl anthranilate, *Vitis labrusca*

ABSTRACT

Table grapes (*Vitis labrusca* and hybrids) are widely cultivated in Brazil [1] due to the climate, their resistance to disease and the way they are consumed and commercialized, either in-natura or for processing, producing whole juices, jams and table wines. Focusing on juices, which are widely studied for their antioxidant characteristics and for being alcohol-free products, the diversity of cultivars is interesting due to their specific organoleptic characteristics [2] to increase consumption. The aim of this study was to evaluate the volatile composition profile of 9 grape juices produced in the summer harvest 22/23 using the enzymatic method [3] in the microprocessing laboratory of the Agronomical Research Centre of Minas Gerais (EPAMIG) in Caldas - Minas Gerais/Brazil. The juices of Bordô Clone Bocaína, BRS Carmem, BRS Concord Clone 30, BRS Cora, Isabel, Isabel Precoce, BRS Magna, BRS Rúbea and BRS Violeta cultivars were analyzed by HS-SPME/GC-MS and a total of 118 free compounds were identified among the varieties, with qualitative as well as quantitative differences between them. Among the classes of compounds that stand out most for their pleasant sensory characteristics are benzenoids, terpenoids, furanoids and esters, and it is possible to see differences in these classes between the cultivars. For Isabel Precoce, Bordô, Isabel and Concord Cl 30 cultivars, the classes that stand out are the benzenoids, mainly the phenethyl alcohol compound with a rose aroma, and the terpenoids, the α-terpineol and linalool compounds, with a lilac and pleasant flower smell, respectively, as well as the combination of other compounds in smaller quantities. In the Cora and Violeta cultivars, the esters were more prominent, with ethyl 2-butenoate having a caramelized, fruity smell. Furanoids such as mesifuran (sweet, baked caramel, strawberry) and to a lesser extent furfural (sweet, almond, baked bread), and terpenoids linalool and β-damascenone (fruity, sweet, honey) in the juice of Rúbea cultivar. For Carmem juice, furanoids stand out, especially the compound furfural; and for Magna juice, esters and terpenoids, ethyl 2-butenoate, ethyl phenylacetate (odor suggestive of honey), β-damascenone and linalool. Studies have shown that the main compounds in *Vitis labrusca* and hybrid grapes are methyl anthranilate and furaneol, which have a foxy, earthy and sweet aroma; nevertheless, methyl anthranilate and ethyl anthranilate were evaluated in greater quantities in the Bordô cl Bocaína and Concord cl 30 juices and furaneol in the juice of Concord Cl 30 cultivar. Thus, the volatile compounds evaluated on this first harvest showed the peculiarities on the aromatic profile of grape juices from 9 different cultivars, demonstrating the potential to diversify grape juices production.

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POSTER

Comprehensive lipid profiling of grape musts: impact of static settling

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Keywords: lipids profiling, musts, yeast nutrition, settling

ABSTRACT

Lipids are crucial in alcoholic fermentation, influencing yeast metabolism by providing nutrients and modulating membrane composition [1]. They also serve as precursors to aromatic compounds shaping wine sensory profiles [2]. While sterols and unsaturated fatty acids have been extensively studied, the overall lipid composition in grape musts remains poorly understood. Many lipid families, including phospholipids, sphingolipids, and glycolipids, have been largely overlooked. This study aims to provide a comprehensive lipid profile by identifying as many species as possible, beyond the commonly studied sterols and fatty acids.

Clarification, a widespread winemaking process, significantly reduces lipid availability, potentially leading to slow or stuck fermentations and undesirable aromas [4-6]. This study examines white grape musts from eight varieties and the impact of static settling on lipid composition. Initially, untargeted LC-MS QToF was used to capture a broad lipid spectrum, guiding targeted quantification methods. Free fatty acids, total fatty acids, and sterols were quantified via GC-MS, while phosphatidylcholine, phosphatidylethanolamine, phosphatidylinositol, steryl esters, glycerolipids, and ceramides were analyzed by LC-MS.

For the first time in grape must analysis, an untargeted LC-MS QToF approach enabled the detection of 562 lipid compounds, 112 of which were confirmed as sphingolipids, fatty acids, phospholipids, glycerolipids, and sterols. Some lipid subclasses, such as (lyso)phosphatidylethanolamines, (lyso)phosphatidylinositols, and steryl esters, had never been reported in grape musts. Targeted quantification by GC-MS and LC-MS identified 375 lipids across nine subclasses, with 297 displaying significant differences (ANOVA α=0.05). Clarification significantly affected lipid concentrations, impacting 73% of detected species (Kruskal-Wallis α=0.05), particularly sterols, fatty acids, and phospholipids—key molecules for yeast metabolism.

These findings underscore the importance of studying the full complexity of lipid composition in grape musts and suggest that revising clarification practices could help preserve essential lipids, thereby improving fermentation efficiency and wine quality. Overall, this study provides new insights into the lipid composition of grape musts and the nutritional challenges yeast may face during fermentation.

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FLASH TALK

The impact of selected odorant combinations in wine oxidative aroma and their interactive role on the olfactory perception

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Keywords: wine oxidative aroma, Olfactoscan, RATA, perceptual interactions

ABSTRACT

It is widely known the impact that oxidation has on wine sensory degradation and eventually, in the shortening of its longevity. To date, several molecules emerging through oxidation have been identified as potentially responsible for certain aromatic deviations (ADs) provoking in the wine notes of "dried fruit", "cooked vegetables" or "spirit-like alcohol". However, their combined role remains unexplored, not only for the expression of these notes but also for the omission of other positives such as "red fruit" or "spicy". Meanwhile, recent chemo-sensory advancements suggest that perception is determined by odorant interactions (creative, associative, competitive or destructive), merging in different aromatic vectors [1], and that it is also influenced by the aromatic context [2]. Hence, the main objective of the work is to evaluate different combinations of these odorants and their impact on the expression of certain attributes in different aromatic contexts of red wine.

The analysis is based on a systematic chemo-sensory study conducted on red wines. Eight combinations of the odorants prompted to play a major role in oxidative aroma (acetaldehyde, 2,4,5-trimethyl-1,3-dioxolane, diethyl acetal, 3-methylbutanal, methional and phenylacetaldehyde), were selected through multivariate analysis (PCA, ANOVAs, and k-means clustering). These combinations as well as the impact of the omission of each odorant on the expression of certain notes were evaluated using the Olfactoscan. The stimuli were assessed for model wine solutions representing aromatic contexts of young red wine, oak-aged and Cabernet-Sauvignon.

This study determines the relationship that the selected odorants have in the development or inhibition of certain attributes. Besides, it is observed that the influence of the aromatic buffer is crucial for the aromatic robustness of the wine. Proof of this is that large compositional changes generate minimal impact on Cabernet Sauvignon, probably due to the differential role of its pyrazines, which act as aromatic suppressors.

Finally, results reveal the existence of certain "key" combinations triggering great aromatic changes, indicating the existence of configurational-type interactions.

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POSTER

The role of malolactic bacteria metabolism on the organoleptic qualities of wines

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Keywords: wine, lactic acid bacteria, malolactic fermentation, metabolomic

ABSTRACT

Lactic acid bacteria (LAB) are essential microorganisms in winemaking due to their role in malolactic fermentation (MLF) [1]. This process not only ensures the biological stabilization of wine through the decarboxylation of malic acid into lactic acid but also contributes to modifications in the chemical composition of the wine [2][3]. In fact, volatile and non-volatile compounds provided by LAB metabolism are important for the aromatic complexity of wines [2]. While the metabolic activity of LAB is known to influence key wine properties, the detailed metabolomic impact of different LAB strains in varying wine matrices remains poorly understood.

This study aimed to investigate metabolomic profiles resulting from the activity of nine LAB strains across four distinct wine matrices, using advanced metabolomic tools such as liquid chromatography-mass spectrometry (LC-MS) [4]. First the untargeted analysis focused on major families of compounds, including phenolic compounds, lipids, amino sugars, peptides, and carbohydrates. Then a targeted approach using KEGG libraries allowed to identify molecules of interest.

The results reveal different metabolic profiles, which can be attributed to the specific metabolic characteristics of the strains tested. Indeed, some of the tested LAB strains exhibited higher activity on phenolic compounds, potentially impacting wine stability and mouthfeel, while others were more associated with changes in lipids, carbohydrates or peptides fractions, which could influence downstream fermentation processes or the physicochemical properties of wine. The composition of the starting wine matrix was also found to play a critical role, as certain matrices favored the production or transformation of specific families of compounds within the same strain.

These findings provide new insights into the metabolic diversity of LAB and their interactions with the chemical environment of wine. Thus, the selection of specific LAB strains could be a powerful tool for tailoring the metabolic profile of wines, depending on the initial composition of the wine and the desired characteristics.

Further exploration could be undertaken into how LAB metabolism can be harnessed to achieve specific enological objectives and improve the aroma complexity of wines.

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POSTER

Antioxidant activity of yeast peptides released during fermentation and autolysis in model conditions

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Keywords: wine oxidation, yeast peptides, antioxidant activity, autolysis

ABSTRACT

Aging wine on lees benefits different wine sensory and technological properties including an enhanced resistance to oxidation. Several molecules released by yeast, such as membrane sterols and glutathione, have been previously proposed as key factors for this activity [1]. However, recent research testing various yeast extracts from wine lees reported that the improved oxidative stability did not appear to be related to membrane lipids nor directly correlated with glutathione concentration [2,3]. Conversely, chemical and electrochemical tests indicated the extract's low molecular weight fraction, containing yeast-derived peptides beyond glutathione, as the primary in slowing catechin oxidation in model wine [2]. A subsequent study investigated the peptides' release under model conditions during synthetic must fermentation and up to six months of lees contact, revealing the release of a significant peptide fraction (~1 g/L) composed of over 2300 sequences identified via LC-MS/MS, whose antioxidant activity was not tested [4].

Building on this approach, the present study examined peptides released after 7 and 240 days from inoculum. After ultrafiltration (MWCO 3 kDa) and purification using C18 cartridges, peptides were quantified with Pierce Quantitative Peptide Assays and their antioxidant activity was assessed with DPPH assay and by measuring their effect in reducing the browning due to the oxidation of catechin in model wine.

Results showed an increase in peptide concentration from 0.19 g/L at 7 days to 0.44 g/L at 240 days. Despite the lower concentration, the 7-day peptide fraction exhibited slightly higher antioxidant activity than the 240-day one (0.32 vs. 0.21 mM Trolox equivalents, respectively). When both peptide fractions were added at the same concentration (0.3 g/L) to a model wine enriched with catechin and exposed to oxygen at 13°C for 50 days, browning development (measured as A450nm) was 10 times lower than that of the untreated control. These results suggest that yeast-derived peptides capable of protecting catechin from oxidation were already present in the system at the end of fermentation.

These findings highlight the role of yeast-derived peptides in protecting wine from oxidation, explaining the reasons behind the application of lees aging and the addition of inactivated yeast extracts for this purpose. Future research will focus on identifying the peptides with antioxidant activities, and also those with antimicrobial properties, providing a wider understanding of the role of yeast peptides in the wine matrix.

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POSTER

Colloidal color stabilization in wine: A comparative study of *Saccharomyces* and non-*Saccharomyces* mannoproteins

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Keywords: mannoproteins, polysaccharide characterization, non-*Saccharomyces* strains, colloidal stability

ABSTRACT

Structure-function relationships between the polysaccharide part of *S. cerevisiae* Mannoprotein Pools (MPs) and their potential to interact with anthocyanins and Protein-Tannins aggregates was previously assessed [1,2]. Herein, MPs from nine yeast strains including *Saccharomyces* and non-*Saccharomyces* species were evaluated by their potential to stabilize Colloidal Coloring Matter (CCM) of red wines. β-glucanases extraction procedure preserved mannoproteins native structure to their uttermost extent. The strains comprised a wild-type (MP-WT) *S. cerevisiae* strain and its mutants ΔMnn2 (MP-Mnn2) and ΔMnn4 (MP-Mnn4) – linear N-glycosylated backbone and absence of mannosyl-phosphate groups, respectively; non-*Saccharomyces* strains of 3 different species: *Hanseniaspora vineae* (MP-Hv), *Torulaspora delbrueckii* (MP-Td), and *Schizosaccharomyces japonicus* (MP-Sj) all grown in anaerobiosis; and three enological *Saccharomyces cerevisiae* strains grown in different metabolic conditions: MP-C1 (anaerobiosis), and MP-IC1 and MP-IC2 (aerobiosis). MPs colloidal stabilization properties were evaluated at first by their capacity to stabilize $K_4[Fe(CN)_6]$ (Prussian Blue) in presence of $CaCl_2$ [3], then by their capacity to inhibit turbidity increases (ΔNTU) of young Merlot and oxidized Marselan wines stored for 2 days at 4 °C. Wine samples after cold test were centrifuged and the color parameters of the supernatant were assessed.

Prussian blue control samples lost complete absorbance at 750 nm 24 hours after $CaCl_2$ addition at 0.8 $g.L_{-1}$. MP-Sj and MP-IC2 accelerated blue color loss. Other MPs had a stabilization effect whose efficiency depended on the MP. MP-Mnn2/MP-Mnn4 stabilized 90-100% of color followed by MP-Hv/MP-WT (~80%), and MP-C1/MP-IC1 (~60%). Increases in MP concentration did not systematically led to an increase in stability, which indicates that several physico-chemical interactions were taking place simultaneously.

Concerning the stability tests in real wine conditions, MP-Sj and MP-IC2 had the same effect as in model conditions (Prussian blue) while, the positive impact on colloidal stability was dependent on the wine matrix and MP concentration. In Marselan wines, MPs had a mild impact on ΔNTU at concentration of 1 $g.L_{-1}$ whereas in Merlot wines, at the same concentration, MP-Hv, MP-Td, and MP-IC1 reduced ΔNTU of 2 to 3-fold in comparison with control samples.

Associated with the characteristics of each MP polysaccharide moiety, our findings help discover the interaction mechanisms involved in CCM and how MPs can improve its stability. The net negative charge of mannoproteins seems to have a negative impact on color stability. Other molecular characteristics counter-balance this instability effect such as compactness and the protein mass percentage.

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FLASH TALK

Chemical composition of press and free-run wines from three vintages and Bordeaux grape varieties. A comprehensive analysis

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Keywords: press wines, aromatic composition, phenolic composition, vintage

ABSTRACT

Press wines play a crucial role in red winemaking, representing up to 15% of the final blend [1]. Optimizing their value is essential both economically and for maintaining wine identity, especially given evolving climatic and societal challenges. However, little recent research exists on their composition. This study provides an initial assessment of press wines' chemical characteristics.

A total of 262 press wines and their corresponding free-run wines were analyzed from Cabernet-Sauvignon and Merlot across three vintages (2021–2023). General parameters, including pH, total acidity, volatile acidity, and total alcohol (TAV), were measured alongside color analysis. Volatile compounds (dimethyl sulfide, its precursor, and 32 esters) were analyzed via SPME-GC-MS. Phenolic content, including total tannins, total anthocyanins, anthocyanin monomers, and flavanols, was determined using spectrophotometry, HPLC, and UPLC techniques.

Results revealed significant compositional differences between press and free-run wines, influenced by grape variety and vintage. Principal Component Analysis confirmed distinct chemical profiles.

For Merlot, press wines had higher pH and lower TAV across all vintages. Esters were more abundant in free-run wines, while pDMS levels varied depending on the year. Press wines contained more tannins and flavanols, but total anthocyanin levels showed no significant differences.

For Cabernet-Sauvignon, trends were similar: press wines had higher pH and lower TAV, and free-run wines had higher ester concentrations. Press wines exhibited greater tannin and flavanol content, with no significant anthocyanin variation. Unlike Merlot, pDMS concentrations in Cabernet-Sauvignon remained stable in 2021 and 2022 but were significantly higher in free-run wines in 2023.

This study provides a foundational database on the aromatic and phenolic composition of press wines over three vintages. The findings challenge assumptions about their role, revealing significant chemical differences.

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POSTER

Effect of polysaccharide extracts from grape pomace on the oxidative evolution of hydroxycinnamic acids

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Keywords: phenolic acids, wine by-products, antioxidant activity, oxidative degradation, HPLC-DAD-MS

ABSTRACT

Phenolic acids are especially sensitive to oxidation, so they can greatly impact wine sensory characteristics and stability [1]. Furthermore, extracts derived from grape pomace have been previously postulated as possible oenological adjuvants for wine protection [2].

Thus, in this work, the oxidative evolution of the main three hydroxycinnamic acids (HA) present in wine (caffeic, *p*-coumaric and ferulic acids) was studied for two months by means of HPLC-DAD-MS [3], identifying and quantifying their degradation products. Ethanol-free wine like media (pH 3.4; 5 g/L tartaric acid; 4 mg/L $FeCl_3$; 0.4 mg/L $CuSO_4$) containing the HA (67 mg/L each) were oxygen-saturated with air. The absence of ethanol ensured oxygen availability for the oxidation of HA and oxygen consumption was monitored. Additionally, the effect of soluble polysaccharidic extracts (PS), obtained from white (WPS) or red grape pomace (RPS), on the evolution of the media was studied. These PS were fully characterized, and their antioxidant activity was assayed by the ABTS and FRAP methods [4]. The antioxidant activity of HA in the presence of PS was also studied and ITC experiments were performed to elucidate the nature of the interactions between HA and PS.

All HA decreased their concentration with time and oxygen consumption, especially in the presence of PS, which was contrary to the expected protective effect. Several degradation products of HA were identified, with a notable increase and subsequent degradation over time of the hydroxybenzoic acids derived from each respective HA. These degradation products could, therefore, serve as oxidation markers in wines rich in phenolic acids, such as white or rosé wines, which are especially susceptible to oxidation. Ferulic acid, followed by *p*-coumaric acid, greatly decreased in concentration, achieving a reduction of around 90% with PS addition (WPS and RPS). RPS showed greater antioxidant activity than WPS, and its presence in the HA evolution assays resulted in a greater degradation of HA.

PS acid hydrolysis and HPLS-DAD-MS analysis revealed the presence of polyphenolic residues that cannot be removed and that are only released after PS hydrolysis, including cyanidin and delphinidin derived from their proanthocyanidin precursors. In RPS, malvidin was also found, so the anthocyanin content could explain the difference in antioxidant activity.

In the presence of transition metals (like Fe_{3+} and Cu_{2+}), some polyphenols can act as prooxidants [4], favouring the oxidative degradation of phenolic acids. In this experiment, the absence of other antioxidants in the matrix (such as free anthocyanins or tannins) can explain the faster degradation of HA, stimulated by the polyphenols in the PS, contrary to what it is believed to be the overall protective effect of polysaccharides seen in wine. The findings in HA degradation and their relationship with PS provides a deeper insight in wine oxidation and the molecular interactions in its matrix.

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FLASH TALK

Elucidating white wines peptides: An analytical breaktrough

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Keywords: wine oxidative stability, peptides, SPE, LC-MS

ABSTRACT

The chemistry of wine is particularly complex due to biochemical and chemical interactions that significantly modify its organoleptic characteristics and stability over time. Aging on lees is a well-known practice during which various compounds are released, ensuring wines oxidative stability and its overall sensory quality [1,2]. Peptides are key compounds extractible from wine lees known for their tensioactivity [3], antimicrobial [3] and their antioxidant activities [4,5], however their chemical diversity is poorly studied. Our research team is interested in characterizing and evaluating the evolution of wine peptidic fraction during aging on lees, to determine how their different physico-chemical properties (polarity and size) influence the overall quality of the wine. In that respect, we have developed a combined SPE / LC-MS analytical methodology for overcoming the challenges associated with peptides separation and detection. Method optimization was carried out using a rich pool of peptides generated after BSA enzymatic digestion in model wine solution. Two SPE cartridges, a reversed-phase and a cation-exchange, were tested after adapting elution conditions. Results show that the extraction efficiency varied between the two approaches. The cation-exchange cartridge provided higher overall recovery and helped to overcome some limitation of reversed-phase cartridge, related to the loss of hydrophilic and small peptides. Five different LC columns were compared, including reverse phase (RP) and hydrophilic interaction (HILIC), with different gradient conditions (solvent pH and composition in ACN, elution time) as well as sample solubilization conditions. The results show that one of the columns, combined with specific conditions, including elution gradient for RP and elution gradient, mobile phase composition, and pH for HILIC, demonstrated superior performance. The separation performance was characterized by an increased number and a better distribution of detected features throughout the analysis time. In detail, in a total of respectively 4308 and 2964 detected features for RP and HILIC columns, only 1475 (34.24%) were in common. These results show a good complementarity between RP and HILIC separation modes indicating the use of both for a more complete description of wines peptidic fraction. To conclude, the proposed analytical approach shall allow complete description of peptide composition with highly repeatable annotations and quantification of peptides even in mixed hydrolysates.

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POSTER

Impact of grape ripening and post-harvest withering on must composition and fermentation kinetics

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Keywords: withering, postharvest dehydration, red straw wines, fermentation

ABSTRACT

Postharvest dehydration is a widely employed technique in winemaking to enhance sugar concentration and secondary metabolites from grapes. Different grape varieties exhibit varying responses in terms of dehydration rate and the resulting chemical composition. Additionally, the harvest time, reflecting different ripeness levels, can significantly influence the process [1]. This study aimed to investigate the impact of ripening level on the composition of must and the resulting straw wine. *Vitis vinifera* L. cv 'Corvina', 'Moscato di Scanzo' and 'Nebbiolo' were harvested at three ripeness levels: low (LR; 18°Bx), medium (MR; 21°Bx) and high (HR; 23°Bx). Grapes were subjected to controlled postharvest dehydration until achieving 20% grape weight loss. Musts were produced and sugar concentration, readily assimilable nitrogen, pH, titratable acidity were evaluated. Micro scale winemaking trials were performed with skin maceration, monitoring the inoculated fermentation by weight decrease. At the end of alcoholic fermentation, the wines were racked, stabilized and bottled. The sugar concentration in musts increased from the samplings at LR to MR, while decreased in grapes harvested at HR. This could be due to the glucose respiration occurring during the withering that seemed to be facilitated for more ripe grapes [2]. Readily assimilable nitrogen varied by variety: it increased in 'Corvina', but decreased in the others varieties. The pH rose of about 0.3 units from LR to HR in all varieties, while the titratable acidity remained stable in 'Corvina' and it reached its lowest level in the HR harvested sample for 'Moscato di Scanzo' and 'Nebbiolo'. The musts obtained from grapes harvested at LR completed the alcoholic fermentation within 10–11 days for all the grape varieties. Similar fermentation rates were found for 'Corvina' musts from withered grapes harvested at MR and HR being complete within 12–13 days. In contrast, the fermentation was completed in 16 days for 'Nebbiolo' musts, while the musts from 'Moscato di Scanzo' withered grapes collected at MR and HR did complete the fermentation at day 20. From an applicative point of view, the grapes harvested at the higher ripening level resulted more susceptible to pathogen infection suggesting that the ripest grapes are less adapted to the withering even if this process took shorter time. This study expands the knowledge on the varietal effect in grape postharvest dehydration, covering red varieties majorly used in this production technique.

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POSTER

Aroma typicity of Timorasso wines: influence of ageing on volatile organic compounds and sensory descriptors

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Keywords: Timorasso, sensory analysis, wine typicity, volatile organic compounds

ABSTRACT

'Timorasso' is an autochthonous white grape variety from southern Piedmont (Italy) used for producing wines in the Colli Tortonesi product designation of origin (PDO). Over the last decade, there has been a notable rise in its production, due to the increased interest of wine enthusiasts who prized its wine distinctive ageing notes [1].

The aim of this study was to investigate Timorasso wines belonging to vintages 2015-2021, using sensory and analytical methods, through two research stages: *i*) a preliminary sensory examination of 31 wines by an expert panel to determine Timorasso wine relevant descriptors; *ii*) a detailed analysis of free volatile organic compounds (VOCs) in a selected subsample of 18 wines, quantifying varietal VOCs (terpenes and C_{13}-norisoprenoids) and fermentation-related VOCs (esters, higher alcohols, fatty acids) by HS-SPME/GC-MS techniques, whereas low molecular weight sulphur compounds (LMWSCs) were analysed by HS-GC-PFPD [2]. This stage also included a descriptive sensory analysis (DA) with a trained panel on pre-defined relevant descriptors.

The experts panel most frequently characterized Timorasso wines with "Kerosene" (27.9% of citation), "White flowers" (15.5%) and "Yellow pulp fruits" (14.8%) categories. "Kerosene", "Balsamic" (10.8%), and "Empyreumatic" (5.5%) were positively correlated with aroma typicity (rated by the expert panel) of Timorasso wines, and they were found to be particularly relevant for wines aged for 5-6 years. Fruity-floral notes characterized the young wines (2021) but were not considered typicity markers. The VOCs analysis of 18 selected wines confirmed that the younger wines (2021) had significantly higher acetate esters content (and "Fruity" descriptors intensity in the DA). Six terpenes were detected, but in moderate concentrations and usually below sensory thresholds. C_{13}-Norisoprenoids found were β-damascenone, vitispirane, and 1,1,6-trimethyl-1,2-dihydronaphthalene (TDN). TDN was detected above the recognition threshold (10-12 ng/L) in some Timorasso wines [3], which is remarkable because it has previously been found mainly in Riesling wines. Higher concentrations of TDN were noticed in older wines (2017 vintage), which also showed a higher intensity of "Kerosene/beeswax" descriptor according to the DA. The "Empyreumatic" descriptor in the DA was relevant for the 2019 vintage. Some LMWSCs may be involved in the higher empyreumatic scores of certain wines. Understanding the chemical markers may help future research on the winemaking approaches to better express the Timorasso wines varietal typicity.

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POSTER

UV-VIS-NIR spectroscopy as a tool for predicting volatile compounds in grape must

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Keywords: NIR, spectroscopy, wine, must, PLS-R, volatile compounds

ABSTRACT

The wine sector is one of the most significant industries worldwide, with Spain being a leading country in wine production and export. A key factor in wine quality is its aroma, which is directly influenced by the volatile compounds present in the grape, with terpenes being among the most significant contributors. These compounds are responsible for the floral and fruity aromas characteristic of wine (1). Analytical methods for grape and wine analysis, particularly for volatile metabolites, often involve costly instrumentation and labor-intensive extraction procedures. In contrast, vibrational spectroscopy techniques, such as ultraviolet-visible (UV-Vis), and near-infrared (NIR) spectroscopy, have gained recognition as valuable analytical tool due to their simplicity, speed, and non-destructive nature. Currently, there is a notable scarcity of studies presenting accurate predictive models for terpene compounds in grape must (2). The objective of this work is to ascertain the viability of applying a wide range spectrum spectroscopy (UV-Vis-NIR) to develop precise models capable of predicting the terpene composition of the grape must. Our investigation specifically targets on the determination of glycosylated terpenes, including Z-8-hydroxylinalool, cis-furan linalool oxide, cis-pyran linalool oxide, geraniol (trans), HO-trienol (3,7-dimethyl-1,5,7-octatrien-3-ol), linalool, trans-furan linalool oxide, trans-pyran linalool oxide, and α-terpineol. Partial Least Squares Regression (PLSR) was employed to construct models. The results showed satisfactory predictive models for linalool (r^2 = 0.8; RMSE = 0.89), geraniol (r^2 = 0.8; RMSE = 8.63), and α-terpineol (r^2 = 0.84; RMSE = 2.56). The remaining predictive models developed showed acceptable coefficients of determination. UV region was identified as the most relevant region for the construction of the PLS-R models. These findings highlight the potential of this innovative technique to revolutionize the wine industry by enabling faster and cost-effective analysis of volatile compounds in must, thereby optimizing the winemaking process and improving product traceability.

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POSTER

Bioanalytical workflow for exploring the chemical diversity and antioxidant capacity of grape juice peptides

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Keywords: purification, enzymatic digestion, biochemistry, oxidative stability

ABSTRACT

The oxidative stability of white wines is related to a flow of chemical reactions involving a number of native wine containing compounds composing their antioxidant metabolome. Our research group could define wine antioxidant metabolome as the sum of molecular antioxidant markers characterized by their radical scavenging and nucleophilic properties [1–3]. The significant share of sulfur-containing peptides in wines antioxidant metabolome and their variation according to the vintage, the grape variety and the pre-fermentation oenological practices, shows the need to better explore the grape juice peptidic composition.

In the present work, by the application of biochemical technics, including low pressure purification, protein digestion, gel electrophoresis and size-exclusion chromatography coupled with a light scattering detector, qualitative and quantitative analysis of grape juice derived peptides were performed. Here we describe the optimization of a double digestion protocol used for peptide mapping of grape juice which addresses the challenge of balancing maximum digestion efficiency with minimum artificial modifications. The parameters on which we focused include, digestion time and temperature, as well as the source of acid protease used which are pepsins and Aspergillopepsins I, derived from the controlled fermentation of a selected strain. Using the optimized protocol we generated a pool of peptide compounds, which allowed us to firstly, determine its antioxidant capacity (DPPH essay) and secondly, to explore its chemical diversity by applying LC-MSq-Tof based metabolomics.

The proposed approach allows the validation of a workflow for complete description of peptide composition and antioxidant capacity in grape juices, and opens a new pathway to better manage wines oxidative stability already at the vineyard stage.

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POSTER

Further insight on the use of yeast derivative products as alcoholic fermentation enhancers

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Keywords: yeast derivatives, alcoholic fermentation, volatile compounds, design of experiment

ABSTRACT

Issues that can arise during the alcoholic fermentation are frequently attributed to imbalances or deficiencies in the nutrient composition of the fermentation medium. In particular, insufficient levels of assimilable nitrogen,high ethanol concentrations and certain yeast metabolic by-products, such as short and medium-chain fatty acids, could cause fermentation issues by inhibiting yeast activity [1]. Yeast derivative products (YDPs) have been widely employed in order to minimize these issues as they could supplement assimilable nitrogen. YDPs can also detoxify the fermentation matrix by neutralizing short and medium-chain fatty acids. Previous studies indicated that YDPs could release of long-chain fatty acids, which may improve membrane transport activity in yeast cells [2]. YDPs were also used in winemaking in order to enhance the rehydration of active dry yeast (ADY), thereby improving fermentation kinetics and reducing its duration. This could be due to the release of yeast cell wall fragments containing sterols which integrates in the membranes of ADY cells, facilitating their repairment after the damages sustained during the dehydration process [3].

In this study, the impact of YDPs on alcoholic fermentation was investigated.

Trials were carried out with 6 YDPs belonging to different classes added either in must or during the rehydration of ADY. In addition, a Response surface methodology approach was performed considering 3 different musts fermented at 3 different temperatures, in the presence of 3 YDPs added at 3 concentrations. The fermentation kinetics were monitored and the resultant wines were characterized in terms of chemical parameters, color parameters, volatile compounds (VOCs) and sensory characteristics.

Results showed no relevant difference in fermentation kinetics and chemical parameters due to the YDPs addition performed both in must and during the rehydration. Similarly, increasing concentration of YDPs did not affect neither the fermentation kinetics nor the general composition. This could be probably due to adequate content of readily assimilable nitrogen of the must. However, the determination of VOCs and the sensory analysis evidenced the YDPs led to changes of volatile profile and appreciation. These aspects were influenced by the addition of YDPs in must or in pied de cuve, the concentration employed and the fermentation temperature. The interactions between these parameters should be carefully considered during the winemaking operations as they could play a relevant impact on the characteristics of the resulting wine.

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POSTER

Determining the impact of thiophenols on ashy flavor recognition in smoke-affected wines

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Keywords: smoke taint, recognition threshold, ashy flavor, thiophenols

ABSTRACT

Wildfires are an increasing concern for wine-producing regions worldwide, as they generate smoke containing volatile organic compounds that can be transported over long distances and can be absorbed by wine grapes [1]. Wines produced with smoke-impacted grapes are found to have uncharacteristic smoky, burnt, and dirty flavors, with an ashy aftertaste being a particularly distinctive and negative attribute [2].

While volatile phenols are well-documented contributors to smoke-related flavors in wine, recent research suggests that thiophenols play a key role in the perception of ashy off-flavors [3]. The objective of this study was to determine the concentration at which thiophenols induce the perceptual «ashy» attribute in different styles of Pinot noir and Cabernet sauvignon wines. Using an adaptive staircase procedure, ashy flavor recognition thresholds for total thiophenols were assessed in wines containing varying levels of smoke-related volatile phenols (45 µg/L, 135 µg/L, 450 µg/L). Psychometric curves were fitted to estimate threshold distributions across individuals to be able to determine risk levels of a consumer perceiving a wine as ashy.

Results indicated that an inverse relationship was found between phenol and thiophenol concentration to produce a perceptual ashy flavor. This is important to be understood by the wine industry, as volatile phenols can be introduced to a wine during other parts of the winemaking process. Additionally, differences in recognition between styles were evident at the lowest phenol concentration, but at higher phenol concentrations, threshold variability decreased. This allows for better guidance of interpretation of chemical markers for potential sensory descriptors. These findings provide critical insight for winemakers and industry stakeholders, enabling informed decision-making regarding smoke-affected vintages. Beyond threshold determination, this study underscores the broad range of individual sensitivities to smoke-related compounds, highlighting the importance of consumer perception in mitigating economic losses due to wildfire events. Understanding these sensory impacts will help guide strategies to reduce waste and optimize wine quality in the face of increasing wildfire challenges.

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POSTER

Exploring the behavior of alternatives to montmorillonite clays in white wine protein stabilization

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Keywords: protein stabilization, bentonite alternatives, white wine clarity, volatile organic compounds, wine composition

ABSTRACT

Visual clarity in wines is crucial for commercial purposes [1]. Potential protein haze in white wines remains a constant concern in wineries, commonly addressed using bentonite [2]. Despite its effectiveness, bentonite's lack of specificity leads to several drawbacks [3], including negative impacts on aroma and phenolic compounds, product loss due to sludge formation after treatment [4], and health and safety concerns related to its production [5]. Thus, interest in alternatives to bentonite has grown in recent decades. In this study, we tested for the first time two alternative clays (sepiolite and palygorskite), comparing their effects, at an equivalent stabilizing dose, with two commercial bentonites and an experimental montmorillonite. The comparison was based on deproteinizing capacity (assessed via protein quantification using HPLC), basic parameters, CIELab color coordinates, volatile organic compounds (VOCs) analyzed by GC-MS, and phenolic compounds (assessed via spectrophotometric indexes) in a white wine from cv. 'Moscato bianco'. The required stabilization dose with commercial bentonites and experimental montmorillonite was 10 g/hL, while the tested clays needed a sixfold higher dose. No significant differences were observed in pH, whereas slight differences were detected in total acidity. Regarding color, all treatments decreased absorbance at 420 nm compared to the control, except for one commercial bentonite. Significant differences were found among products, with the tested clays showing the lowest absorbance value. Although significant differences were found in CIELab coordinates, none of the treatments led to visual differences compared to the control. Among the 54 detected VOCs, only ethyl butanoate, methyl decanoate, octyl acetate, and dodecanoic acid showed significant differences, with no consistent trend. These results confirm that bentonite does not affect varietal compounds (terpenes and C_{13}-norisoprenoids), and that, at low doses, its negative effects on VOCs are minimal [6]. All treatments significantly reduced the total polyphenols index (TPI) compared to the control. Notably, a highly significant correlation ($r^2 = 0.63$) was found between removed proteins and the decrease in TPI, confirming protein-mediated phenolics removal [7].

These results highlight the challenges of finding viable alternatives to bentonite and suggest that bentonite, when used at low doses, can stabilize white wine without compromising its qualitative traits.

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FLASH TALK

Effect of must temperature and aspergillopepsin-I supplementation on PR-protein derived peptides

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Keywords: proteases, chitinases, TLPs, protein stability

ABSTRACT

Protein instability in wines is challenging, and despite many efforts to find satisfactory alternatives to bentonite, both in terms of stability and quality, the solutions are limited in the wine industry. Among those proposed, aspergillopepsin-I supplementation (AP-I) completely stabilises wine when combined with the flash heating of musts, without compromising wine quality [1, 2]. However, the pasteurisation of must remains an arduous and economically disadvantaged process. Nevertheless, AP-I supplementation during fermentation has been reported to improve stability indices [3] through a mechanism that is still not fully explained.

This study investigates the effect of AP-I supplementation on the number and concentration of peptides resulting from the degradation of grape-derived proteins and the influence of temperature and reaction time. A Gewürztraminer grape must was heated at 20°C, 30°C, and 40°C in the presence or absence of AP-I (100 µg/L). The temperature was maintained for 1, 180, and 360 min, after which the musts samples were frozen, until analysis. The peptide composition of the samples was analysed using high-throughput ultra-high pressure liquid chromatography coupled to data-independent acquisition-based ion mobility separation-enabled high resolution mass spectrometry (UPLC-DIA-IMS-HRMS) and peptide mapping was conducted according to [4], [5].

AP-I supplementation significantly increased both the number of individual peptides (up to +51% at 40°C) and the abundance (up to +120% at 20°C) of grape-derived peptides. A statistically significant increase was observed regardless of temperature and was consistent across all analysed protein derivatives (Chitinases, PR-protein, Polyphenol oxidases, and Thaumatin-like proteins). Regarding reaction time, all treatment intervals increased both the number and concentration of grape-derived peptides with respect to the untreated control. However, extended treatment duration did not result in a further increase, potentially indicating an elevated rate of reaction with proteins suspected to be degraded.

The addition of AP-I to grape must, enlarged the peptides pool within the grape juice, also at temperature below 40°C. This new approach in the use of the enzyme is suggesting a proteolytic effect not only when AP-I is coupled with high temperature.

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POSTER

Effects of winemaking variables on the chemical and sensory quality of Schiava wines up to one year storage in bottle

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Keywords: Schiava wine, wine color, volatile compounds, polyphenols, sensory profile

ABSTRACT

The interactive effects of three major enological variables were evaluated on the quality of Schiava wine up to one year of storage in bottle. Differing from most red varieties, 'Schiava' grapes contain peonidin-3-glucoside as the main anthocyanin; together with other factors (e.g. low tannin content, high pH), the loss of peonidin-3-glucoside is thought to be a main cause for discolouration in the derived wines [1,2]. A primary objective was to test specific variables (e.g. grape freezing), for their possible ability to increase the extraction of pigments from the grapes, or to increase the colour stability in wine. Secondarily, potential interactive effects of variables such as grape freezing and the malolactic fermentation were targeted, as it previously showed to cause differences in the phenolic and volatile profiles of white wines made with other grape varieties [1]. The evaluated variables were: (1) grapes frozen or not for 2 weeks at -20 °C; (2) fermentation with or without fermentative maceration; (3) inoculum with *Saccharomyces cerevisiae*, or co-inoculum with *S. cerevisiae* and *Oenococcus oeni*. The storage in bottle was conducted in darkness at 4 °C for one year. Basic oenological parameters, colour, spectroscopical parameters [3,4], volatile profile, and polyphenols were monitored overtime. The sensory analysis was conducted after storage. The fermentative maceration was here excluded as a factor to use for comparison. The major trends associated with the grape freezing and the co-inoculum manifested in differences in the volatiles, condensed tannins, and colour profiles. Wines made without fermentative maceration presented a neat effect from the grape freezing; this was not so clear for wines made with fermentative maceration. In wines made without fermentative maceration, the grape freezing factor was associated to distinctive visual sensory attributes such as 'light pink' and 'pink salmon', and aroma descriptors such as 'nutty/almond' and 'tropical/banana'. Despite the higher initial content of peonidin-3-glucoside extracted from frozen grapes, no significant difference was found after bottle storage in relation to grape freezing. Interestingly, the colorimetric and visual parameters were instead positively impacted by grape freezing; this was attributed to the extraction from the frozen grapes of more chemical components participating in the colour stabilization. Overall, these factors greatly influenced the wine quality, offering the winemakers strategies to modulate the colour of Schiava wine even after one year of storage.

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FLASH TALK

Unveiling the fungal diversity of Falanghina grapes and the role of autochthonous *Saccharomyces* and non-*Saccharomyces* yeasts in wine fermentation

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Keywords: metabarcoding, microbial terroir, wine fermentation, sensory analysis, co-inoculation

ABSTRACT

Falanghina, a typical wine from the Sannio (Campania region, Italy), hosts a complex fungal microbiota that significantly influences both fermentation dynamics and sensory characteristics. This study aimed to compare different metabarcoding markers for profiling fungal communities and to characterize the diversity and role of non-*Saccharomyces* yeasts in natural fermentations. To assess fungal diversity, three DNA barcode markers (ITS1, ITS2, and D1/D2 of 26S rDNA) [1, 2, 3] were evaluated across six Falanghina grape samples and their corresponding musts at different fermentation stages. ITS2 provided the most comprehensive taxonomic resolution, identifying 63 fungal genera, whereas ITS1 and 26S revealed 20 and 17 genera, respectively. The predominant mycobiota included *Metschnikowia*, *Hanseniaspora*, *Saccharomyces*, *Pichia*, *Aureobasidium*, and *Starmerella*. However, culture-based methods enabled the identification of additional genera, such as *Candida*, *Wickerhamomyces*, *Rhodotorula*, and *Sarocladium*, reinforcing the importance of integrating molecular and traditional approaches. A complementary study focused on the isolation and characterization of non-*Saccharomyces* yeasts from these fermentations. Fifty-seven biotypes were distinguished based on morpho-physiological traits and enzymatic activities, including β-glucosidase production and ethanol tolerance. ITS sequencing (ITS1-5.8S-ITS2 rDNA) [4] of strains confirmed the presence, in addition to *Saccharomyces (S.) cerevisiae,* of 13 non-*Saccharomyces* species, with *Metschnikowia (M.) pulcherrima* and *Hanseniaspora guilliermondii* being the most frequently occurring. Notably, microbial composition varied according to the grape's terroir. Autochthonous selected strains of *M. pulcherrima* (MP12 and MP24) and *S. cerevisiae* (BIO3) in 120L vinification trials were tested. Sensory analysis revealed distinct aroma profiles: wines fermented with BIO3 alone exhibited pronounced banana notes, while MP12+BIO3 enhanced pear and exotic fruit aromas, and MP24+BIO3 contributed citrus, grapefruit, floral, and vegetal nuances. These findings highlight the value of ITS2 as a metabarcoding marker for fungal diversity analysis in wine and underscore the potential of non-*Saccharomyces* yeasts in modulating sensory attributes. Co-inoculation strategies with *S. cerevisiae* offer promising applications to improve fermentation performance and enhance the aromatic complexity of Falanghina wines.

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POSTER

Optimized grape seed protein extraction for wine fining

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Keywords: grape seed protein, fining agent, sustainability

ABSTRACT

The extraction of proteins from grape seeds represents a promising strategy to revalorize wine industry by-products. As a natural endogenous fining agent, grape seed protein (GSE) offers an effective solution for wine clarification [1] without requiring label declaration. This study optimized the laboratory-scale GSE extraction protocol proposed by Vincenzi et al. (2013) [2] and evaluated its potential as a sustainable clarifying agent. Improvements to the protocol enhanced protein purity, partially meeting the OIV threshold of 65%, while ash content remained below 3%, within the OIV limit of 8%. Protein composition was assessed via SDS-PAGE and analyzed for total protein, total polyphenols, and polysaccharides. The potential to increase yield was explored by introducing a defatting step, which improved protein purity, though its impact on process sustainability requires further evaluation. Additionally, certain by-products during the extraction process (such as the white fraction from the initial centrifugation) were found rich in proteins and polysaccharides, suggesting potential for recovery and reuse. Reducing the water-to-solid ratio from 1:10 to 1:5 (w/v) did not significantly affect protein yield, indicating opportunities for water savings. GSE's clarification performance was evaluated in different wine types (white, rosé, and sparkling), showing particularly strong results in white and sparkling wines. Compared to commercial fining agents (gelatin, casein, pea protein, and potato protein) GSE demonstrated comparable performance to gelatin in certain cases. Its effects on wine colour and total polyphenol retention were also assessed. In conclusion, this study highlights grape seed protein as a viable, plant-based alternative to conventional fining agents, offering efficient clarification and aligning with sustainable winemaking practices.

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POSTER

Sorption of aroma compounds by commercial specific yeast derivatives and the influence of polyphenols

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Keywords: yeast derivatives, aroma compounds, sorption, polyphenols

ABSTRACT

Specific inactivated yeast derivatives (SYDs) from *S. cerevisiae* are obtained through thermal, mechanical, and enzymatic processes and are used to enhance wine quality. Their impact on wine sensory properties varies depending on SYD type, fraction, matrix interactions and time, as they can modify aroma compounds' volatility or concentration (1). Some studies have examined SYDs' sorption of undesirable aroma compounds (2) but the sorption of key aroma compounds remains underexplored, particularly in relation to wine macromolecules such as polyphenols. Furthermore, no comparative study was found on the sorption capacity of different SYDs.

The aim of this research was to evaluate the sorption capacities of different SYDs in model wine conditions and to investigate the influence of polyphenols on such interactions with aroma compounds.

Three selected SYDs provided by Lallemand — inactivated yeast (IY), selected cell walls (CW), yeast protein extracts (YPE) — were fractionated based on solubility criteria. Insoluble fractions were added at 1 g/L to model wines containing 21 aroma compounds (esters, terpenoids, norisoprenoids, alcohols, aldehydes, phenols, sulphur compounds) in order to investigate their sorption according to functional groups and structural characteristics. Equilibrium sorption time was determined at 15°C, under constant agitation by monitoring free aroma concentrations in the supernatant over time. Aroma compounds were quantified by GC-MS (SIM mode) using external calibration for each compound, and after their liquid extraction with dichloromethane in presence of specific internal standards. Under equilibrium conditions, the impact of polyphenols was assessed using a 2 g/L polyphenol pool isolated from Syrah wine.

Sorption equilibrium was reached within 4 hours, and all insoluble fractions of SYDs exhibited aroma sorption capacity. The sorption capacity of the insoluble fraction of SYDs was influenced by their physicochemical properties and YPE showed the highest capacity, followed by IY and CW. Aroma compounds hydrophobicity played a key role since the most hydrophobic compounds within chemical groups (except for norisoprenoids), were preferentially sorbed, but structural properties have also shown an effect. Notably, polyphenols reduced sorption for some compouwwnds, highlighting the importance of the wine matrix in SYD-aroma interactions. These findings provide insight into SYDs' functionality and their potential application in aroma modulation during winemaking processes.

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POSTER

Photodegradation of retsina wine: does pine resin protect against light-induced changes?

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Keywords: *Pinus halepensis*, light-strike, terpenes, GC-MS/MS

ABSTRACT

Retsina is a wine deeply rooted in Greek tradition but often misunderstood, largely due to the poor quality associated with past production. Historically, pine resin was used to seal wine transport containers, and over time, its distinctive aroma led to its intentional incorporation into winemaking. While Retsina has a long history, it gained widespread popularity after World War II as an inexpensive, highly aromatic, and widely consumed wine. Today, Retsina is classified under the Designation of Traditional Appellation and is exclusively produced in Greece as a white or rosé dry wine, using the traditional method of adding pine resin to the must. Typically, retsina wine is bottled in flint glass bottles, and although is know that light can damage wine aroma compounds [1], the effect of light in aromatised wines, like Retsina, has never been studied before. It remains unknown whether the enrichment of the wine with resin-derived phenolic compounds (antioxidants) and terpenes can protect it from photodegradation. To address this gap, this project aimed to study the behaviour of Retsina's volatile components when stored in flint glass bottles. For this purpose, 12 Retsina wines, prepared with three levels of resin addition (0.1, 0.3, and >0.5 g/L), were stored for four weeks at room temperature under two conditions: a) Exposed to natural and artificial light in flint glass bottles, b) Stored in a box without any light exposure. After this period, the wines were analyzed using a state-of-the-art fast GC-MS/MS method, recently published [2]. The results were categorized into four groups: i) compounds that increased with resin addition, ii) compounds that decreased with resin addition, iii) compounds that increased due to light exposure, and iv) compounds that decreased due to light exposure. Notably, several terpenes increased with resin addition but decreased due to light exposure, while norisoprenoids decreased under light exposure. Some esters were reduced due to resin addition, and 2-AAP (2-aminoacetophenone) was increased by light exposure.

In conclusion, this study demonstrated that the addition of resin significantly influences the aroma profile of Retsina, affecting both primary and secondary volatile metabolites. Furthermore, flint glass should be avoided for bottling, as resin does not provide sufficient protection against photodegradation.

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POSTER

Mannoproteins from oenological by-products as tartaric stabilization and color agents in white and red wines

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Keywords: mannoproteins, tartaric stability, wine colour, phenolic composition

ABSTRACT

Climate change is drastically modifying grape composition and wine quality. As consequence, must and wines are becoming unbalanced, with high sugar concentration, increased alcohol content, lower acidity, excessive astringency, color instability and also a rise in the incidence of tartaric instability is being showed. The winemaking industry generates large quantities of byproducts, such as skins, grape pomace and lees, which represents an important environmental impact. In recent years, there has been increasing interest in the valorization of these byproducts, since contain high value-added compounds, such as polysaccharides among others [1]. Therefore, the obtention of polysaccharides from wine industry byproducts could diminish the environmental impact, enhance the sustainability in the wine industry byproducts, and also promote the circular economy due to the subsequent application in the winemaking process [2]. The aim of this study was to obtain mannoproteins from wine lees resulting from different winemaking processes and origins, as well as from the vinification of both white and red grapes, and to evaluate their influence on tartaric stability, color and phenolic composition in white and red wines. Thirteen different mannoproteins extracts (issued from wine lees) were characterized by SDS-PAGE, HPLC-RID and HPLC-MS. The analysed mannoproteins presented molecular weights between 160 kDa and 213 kDa and their protein content was ranging from 15 to 31% and had notable differences in their monosaccharide composition. Four mannoproteins with the highest and lowest average molecular weight and protein content were selected and each selected individual mannoprotein was added at a concentration 500 mg/L to white wine (cv Verdejo) and red wine (cv Tempranillo) in order to their effect on tartaric stability and phenolic composition at 0, 7, 14 and 40 days. Tartaric stability was assessed by a Cryosmart 2.0 equipment and color and phenolic compounds using CIELAB and HPLC-DAD-MS, respectively. The results showed that the addition of mannoproteins had an effect on the tartaric stability of white and red wines that depends on the structural characteristics of the mannoprotein. Similarly, differences in the phenolic profile and on color of the different wine samples were observed, that could be attributable to the effect of the mannoproteins and related to the differences presented in their structure.

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POSTER

Quantification of quercetin and quercetin-3-glucoside in Nebbiolo red wines

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Keywords: Nebbiolo, isoquercetin, anthocyanins, pH

ABSTRACT

Quercetin-3-glucoside, a grape flavonol defence metabolite, is extracted during winemaking and may undergo subsequent degradation in wines. Hydrolysation reactions lead to the formation of the aglycone quercetin, which presents limited solubility in the wine matrix and can induce visible precipitations. This issue potentially affects a wide range of wines. Red wines with low anthocyanin content, such as those produced from cv. Sangiovese grapes, seem more prone to quercetin instability [1]. Few cases of quercetin precipitation have been recently observed in wines from cv. Nebbiolo, a grape variety often destined to the production of monovarietal wines presenting a high content of phenolic compounds but low and oxidation-prone red colour pigments [2].

In this preliminary assessment, the quercetin-3-glucoside and (aglycone) quercetin contents were evaluated in 60 cv. Nebbiolo wines (containing a minimum varietal content of 90% or as monovarietal) covering a range of variability in terms of growing zones (Langhe, Roero, and Valtellina terroirs in northern Italy), production stages (bottle, tank, cask), and vintages (2012 to 2023), with most wines belonging to the last four vintages. Wine acidity and pH, as well as colour and key phenolic traits were also determined to investigate possible relations [1-3].

The average quercetin-3-glucoside and quercetin contents found were 1.8 and 8.0 mg/L, respectively, with high coefficients of variation (above 65%). Moreover, 18 wines presented quercetin amounts above 12 mg/L, with the highest detected concentration being 18.0 mg/L. For quercetin-3-glucoside, the maximum value was 10.8 mg/L, while no residual content was found in 37 wines, although these latter preserved a variable aglycone presence (5.6 ±5.0 mg/L). The average aglycone contents found are higher with respect to those from a previous survey of 22 cv. Sangiovese wines (estimated average below 5 mg/L, range 0.4-8.6 mg/L) [1]. No relevant correlations for quercetin were found with total anthocyanin content or colour intensity, however a strong negative correlation between wine pH and quercetin concentration was evidenced (p<0.001). The role of pH is highlighted as a possible influencing factor concerning wine quercetin content and its stabilization.

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POSTER

Photo-oxidative stress and light-struck defect in Corvina rosé wines: influence of yeast nutritional strategies

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Keywords: light struck defect, yeast nitrogen nutrition, volatile sulfur compound

ABSTRACT

Light exposure is one of the major factors affecting the sensory quality of rosé wines and resulting in the light-struck fault. The photochemical reaction between methionine and riboflavin leads to the light-struck fault resulting in volatile sulfur compounds such as methanethiol (MeSH) and dimethyl disulfide (DMDS) that are responsible for off-odors with descriptors of onion and cooked cabbage (Fracassetti *et al.*, 2021).

The study investigates the chemical processes that lead to modifications of the volatile chemical profile of Corvina-based rosé wines following light exposure, with a particular focus on the role of yeast nitrogen nutrition.

The study tested seven different nitrogen supplementations: a control (no nutrients), inorganic nitrogen (DAP), organic nitrogen sources (Organic and Organic+Methionine), and combinations of organic and inorganic nitrogen (Mix).

The wines were produced in laboratory scale, all fermentations were carried out in triplicate, in 3 L volumes, at a temperature of 16°C.

After fermentation, the wines were divided into two groups. The first group was bottled into amber bottles then stored in the dark at 16°C temperature for 30 days. The second group was bottled in flint bottles and stored under direct exposure to light for 30 days at a temperature of 16°C.

Volatile compounds were analyzed by the mean of HS-SPME-GC-MS techniques. In total 38 volatile compounds were analyzed belonging to different biochemical classes such as volatile sulfur compounds, esters, fatty acids, alcohols, C_6 alcohols, terpenes, norisoprenoids, benzenoids.

The results showed that light exposure decreased esters, terpenes (linalool, α-terpineol), and norisoprenoids (β-damascenone) while concurrently raising the amount of sulfur compounds linked to light struck defect, like MeSH, DMDS, DMTS.

Finally, a sorting task was conducted to evaluate olfactory similarities among the samples subjected to the nitrogen supplementation after light exposure. It showed that organic nitrogen nutrition strategies clustered together, exhibiting increased attributes of cooked vegetables. These wines showed higher concentrations of sulfur compounds (DMDS, DMTS, MeSH) and a lower content of fruity and floral volatile compounds (α-terpineol, β-damascenone) compared to those in the other cluster, which included the other nitrogen nutrition combinations.

These findings highlighted the importance of nitrogen supplementation sources and management and suitable packaging choices to mitigate the occurrence of light-struck fault in rosé wines, according to the insurgence of faults over the supply chain (Carlin *et al.*, 2022; Fracassetti *et al.*, 2017).

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POSTER

Kegged wine as a sustainable alternative: impact on conservation and sensory quality

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Keywords: sustainable wine packaging, wine-on-tap, kegged wine, conservation, sensory quality

ABSTRACT

Wine is not just a beverage; it represents an entire ecosystem in winemaking regions and is deeply linked to economic, social, and environmental factors. As global consumers increasingly prioritize sustainability, ethics, and health in their food and beverage choices, the wine industry is under pressure to develop greener production, distribution, and consumption models [1] [2]. While sustainability has become a key focus for the industry, there is limited academic research on the technological, ecological, and economic benefits of kegged wine and how industry stakeholders perceive them [3] [4].

The ECOFASS-vin project, initiated in 2017 under the Interreg program, aimed to evaluate the suitability of Ecofass® kegs—recyclable HDPE containers with internal aluminum pouches—for long-term wine storage and service. This study examined their impact on oenological and sensory quality over several months, analyzing different storage conditions, dispensing gases (nitrogen vs. compressed air), and pouch materials (PETMET vs. EVOH). Key parameters such as free SO_2 and CO_2 levels were monitored, along with sensory evaluations.

The results confirm that kegged wine can offer a viable conservation method, with PETMET pouches providing better oxidation protection and nitrogen gas preserving wine quality more effectively than compressed air. However, significant sensory differences were observed depending on storage conditions, highlighting the importance of material selection and gas composition. These findings suggest that properly optimized kegging systems could reduce SO_2 requirements, enhance wine preservation, and offer a sustainable alternative to traditional packaging.

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POSTER

Exploring non-*Saccharomyces* wine yeasts native from Castilla-La Mancha (Spain) to enhance bioprotection and quality of wines

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Keywords: microorganisms, isolation, grape, identification

ABSTRACT

The current tendency to reduce SO_2 in winemaking, due to its adverse effects in sensitive individuals [1], has led to the development of new techniques to mitigate SO_2 absence and to exert the same antimicrobial and antioxidant effects. Bioprotection is defined as the use of microorganisms or metabolites derived from them for the adequate preservation of food, reducing the use of chemicals [2,3]. Several studies showed the ability of different microorganisms to preserve and improve food quality [3]. More specifically, non-*Saccharomyces* yeasts have shown numerous positive effects, preserving and improving the organoleptic characteristics of wines [4,5,6].

Thus, this work addressed the isolation and identification of non-*Saccharomyces* yeasts from different viticultural areas within the Castilla-La Mancha Spanish region, in order to use them as a bioprotection tool in winemaking. Serial dilutions of 27 samples obtained from grapes and musts were seeded onto WL agar plates supplemented with biphenyl (150 mg/L) and chloramphenicol (100 mg/L) and incubated at 25°C for three days.

A total of 214 yeast colonies were isolated and identified to species level by PCR (ITS-5.8S rDNA)-RFLP [7]. Then, one or two isolates of each molecular profile were sequenced using the D1/D2 domains of the 26S region to confirm their identity, obtaining 27 different species of which the most prevalent was *Aerobasidium pullulans*, followed by *Hanseniaspora uvarum*, *Hanseniaspora guillermondii* and *Metschnikowia pulcherrima*. In addition, other species of interest such as *Torulaspora delbrueckii, Lachancea thermotolerans* or *Pichia kluyveri* were also isolated in a minority proportion. The 214 isolates were also evaluated in terms of their acetic acid and hydrogen sulfide production, as well as tolerance to 25 mg/L of SO_2 [8], reducing the number to 39 isolates from 16 different species. Based on these results, these yeasts will be further evaluated depending on their metabolism and possible beneficial effects on wine quality.

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POSTER

Discrimination of South Tyrol's wines by their cultivation practices: A detailed mass spectrometric approach

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Keywords: climate change, wine profiling, mass spectrometry

ABSTRACT

Climate change is having a profound effect on viticulture by altering the conditions under which vines grow, leading to increased water stress and earlier harvests, which in turn affect the quality and character of wines [1]. Climatic variations also influence the concentration of phenolic compounds, essential for wine structure and colour, forcing winegrowers to adapt their practices [2]. In addition, diseases such as powdery mildew, downy mildew and grey rot, favoured by these climatic changes, threaten harvests and wine quality [3]. The excessive use of pesticides to combat them presents significant environmental and health challenges, negatively affecting biodiversity and human health. Faced with these challenges, winegrowing is moving towards more sustainable approaches, such as biological control, the use of disease-resistant/tolerant grape varieties and preventive techniques [4]. New disease-resistant grape varieties promise to produce quality wines while significantly reducing pesticide use. Studies indicate that wines from these varieties have phenolic, anthocyanin, and volatile profiles comparable to traditional *Vitis vinifera* wines while also displaying distinctive compositional differences [5].

Our global project, carried out jointly by the University of Bordeaux and the University of Bolzano, aims to establish a comparison of French (Bordeaux & Pays d'Oc) and Italian (South Tyrol) wines from different cultivars (local and international), terroirs and different conditions (organic/conventional wines) and develop interlaboratory comparisons of targeted and non-targeted analysis methods based on the use of NMR and MS, coupled with HPLC and GC. An initial targeted and non-targeted profiling of 61 commercial monovarietal wines from Pays d'Oc (France), using UHPLC-HRMS/MS has already been carried out. The targeted analysis was conducted using a calibration curve of over 45 polyphenols, while the untargeted approach was based on a Full Scan HRMS acquisition with data-dependent fragmentation. The initial results showed a clear discrimination between wines based on the grape variety and cultural practices.

The same strategy is now being used on an additional dataset of 59 monovarietal wines from South Tyrol (Italy) coupled with HS-SPME-GCxGC-ToF/MS for their volatile profile and HPLC-QQQ-MS for anthocyanins, polyphenols and proanthocyanidins profiles. These multi-omics approaches should provide new knowledge and methodologies to discriminate wines based on their cultural practices [6].

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POSTER

Exploring typicity in Nebbiolo wines across different areas through chemical analysis

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Keywords: Nebbiolo, *terroir*, wine typicity, chemical analyses

ABSTRACT

"Nebbiolo" is a red winegrape variety well known to produce monovarietal wines in Piemonte, Valle d'Aosta, and Lombardia regions, taking part to 7 DOCG (Denominazione di Origine Controllata e Garantita) and 22 DOC (Denominazione di Origine Controllata) protected designations of origin (PDO) [1,2]. In a context affected by climate change and its repercussions on wine quality, identifying typicity markers is essential to preserve this heritage. The *terroir* concept encompasses the varietal identity, the geographic area, and related environmental factors, as well as the impact of the viticultural and oenological practices resulting in distinctive products [3]. Recent studies on different *terroirs* showed how physico-chemical and sensory characterizations help differentiate the deriving wines and identify varietal traits [4,5]. To this aim, a comprehensive study on more than 150 Nebbiolo based wines from different areas (North Piemonte and Valle d'Aosta, South Piemonte, Lombardia), designations (Barbaresco, Barolo, Canavese, Carema, Gattinara, Ghemme, Roero, *Sfursat* or Sforzato di Valtellina), and vintages (2015-2022, ageing 1-9 years) is being performed to characterize their matrix composition, color, and phenolic characteristics. Various parameters were determined, with a special focus on polyphenol content. The Nebbiolo wine population showed pH values ranging 3.01-3.86, alcohol strength 12.2-17.0% v/v, dry net extract 22.4-36.5 g/L, and total acidity 4.65-7.76 g/L (as tartaric acid). Phenolic analysis revealed a total polyphenol index ranging from 2682 to 6412 mg/L as (–)-epicatechin, and total flavonoids from 1091 to 3554 mg/L as (+)-catechin. These findings confirm the bold phenolic richness of Nebbiolo wines, predominantly flavanols. Low total anthocyanin content was evidenced, with values between 45.3 and 203.9 mg/L as malvidin-3-*O*-glucoside chloride. This last factor contributes to the low values of color intensity parameter (average 5.1) typical of Nebbiolo wines [5]. This values ranges from 2.43 to 9.42 depending on wine ageing and wine style. The results will be further evaluated considering their geographical origin, different designations, and ageing time and modality.

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POSTER

Validating a portable ad-hoc fluorescence spectrometer for monitoring phenolic compounds during wine fermentation

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Keywords: phenolic compounds, fluorescence spectroscopy, winemaking monitoring, chemometrics

ABSTRACT

Phenolic compounds are fundamental to wine quality, influencing its colour, mouthfeel, stability, and ageing potential [1]. Their extraction and evolution during fermentation plays a crucial role in determining the final sensory attributes and requires careful monitoring to guide winemaking decisions. Traditional analytical techniques such as high-performance liquid chromatography (HPLC) and UV-Vis spectrophotometry are well-established for phenolic quantification but are often impractical for real-time monitoring due to their time-intensive protocols and laboratory requirements. Fluorescence spectroscopy, with its high sensitivity and non-destructive nature, presents an attractive alternative [2]. However, commercially available instruments are not tailored to the unique challenges of winemaking, creating a gap in accessible and practical solutions for on-site monitoring.

This study validates a portable fluorescence spectrometer designed for the direct measurement of phenolic compounds in wine without the need for dilution or sample treatment. This capability allows for real-time monitoring of phenolic evolution throughout the entire fermentation process, providing rapid and reliable data directly from the wine matrix. The analytical performance of the spectrometer was evaluated in terms of its sensitivity, selectivity, repeatability, and robustness under winemaking conditions. A set of phenolic standards representing key wine polyphenols was used to assess figures of merit, including limit of detection (LOD), limit of quantification (LOQ), linearity, and reproducibility, all of which demonstrated strong analytical capabilities. Controlled fermentations with different grape musts were conducted, covering a range of phenolic profiles to test the instrument's ability to differentiate and quantify relevant compounds. Fluorescence single excitation multiple emission matrices were generated and analysed through advanced chemometric methods, including Partial Least Squares Regression (PLSR) and other non-linear prediction algorithms [3]. These models enabled the accurate prediction of critical phenolic parameters such as total polyphenols, anthocyanins, and tannins, with particularly good performance observed in single cultivar specialized model fermentations, where spectral signals exhibited clearer correlations with reference phenolic measurements, achieving correlation coefficients higher than 80%.

The results highlight the potential of custom-designed ad-hoc analytical equipment as a game-changer for winemaking, offering a practical, efficient, and cost-effective alternative to traditional phenolic analysis. Unlike commercial fluorescence instruments adapted for general laboratory use, this tailor-made device is optimised for winery applications, enabling real-time decision-making without reliance on centralised facilities. Additionally, its versatile measuring chamber supports multiple configurations for diverse measurement needs and allows direct wine analysis without prior dilution, ensuring seamless integration into the production process as an effective process analytical technology. Its successful validation paves the way for a new paradigm in phenolic monitoring, empowering winemakers to enhance process control, refine blending and ageing strategies, and ultimately improve wine quality with greater precision and efficiency.

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POSTER

Sensory and consumer perceptions, and consumption barriers of low and no-alcohol wines in Trentino/Alto Adige

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Keywords: consumer survey, NOLO wines, consumer preferences

ABSTRACT

The growing demand for non-alcoholic beverages, driven by health-conscious consumers and shifting social norms, has positioned dealcoholized wines as a promising alternative in the global beverage industry (Akhtar *et al.*, 2025, in press; Kakroo, 2024). Despite increasing interest, limited research explores consumer motivations, perceptions, and demographic trends influencing acceptance (Shaw *et al.*, 2023). This study explores awareness, perceptions, and situational preferences for dealcoholized wines through a survey of over 300 adults in the Italian region of Trentino/Alto Adige, which is situated at the crossroads between Italian and German wine cultures, focusing on demographic disparities and actionable factors influencing consumption. A structured online survey was administered via Survey Monkey, capturing demographic data (age, gender, income, occupation) and responses to address the familiarity, purchase behavior, sensory expectations, and social perceptions of NOLO wines. Descriptive analysis of percentage-based results revealed that despite low familiarity with NOLO wines, a significant 74% of total respondents expressed willingness to recommend it, highlighting promising potential. Major key drivers for trying NOLO wines included wine-tasting opportunities 75%, positive reviews 54%, promotions 32%, and package design 12% while smooth mouthfeel 65% and similarity to traditional wines 71% were critical sensory expectations for the NOLO wines. However, social and practical barriers, such as limited availability and ingrained habits, contributed to 80% never purchasing these wines. The study reveals that while dealcoholized wines are gaining interest among health-conscious consumers in Trentino/Alto Adige, low familiarity and availability are major barriers. Key motivators for trying these wines include tasting opportunities and positive reviews. To increase consumption, producers should focus on providing tasting experiences and addressing availability issues.

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POSTER

Portable NIR spectroscopy for nutrient profiling in rootstock and scion material: enhancing decision-making in the grafting industry

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Keywords: Near-InfraRed (NIR) spectroscopy, grafting compatibility, nutrient profiling, precision viticulture

ABSTRACT

The success of grafting in viticulture is deeply influenced by the nutrient composition of both rootstock and scion materials. Key components such as nitrogen and carbohydrates play a crucial role in graft compatibility, establishment, and overall plant vigor [1]. Traditional methods for assessing nutrient content are often time-consuming, destructive, and resource-intensive, limiting their application for rapid decision-making in commercial settings. This leads to grafting industries often adopting a non-selective grafting approach, where the grafting is attempted without prior assessment of viability (meaning whether or not the rootstock or scion has low nutrient content), relying solely on postgrafting establishment outcomes or vine vigour results to determine success. This method leads to inefficiencies, resource wastage, and variability in plant quality. Near-Infrared (NIR) spectroscopy has emerged as a non-destructive, rapid, and reliable tool for compositional analysis across various agricultural sectors. This study explores the application of NIR spectroscopy for assessing nutrient profiles in rootstock and scion materials, aiming to support data-driven grafting decisions that maximise resource use and optimise plant quality.

The study employed three NIR spectrometers: a benchtop unit, a commercially available portable spectrometer, and a handheld prototype device, to evaluate their performance in analysing nutrient content in grapevine rootstock and scion samples. Samples were collected from three grapevine nurseries, each providing material from different sites, cultivars, and clones, ensuring a diverse and representative sample set. The final dataset consisted of a thousand samples, which were analysed both on the outer layer and on the cross-sectional area of the shoot, following a fresh transverse cut, to avoid bark influence in the spectra. This diversity in samples allowed for a robust validation strategy using an independent dataset that maintained the proportion of different cultivars, ensuring the model's reliability across varied genetic material. Multivariate calibration models were developed for each instrument using Partial Least Squares (PLS) Regression. However, due to the high volume of spectral data, not every sample underwent wet-chemical analysis. Instead, a recursive PLS approach was applied, where an initial subset of samples was chemically analysed, and the resulting model predictions were used to predict additional samples, which were then added to the model [2].

The study demonstrated promising results in predicting nitrogen and carbohydrate content using all three NIR spectrometers. The benchtop instrument exhibited the highest accuracy, but both the portable and handheld devices achieved acceptable predictive performance, making them suitable for industry applications. The resulting errors remained within acceptable thresholds for practical decision-making in the grafting industry. These findings highlight the potential of NIR spectroscopy as a rapid and non-destructive tool for nutrient profiling in rootstock and scion materials, enabling informed decisions that can improve graft success rates, optimise resource allocation, and ultimately enhance plant quality.

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POSTER

Effect of ozone treatments in wine production on colour traits, volatile composition, and sensory characteristics of young and short-term aged white wines

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Keywords: ozone, white wines, aroma compounds, colour characteristics

ABSTRACT

The main aim of WiSSaTech project (PRIN P2022LXY3A),supported by the Italian Ministero dell'Università e della Ricerca and European Union-NextGenerationEU, is to investigate eco-friendly and safe alternatives to sulphur dioxide (SO_2) in wine production. Three treatments were compared on two Italian white wines produced from grapes cv. Fiano and Vermentino: ozone treatment of grapes and cellar equipment either alone (O_3) [1] or following the Purovino® method (PV) [2], and conventional use of SO_2. Colour characteristics (CIELab coordinates [3]), total polyphenols (absorbance at 280 nm and Folin-Ciocalteu method [4]), antioxidant activity (DPPH, ABTS, FRAP, and CUPRAC methods [4]), and volatile organic compounds (HS-SPME-GC-MS method [5]) were determined. Moreover, sensory analysis was conducted using descriptive analysis [6]. All analyses were carried out on the obtained wines (T0), after accelerated aging at 35 °C for one week (T1),and after six months of conventional aging at 18 °C (T6).

Results showed that the antioxidant activity for Vermentino was higher in SO_2-added wines at T0, T1, and T6 followed by O_3-treated samples whereas total polyphenols were higher in the latter. Similar trends were observed for the antioxidant activity in Fiano wines, showing lower values for the PV treatment. Ozone treatments also influenced the VOCs profile. For Fiano, total free VOCs concentration decreased in PV and O_3 wines at T0 compared to SO_2 trial. Particularly, esters and acids diminished for PV treatment whereas benzenoids, terpenes, and norisoprenoids increased. However, benzenoids and terpenes decreased for O_3-treated samples, as also occurred at T1 and T6, whereas norisoprenoids increased. All increasing trends were confirmed at T6. For Vermentino wines, higher concentrations of benzenoids, terpenes, and norisoprenoids were also obtained for both PV and O_3 treatmentsat T0 and T1, but differences were observed between them at T6 leading to ahigher total VOCs concentration in PV-treated samples. Sensory analysis revealed higher fruity and floral notes (*green apple* descriptor at T1, *pear*, *yellow pulp fruit, pineapple* at T6) in O_3 samples for Vermentino and Fiano, probably due to a higher citation of oxidation/reduction faults evidenced in the other wines. Higher sensory perceived colour hue in PV samples was in agreement with instrumental parameters (lower L* and higher b*), showing the highest colour differences (ΔE*) with SO_2 treatments, that were perceived more *green* at the three sampling stages.

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POSTER

Effects of fast dehydration at low temperature and relative humidity on the phenolic composition of Nebbiolo grapes

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Keywords: grape dehydration, dehydration temperature, polyphenols, extractability

ABSTRACT

Grape postharvest dehydration is a widely used technique for the special wines production, where genetic features, ripeness degree and environmental factors strongly influence the metabolic processes [1]. Low temperatures allow a better preservation of secondary metabolites by limiting oxidation reactions, but relative humidity and airflow are also important parameters in regulating the dehydration rate, which induces metabolic responses to water stress [1]. In this study, a cold dryer system (FD), operating at an air temperature and relative humidity of 15 °C and 40%, respectively, was tested for fast grape dehydration. This system was compared to long-term dehydration at 10 °C (LD), allowing better anthocyanin preservation [2], and to an uncontrolled process at 25 °C (MD) to assess the effect on the preservation and extraction of polyphenols in dehydrated grapes. 'Nebbiolo' winegrapes were used and samples from all trials were collected when a 35% of berry weight loss was reached. Standard parameters, total anthocyanins (TA), total flavonoids (TF), condensed tannins (PRO), flavanols reactive to vanillin (FRV) and colour traits were determined [3]. The potential phenolic content in skins and seeds [4] and the extracted content during 14 days of simulated maceration with a model wine solution [4] were determined.

The results showed that dehydration was faster for FD, requiring only 15 days to reach 35% berry weight loss compared to 55 days for LD and 27 days for MD. The latter showed higher potential phenolic contents in skins for TA, TF and PRO than FD, LD and fresh grapes (prevailing concentration effect), whereas presented similar extracted concentrations to LD, showing FD samples the lowest values. Extracted TA contents peaked at 24 h of maceration and then decreased, whereas TF remained constant due to the progressive extraction of PRO and FRV. FD samples also showed the lowest potential and extracted FRV contents in skins, with a decrease of around 50% compared to fresh grapes. On the other hand, the potential FRV and PRO contents in seeds increased in dehydrated grapes, particularly for FD, but the extracted content increased similarly across the three treatments for PRO and achieved the highest values for FRV in FD. This study highlights that the dehydration rate, either too fast or too slow, rather than temperature could promote cell-wall degradation releasing phenolic compounds but inducing oxidation reactions that lead to significantly lower contents and red pigments loss.

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FLASH TALK

Investigating *kokumi* flavour oligopeptides in wine

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Keywords: wine complexity, peptides, *kokumi*, sensomic

ABSTRACT

Kokumi is a complex sensation perceived as enhanced palatability. Under the influence of kokumi substances, foods/beverages tastes become more flavorful with increased intensity, spread, continuity, richness, harmony, and punch which are the six related characteristics corresponding to the Kokumi sensory concept [1]. Kokumi active peptides are distributed in many foodstuffs and relevant in fermented ones due to yeasts derived oligopeptides. Kokumi peptides identified from yeast extract showed diverse sensory features tested by sensomic approach: five leucyl dipeptides, γ-glutamyl dipeptides and the well-known kokumi-active glutathione (GSH) a tripeptide (γ-Glu-Cys-Gly) also present in grape and wine [2] [3].

Wine likely is the fermented beverage for which the sensory features represent one of the main quality characteristic driving appreciation and purchase. Sparkling wines produced through the Champenoise method, undergo a second fermentation in the bottle prior to aging in contact with yeast lees. Based on current knowledge, these production conditions make it possible to speculate on the potential presence of kokumi oligopeptides in wine, an issue that has not been explored. It has been stated that "koku" for wine is customarily expressed as "body" [4] but no evidence is reported and the kokumi sensory dimension in wine is currently unknown.

This gap of knowledge has been addressed in a series of metabolomic, molecular docking and sensory analysis experiments. The kokumi sensory activity of Glycyl-L-Valine (Gly-Val) was shown. This dipeptide has been identified in 34 sparkling wines, within a pool of 11 oligopeptides able to interact (in-silico molecular docking) with the Calcium Sensing Receptor (CaSR), the protein necessary to activate kokumi sensations [5]. Trained panellists (32) evaluated the impact of Gly-Val in model wine (MW: 12% v/v EtOH, 6.30 TA, 3.0 pH)), white wine (WW), and sparkling base wine (SBW) using triangle tests (T), three alternative forced choice test (3-AFC) and descriptive analysis with relative reference scaling (DA with RR scaling). In T the odd sample with Gly-Val was correctly identified only at the highest concentration (120 mg/L) in MW, while at lower concentrations in WW (15-60 mg/L) and SBW (30-90 mg/L). Detection thresholds of Gly-Val, estimated by 3-AFC, ranged from 15 to 60 mg/L in wine, while no threshold was determined in MW. These results show that Gly-Val is discernible in complex wine matrices but not in a simplified matrix such as the model wine. This suggests for the first time that Gly-Val is a kokumi active compound, indeed a kokumi compound is intended as a molecule able to modulate in-mouth sensations in complex matrices [1]. Based on these results, further 6 dipeptides are currently being studied to test their potential kokumi flavor in wine, according to the detected compositional patterns.

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FLASH TALK

Solid Rectified Concentrated grape Must (SRCM) in sparkling wines production: studying the sensory impact of an innovative sugar substrate

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Keywords: sparkling white wines, second-fermentation, MCRS (Mosto Rettificato Concentrato Solido), sensory quality

ABSTRACT

The production of sparkling wines requires sugars for the second fermentation. The Solid Rectified Concentrated Must (SRCM) is a water free crystalline form of grape sugar, offering a purer, more stable, and easier-to-use alternative to the liquid Rectified Concentrated Must (RCM). RCM is a grape must that has been stripped of all components except sugars and then concentrated. However, it is still not considered as pure, stable, or practical to use as crystalline sucrose, which is permitted for sparkling and enrichment practices, but in the latter case, only in certain countries, excluding Italy and other major Mediterranean wine-producing nations. EU Regulation n. 1308/2013 allows the use of SRCM in winemaking under the same conditions as RCM. Previous experiments [1-2] have assessed the microbial stability and fermentation performance of SRCM in sparkling wine production. However, its impact on the sensory characteristics of wines needs to be further explored in depth, in different types of wines.

This study investigated the sensory quality of 3 sugar substrates - SRCM, RCM, and sucrose, the latter in white (WS) or raw cane (CS) form - and six sparkling wines obtained from two different grape varieties (W1 and W2), each re-fermented with the 3 sugar substrates. The different matrices (water solutions of sugar substrates and sparkling wines re-fermented with them) were analysed by sensory analysis to compare and describe the respective sensory characteristics (smell/aroma, taste, mouthfeel). Significant differences and peculiarities were evaluated through discriminant (triangular test: TT) and descriptive (quantitative descriptive assessment: QDA) sensory methods [3-4] by a panel composed of 25 wine experts.

Preliminary results show that no olfactory and taste significant differences exist between water solutions of sugar substrates. Results on wine differed depending on the wine type. The odour of W1 re-fermented with SRCM was significantly different ($\alpha << 0.001$) compared to that of W1 re-fermented with CS. Preliminary descriptive results suggest that W1 treated with SRCM was fresher and fruitier. Differently, W2 re-fermented with SRCM showed significant differences ($\alpha < 0.05$) compared to W2 re-fermented with RCM, mostly due to acidity and more intense and persistent in-mouth effervescence. Further ongoing experiments will be useful to deepen these preliminary evidences, necessary to optimize oenological applications of this innovative and sustainable product.

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POSTER

Consumer perception and preferences regarding grape varieties resilient to climate change

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Keywords: consumer, PIWI, sustainability, climate change, home-use test

ABSTRACT

Innovative solutions have been developed for winemakers to adopt in their cultivation practices [1]. Two of the implementations addressed in this study are the use of strains adapted to arid climates (AAC) and the use of varieties resistant to fungal diseases (PIWIs). Both not only allow adaptation to current climatic conditions but also reduce the environmental impact of viticulture [2] and could contribute to creating a competitive advantage in the wine market [3].

249 consumers answered an online survey assessing the degree of acceptance of alternative varieties in order to mitigate the effects of climate change. The questionnaire was divided into two phases, one without and another with detailed information about the varieties. Subjective knowledge, support to produce wines made from these alternative grape varieties compared to conventional ones (CON), purchase intention and acceptance level attributes were taken into account. Additionally, consumer neophobia toward emerging trends in wine was considered.

On the other hand, a Home-Use Test (HUT) with 71 participants evaluated the sensory acceptance of a set of 10 wines made with studied varieties. For the interpretation of the data, analysis of variance on the variables contemplated was used.

It was observed that the higher the level of subjective knowledge and the lower the level of neophobia, the more consumers tended to accept the varieties studied ($p < 0.05$).

Acceptance levels varied significantly, with conventional varieties (CON) being the most accepted, followed by PIWIs, and finally AACs ($p < 0.01$). This preference pattern aligned with purchase willingness and support for winemaking with these varieties. Additionally, providing information significantly increased consumer acceptance for all types of varieties ($p < 0.01$).

Regarding sensory acceptance from the HUT test (carried out without information), there is a contrast with the levels of acceptance obtained in the online questionnaire, since PIWIs were more accepted than ACAs and CONs ($p < 0.01$).

Consumer preferences, as assessed through an online questionnaire, indicated a higher acceptance towards conventional varieties, followed by PIWIs and ACA varieties. However, findings from HUT revealed that, in a blind tasting context, PIWIs were the most preferred option, highlighting their potential as a strategic and innovative alternative for the wine sector.

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POSTER

Chemical and sensory evolution of total and partial dealcoholized wine in a can

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Keywords: dealcoholized wine, canned wine, physicochemical analysis, wine ageing

ABSTRACT

In recent years, wine consumption has been evolving towards new trends. On the one hand, awareness of health and responsible consumption has been growing, and with it, the demand for wines with lower or without alcohol content [1]. The World Health Organization in its Global Alcohol Action Plan 2022-2030 promoted initiatives to reduce the harmful use of alcohol as a public health priority and to improve the health and well-being of populations around the world, thus urging the alcoholic beverage industry to position itself for the development of products with lower alcohol content [2]. In addition, climate change is having a direct impact on the increase in the alcohol content of wines, increasing the sugars accumulation on grapes resulting in a higher alcoholic content [3]. On the other hand, packaging is key to the wine economy [4]. Therefore, the industry is looking for alternatives to glass, such as cans, for their practicality, lower cost and lower environmental impact. Wine in cans therefore aims to compete with soft drinks and beer, including non-alcoholic options. Recent studies have shown that its market is expected to grow from $235.7 million in 2021 to $570 million in 2028 [5], enabling lighter and more sustainable consumption in non-traditional settings.

In this study, we focused on evaluating the evolution of partially and totally dealcoholized wine in cans. For this purpose, the same white wine was partially and totally dealcoholized from a hydrophobic membrane up to 5.11 % vol. and 0.63 % vol. respectively. Subsequently, the wine was refined by correcting taste sensations and finally it was canned. The analyses performed were focused on basic physicochemical tests and color characteristics to see the impact of dealcoholisation process and ageing in a can. Reduction flavours and the total content of metals in the wine were monitorized to know the impact of zero oxygen transmission packaging on wine and monitor the can film status to prevent the contact between wine and aluminium. In addition, fermentative analyses were carried out to monitor the global impact on aromatic perceptions. Sensory analysis on time were used to monitor taste and flavours evolution and know the preference of the consumers. All the analysis were carried out at 0, 3 and 6 months. This study and their results could improve product quality and consumer acceptance of low and non-alcoholic wines in cans. It would also open up new markets among health-conscious consumers and encourage advances in dealcoholization, winemaking and preservation.

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POSTER

Effect of pre-fermentative addition of oenological tannins on the volatile composition and colour characteristics of white wines

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Keywords: oenological tannins, volatile organic compounds, colour traits, fermentation

ABSTRACT

This study investigates the effect of pre-fermentative addition of oenological tannins on basic physicochemical parameters, total polyphenols index (TPI), antioxidant activity (DPPH method), colour traits, and volatile organic compounds (VOCs) of white wines made from 'Vermentino' or 'Erbaluce' grapes (*Vitis vinifera*). Six oenological tannins were used, including hydrolysable (ellagitannins, gallotannins) and condensed tannins (derived from grape skins, grape seeds, quebracho, and acacia), at a dose allowing a similar increase in the TPI value. Nano-vinifications (300 mL) under controlled conditions were evaluated at three alcoholic fermentation stages (80 g/L, 20 g/L, < 2 g/L of reducing sugars; fermentation lasting 18 days). Tannins addition did not significantly influence the basic physicochemical parameters and fermentation kinetics, but it increased TPI and antioxidant activity as expected. In the final wine, the highest TPI value was observed for grape seed tannin, while the grape skin and grape seed tannins exhibited the greatest DPPH values in Vermentino and Erbaluce wines. Colour characteristics determined according to CIELab system [1] showed that the acacia tannin trial resulted in the greater colorimetric difference (ΔE*) with respect to non-added samples in the pre-fermentative stage (lower L* and higher b* colour coordinates). In Vermentino and Erbaluce wines, these colour differences diminished in most of cases, with gallotannin and grape skin tannin having the least impact.

Free VOCs were determined by HS-SPME-GC-MS at the three stages of fermentation [2] and possible changes in volatility were evaluated by simulating the fermentation conditions [3]. Regarding Vermentino, the wines obtained using quebracho tannin showed the highest concentration of all VOCs classes, particularly ethyl esters and acids, increasing total VOCs concentration by up to 28% compared to the control sample. Esters and acids also increased in wines resulting from acacia and grape skin tannin trials but the concentration of terpenes and norisoprenoids was negatively affected. Moreover, grape seed tannin better preserved higher alcohols (mainly 2-phenylethanol), acids, and norisoprenoids. Regarding Erbaluce, the effects were less pronounced. Ellagitannin, quebracho, and grape seed tannins increased the concentration of esters by around 5% whereas tannins from exotic woods decreased that of benzenoids by 10%. Individual VOCs results showed that oenological tannins can significantly improve wine aroma complexity but a varietal effect was observed.

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FLASH TALK

Investigating biotic and abiotic stress responses in grafted grapevine cultivars: A comparative study of Cabernet-Sauvignon and Cabernet Volos on M4 rootstock

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Keywords: grapevine stress responses, water deficit and recovery, copper toxicity, downy mildew susceptibility

ABSTRACT

When grapevine plants are transplanted into already established vineyards, they face multiple challenges, including adverse climate, heavy metal accumulation from agronomic practices [1], and pressure from highly adapted pathogens [2]. For this reason, understanding the interactions between soil biota, scion, and rootstock [3] under environmental stressors is essential for improving grapevine resilience. This study investigates the combined effects of water stress, copper-induced toxicity, and Plasmopara viticola infection on the performance of grafted grapevines. Rootstock M4 was grafted with Cabernet Sauvignon and Cabernet Volos and subjected to copper application at the soil level, drought stress followed by heavy rainfall, and pathogen inoculation. Physiological and biochemical data were collected using both traditional methods and smart phenotyping to assess plant responses [4]. Results showed that while both cultivars experienced similar levels of water stress, they successfully restored water balance post-recovery, indicating preserved root functionality. However, photosynthetic rate and transpiration rate declined under drought conditions, with a slower recovery in inoculated plants, suggesting potential impairment of above-ground structures. The severity of *Plasmopara* infection was largely cultivar-dependent, with a noticeable increase in downy mildew incidence in the resistant *Cabernet Volos*, particularly under combined stress conditions. In both cultivars, all stressors led to a minor accumulation of molybdenum in both roots and leaves, while the two cultivars exhibited different behaviours regarding iron content at the root level. These findings highlight the complex interplay between abiotic and biotic stressors and provide insights into the adaptive responses of grapevines, which can inform future vineyard management strategies to enhance plant resilience. The next phase of this research will involve conducting open-field trials to evaluate how the observed stress responses influence grape and wine quality. This approach will support the development of viticultural practices aimed at enhancing plant resilience while preserving key fruit and wine traits.

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POSTER

Evaluation of the hydroxyethyl radical formation kinetic and Strecker aldehydes distribution for assessing the oxidative susceptibility of Chardonnay wines

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Keywords: Chardonnay, Fenton reaction, EPR, 1-HER

ABSTRACT

Over the last decade, much attention has been paid on the oxidative susceptibility of white wines, given its key role in determining their ageing potential. Some wines may undergo premature oxidative ageing, during which the oxidative cascade can trigger the formation of hydroxyl radicals producing 1-hydroxyethyl radicals (1-HER) [2] and Strecker aldehydes (SA), such as methional and phenylacetaldehyde [1]. To date, the potential relationship between SA and the kinetics of 1-HER formation (K1-HER) is poorly documented.

The electron paramagnetic resonance (EPR) technique, dedicated for radical analysis, has been used in enological studies [3], [4]. Based on the literature, we recently proposed an optimized version of the EPR-spin trap approach to study K1-HER in Chardonnay wines [6]. New indexes derived from a log-normal model of kinetic curve were proposed. These analytical indexes were validated in terms of repeatability and reproducibility (RSD < 8 %). In parallel, a strategy inspired from literature [5] was slightly modified to analysis free and total SA (methional and phenylacetaldehyde) by SPE-GC-MS.

In a first experiment we analyzed twenty young commercial Chardonnay wines (2019-2022) from various appellations. Total and free methional levels ranged from 4-40 µg/L and 0.1-3 µg/L, respectively, whereas the bounded form represented 60 to 90% of the total methional content. Distinct EPR signatures were obtained allowing us to classify the wines according to their EPR signals and the SA content.

Additional slow oxidation experiments carried out in controlled conditions with different stoppers showed that after, at least six years of bottle aging, wines with a higher EPR index (≥30%) tended to exhibit elevated levels of both free and total methional. Finally, the EPR approach was applied on young wines made from grapes harvested at four ripening levels. Microvinifications (50 L, n=3) were carried out at the BIVB located in Burgundy. The first results showed the impact of the maturity level of the grapes on the capacity of young white wines to produce free radicals and SA. Although these results suggest that the EPR index may serve as a reliable predictor of wine susceptibility to oxidation, additional experiments will be carried out to validate these observations.

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FLASH TALK

Classification of "Valpolicella Superiore" wines in relation to aromatic composition: influence of geographical origin, vintage and aging

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Keywords: Valpolicella, aging, withering, geographical origin

ABSTRACT

The Valpolicella appellation, mainly known for Amarone and Ripasso, is experiencing growing interest in Valpolicella Superiore (VS), a lighter red wine aligning with consumer demand. However, anecdotal evidence suggests different stylistic interpretations of VS, potentially causing consumer confusion. This study aimed to assess how vintage, grape origin, aging, and post-harvest withering influence VS aromatic composition and to identify vinification styles within the sample set.

Seventy commercial VS wines, differing in vintage, grape origin, and post-harvest withering, were analyzed. The volatile chemical profile was assessed via GC-MS coupled with SPE and SPME techniques, while enological and phenolic parameters were determined through spectrophotometric analysis. These data were compared to sensory evaluations from a wine competition panel. Multivariate analysis classified VS wines based on volatile profiles, with vintage/aging and grape origin being key differentiators, mainly affecting terpenes, norisoprenoids, esters, lactones, benzenoids, and fatty acids. Grape withering also influenced certain subsets, impacting benzenoids, norisoprenoids, terpenes, and esters.

Complex interactions emerged between grape origin and vintage, particularly in norisoprenoid and terpene content, distinguishing VS wines from those of the Classico sub-region. In VS wines from the Classico sub-region, older vintages (2017–2018) exhibited higher levels of norisoprenoids such as β-damascenone, TPB, and TDN, alongside linear terpenes like β-citronellol and geraniol. More recent vintages (2019–2020) were richer in norisoprenoids such as β-ionone and β-damascone. In VS wines, cyclic and bicyclic terpenes were found in higher concentrations: older vintages contained greater levels of α-phellandrene, limonene, and terpinolene, as well as β-damascenone, β-ionone, and β-hydroxy-damascone. More recent vintages were distinguished by higher concentrations of TPB, vitispirane, 3-hydroxy-β-damascone, linalool oxide, and 1,4-cineole.

Sensory evaluation categorized the wines into seven stylistic groups with distinct organoleptic traits. The analysis underscored the aromatic complexity of each style, with alcohol content and compounds such as dimethyl sulfide, various terpenes, trans-3-esen-1-ol, ethyl butanoate, 3-methylbutanoic acid, and furfural contributing to the sensory heterogeneity of the examined wines.

FLASH TALK

Study of Malvasia di Candia Aromatica shelf-life: effect of time and temperature on aroma compounds through an HS-SPME GCxGC-Ms approach

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Keywords: Malvasia di Candia Aromatica, volatile organic compounds (VOCs), shelf-life, white wine

ABSTRACT

Young white wines should be consumed within a short time after bottling to avoid loss of their fresh, fruity attributes. Shelf-life of white wines can be extended if they are stored under suitable conditions of time and temperature prior to consumption[1]. The acidic environment plays a major role on the evolution of wine bouquet, promoting several reactions such as formation and hydrolysis, oxidation and cyclization. The aim of this study was to evaluate the effect of time and temperature on the aromatic composition of white wines (Malvasia di Candia Aromatica) coming from different vigor zones (High (HV);Low (LV);control) of the same vineyard.

After the vigor determination along the season[2], a prescription map was used for a mechanical selective harvesting. For each vigor zone, 30 kg of grape were sampled, stored in cool anoxia until processing. At the end of the fermentation, the wines were stored for 12 months at 5,15,25°C and sampled at 0,3,6,9,12 months. The Aromatic profile was performed by a SPME-HS-GC×GC-MS system. Data analysis was performed by MetaboAnalyst 6.0.

At the harvest, the LV grape showed the highest level of sugars and lowest total acidity than the C and HV, while for pH value no significant differences were detected among the treatments. Therefore, the LV wines showed the highest alcohol content and pH values, and lowest total acidity compared to HV and C. A pool of 78 volatile compounds were quantified. The LV wines showed higher concentrations of terpenes respect to HV and Control wines[3]. To evaluate the effect of time and temperature, OPLS-DA were applied, then the VIPs behavior was defined with FC analysis. For storage time, the most characterizing compounds were terpenes and were mainly down-accumulated over the time. On the other hand, 1,3,8-p-Menthatriene, p-Mentha-1,5,8-triene and β-Myrcene were up-accumulated. For the temperature, more heterogenous results were obtained: both terpenes and esters characterized the change of aromatic profile and both down and up-regulated compounds were recorded. Among terpenes, a general reduction (Linalool;Geraniol; β-Myrcene) coupled with the increase of their oxidated and derivates forms (Nerol oxide;Linalool oxide) was recorded. These preliminary data confirmed the expected differences in aroma composition among wines (LV;HV;C), especially for terpenes[1]. According to the data, the aroma compounds follow the available literature, especially when stored for a long time at higher temperatures[4].

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POSTER

Quantitative assessment of must composition using benchtop NMR spectroscopy: comparative evaluation with FTIR and validation by reference

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Keywords: benchtop-NMR-spectroscopy, chemical analysis, quality assessment, quantum mechanics

ABSTRACT

The foundation of wine production lies in the use of high-quality grapes. To produce wines that meet the highest standards, a fast and reliable analytical assessment of grape quality is essential. Many wineries currently employ Fourier-Transform Middle-Infrared Spectroscopy (FTIR) for this purpose. However, this technique demands frequent and intricate calibration with authentic reference samples, and its indirect quantification approach raises concerns about reliability for certain parameters. Additionally, FTIR has high detection limits for key indicators of grape rot, such as gluconic acid and volatile acids.

Nuclear magnetic resonance spectroscopy (NMR), on the other hand, enables the direct measurement of these compounds, eliminating the need for calibration and enabling precise quantification. However, conventional high-field NMR systems are associated with high acquisition and maintenance costs, limiting their widespread use. Continuous development has optimised benchtop NMR spectrometers providing a cost-effective alternative. Although these devices operate at lower magnetic field strengths and therefore have reduced resolution, they are a viable alternative. To overcome this limitation, we use a spectral correction and peak analysis algorithm based on quantum mechanical calculations and pattern recognition [1,2].

In this study, the must components were analysed quantitatively using benchtop NMR. The results obtained were compared with FTIR measurements and validated against established reference methods, including photochemical and titrations. The measurements showed good agreement with the reference values, demonstrating higher precision and possibly even better accuracy than conventional methods. This is to be verified in more detail by further gravimetric investigations. In addition, the sample preparation process was considerably simplified, as initial tests showed insensitivity to known interfering factors such as turbidity. This indicates a robust and efficient analysis method with reduced preparation effort.

Our results suggest that this method could be integrated into automated grape reception processes, allowing wineries and cooperatives to obtain important quality data in a timely manner. Further validation is required in order to conclusively assess its suitability for routine use.

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POSTER

Modulation of Huntingtin protein aggregation by (+)-catechin: An NMR study on kinetic mechanisms

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Keywords: catechins, NMR, Huntington's disease, protein aggregation modulation

ABSTRACT

Catechins, a subclass of flavonoids widely found in plants and plant-based foods and beverages such as wine and tea, not only exhibit significant antioxidant properties [1], as extensively documented in the literature, but can also inhibit amyloid protein aggregation [2], a key process implicated in the onset of neurodegenerative diseases such as Parkinson's, Alzheimer's, and Huntington's.

Observations of kinetics profiles suggested that amyloid fibrils formation could be modelled by a sigmoidal function, reflecting the fact that this process consists primarily of two stages: nucleation and elongation.

Detailed studies on this kind of polymerization have shown that the mass concentration of polymer in solution frequently increases more rapidly than predicted by the classical model, suggesting the extension including secondary nucleation pathways, which can contribute to the increase in the number of polymers in addition to that produced by the straightforward homogeneous nucleation [3]. More specifically, monomer-dependent secondary nucleation [4] and monomer-independent secondary nucleation in the form of fragmentation [5] emerged as a key factor in the propagation.

Our study aims to elucidate the mechanisms by which flavonoids, starting with (+)-catechin (2R,3S) —the most common catechin isomer— modulate the aggregation kinetics of Huntingtin protein exon 1 (the portion of the protein directly involved in the aggregation) encoding CAG/polyglutamine repeat expansion. To achieve this, we integrated NMR spectroscopy with computational analysis. Building on existing literature, we have developed a comprehensive mathematical framework that incorporates primary nucleation, elongation, and secondary nucleation stages of protein aggregation, incorporating additionally the presence of a generic binding molecule by considering all interaction pathways through which it may influence aggregation kinetics. By fitting this model to NMR experimental data, we seek to determine the specific stage within the aggregation cascade where catechin exerts its influence, thereby shedding light on its potential anti-amyloid mechanism of action.

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POSTER

Chardonnay white wine bottled with different oenological tannins: effect on colour traits, volatile composition and sensory attributes during shelf-life

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Keywords: oenological tannins, volatile composition, sensory analysis, white wine

ABSTRACT

The use of oenological tannins during winemaking has been mostly studied for improving colour traits and stability on red wines. Their effectiveness mainly depends on the tannin composition, grape variety and winemaking approach [1]. However, few studies have been conducted for white varieties on the ability of exogenous tannins to preserve wines against oxidation and their influence on sensory properties [2,3]. Therefore, the aim of this research was to evaluate the effect of six tannin formulations (ellagic, gallic, acacia, quebracho, grape skin and grape seed tannins) on a 'Chardonnay' white wine during shelf-life. Each formulation was added at bottling at a dose allowing an equal increase in total polyphenols with respect to the non-added control. Standard parameters, colour characteristics, total polyphenols, antioxidant activity, volatile organic compounds (VOCs) and sensory properties were determined.

The antioxidant activity (DPPH method) decreased for most of treated wines during storage, except for both quebracho and grape seed tannins that showed a lower total polyphenols content after 9 months. After tannin addition and 1 month after bottling, an increased yellowish hue (higher absorbance at 420 nm) was observed in all wines, except for gallotannins. In the wines treated with ellagitannins or grape seed tannins, absorbance at 420 nm decreased after 9 months with small colour differences from control ($\Delta E^* < 2.5$) whereas acacia and skin tannins contributed stronger to wine colour. Regarding sensory traits, there were some differences at 1 month after bottling, gallotannins and ellagitannins gave wines with higher aroma intensity (*banana* and *pear* being mostly cited descriptors), particularly compared to skin, quebracho and seed tannins (*green apple* discriminating the last two wines from the others). In agreement with aroma intensity, the best preservation of varietal VOCs was observed for gallotannnins-treated wines at 1 month after bottling, including terpenes and norisoprenoids. The wines treated with skin and seed tannins were more astringent but less bitter than control. After 9 months of shelf-life, the differences among the wines tested were reduced, gallotannins-added wines showing the lowest aroma intensity, whereas quebracho and seed tannins gave the most astringent wines. At this time, most of VOCs decreased for all tannin formulations but some esters and higher alcohols increased compared to control. These results highlight that oenological tannins can modulate aroma composition during wine shelf-life.

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FLASH TALK

Characterisation of Sicilian Nero d'Avola grape and wine: A preliminary study

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Keywords: Nero d'Avola grape, spontaneous fermentation, vine age, *terroir*

ABSTRACT

The chemical composition and the sensory characteristics of wine result from dynamic interactions between several factors including grape variety, soil, viticultural techniques, climate conditions, yeasts metabolism, oenological approaches. Recently, Grigg et al. [1] described the vine age is commonly attributed to superior vine performance affecting the wine quality. Moreover, spontaneous fermentations can preserve the aromatic varietal character allowing the implementation of the link between the wine and the *terroir*. This study aimed to evaluate the composition of Nero d'Avola grapes from vineyards of different age and production area as well as that one of wines also obtained with spontaneous fermentation. *Vitis vinifera* L. cv. 'Nero d'Avola' samples were collected in 8 vineyards, 4 of them being 10-years old (10Y) and 4 being 20-years old (20Y), located in 3 different areas of Sicily. Grapes were characterised for average berry weight, must yield, general chemical composition (sugars, titratable acidity, pH, readily assimilable nitrogen), total and extractable flavonoids and anthocyanins, and microbiota. Triplicate microvinification trials with maceration were performed considering inoculated and spontaneous fermentations. For the latter, the microbial population was assessed during the fermentation. Once the alcoholic fermentations were completed, the wines were racked, stabilized and bottled. The wines were characterised for general chemical parameters, phenol-related indexes and aroma profile. The must yields were lower for grapes from 10Y vineyards than those from 20Y vineyards in most of the cases. No clear vineyard-age trends were observed for pH and titratable acidity maybe due to the vine irrigation. Little differences were found for total and extractable flavonoids and anthocyanins in grapes collected from the same area. However, the phenolic compounds seemed to be affected by the growing area of grapes with the higher altitude positively affecting their content. Relevant differences were detected for microbial populations on grapes that were found even in the first three days of fermentations. Nonetheless, minor changes in general chemical composition were observed in wines from inoculated and spontaneous fermentations, and from vineyards of different age. The phenolic compounds were higher in wines from 20Y vineyards as well as the colour index suggesting the role that the vineyard age could play on wine features. The study provides preliminary evidence of the impact of vine age and terroir on wine composition for an important grape variety for the Sicilian wine industry.

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POSTER

Isolation, biofilm formation and control of the wine spoilage yeast *Brettanomyces bruxellensis*

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Keywords: wine spoilage, biofilm formation, *Brettanomyces*, spoilage treatement

ABSTRACT

Brettanomyces bruxellensis, commonly referred to as "Brett," is one of the most notorious microorganisms implicated in wine spoilage. This yeast species has developed a noteworthy resistance to sulfur dioxide, a widely used preservative in winemaking, prompting the wine industry to seek new antimicrobial agents. The development of *B. bruxellensis* in wine can change the sensory properties of wine due to the production of undesirable aromas. The present work focuses on i) the biofilm-forming ability of *B. bruxellensis*, derived from Greek wines, on stainless steel surfaces ii) the ability of the adhered cell to cause wine spoilage iii) new treatment to handle the contamination. Three wines from different regions of Greece were collected and subjected in molecular analyses and identification at species level. RAPD (Random Amplified Polymorphic DNA) genomic fingerprinting with the oligo-nucleotide primer M_{13} was used, combined with Matrix Assisted Laser Desorption Ionization–Time of Flight Mass Spectrometry (MALDI-TOF MS) technique. Strain differentiation of *B. bruxellensis* different strains was achieved by rep-PCR fingerprinting method with the oligo-nucleotide primer GTG_5. For the biofilm formation assay, stainless steel coupons were placed in test tubes containing sterilized Ringer solution and pure cultures of the different *B. bruxellensis* strains was inoculated at an initial population of approximately 10^7 CFU/mL. The tubes were incubated at 28 °C for 3 hours to allow attachment of the yeast cells onto the coupons surface. Biofilm growth was evaluated with the bead vortexing method. Finally, different treatments were applied in order to prevent the adherence of *B. bruxellensis* strains to the coupons. Overall, we showed that the attachment and biofilm formation capacity of the spoilage yeast is influenced by the strain effect and tree different types of adherences were noticed. Additionally, all tested treatments achieved to decrease the attached yeast cells proposing a new way of handling *B. bruxellensis* contamination.

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FLASH TALK

Sensory patterns observed towards the oxidation of white, rosé and sparkling wines: An exploratory study

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Keywords: wine oxidative aroma, quantitative descriptive analysis, sensory patterns, attributes ratio

ABSTRACT

Oxygen management is crucial in terms of wine quality. Even more for white and rosé wines, which are less protected against oxidation than reds due to the lower levels of antioxidant polyphenols. This need is due to the existence of equilibria between chemical forms depending on the redox potential. These equilibria lead to the varying impacts of certain molecules on wine's aroma [1] and are essential to preserve positive sensory attributes related to white, yellow or tropical fruit [2,3].

The present work performs an exploratory study of the aromatic evolution of white, rosé and sparkling wines through their exposure to different doses of O_2 (0, 6, 12 and 35 mg/L over the stoichiometric to consume total SO_2). Therefore, it aims to assist the winemaking industry in understanding the aromatic impact of different O_2 doses on the decrease or development of specific notes related to wine quality.

Results outline different capabilities of O_2 consumption, being Verdejo (white) the most and Cava (sparkling) and Rosé the least. Furthermore, these consumption capabilities are related to redox potential measurements and robustness towards sensory changes; in other words, the higher the oxygen consumption, the smaller the sensory change.

A common sensory pattern was observed: firstly fruity notes decrease; then, "cooked vegetables" emerge; and finally "honey" and "cider/overriped apple" increase in detriment of the "cooked vegetables" note. Hence, sensory ratios related to the oxidation process were calculated from the quotient (tropical fruit + yellow fruit) / (honey + cider) showing a significant decrease ($p<0.05$) as oxidation progressed. Notably, the higher the O_2 consumption was, the greater the dose required to significantly reduce this quality-related ratio. Last, a remarkably significant correlation ($p<0.001$) was observed between preference and this sensory ratio, implying that preference might be considered as a relation of attributes.

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POSTER

Profiling and evaluating wine lees by-products from various yeast strains against grapevine pathogens

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Keywords: wine lees, antimicrobial molecules, grapevine pathogens

ABSTRACT

Wine lees are the sediment that settles at the bottom of wine barrels, tanks, or bottles during the winemaking process and represent the second most significant by-product of wineries. Wine lees consist primarily of dead yeast cells which contain a complex mixture of both organic and inorganic molecules, such as proteins, peptides, polysaccharides, sterols, and long-chain fatty acids. This study aimed to evaluate the potential role of wine lees in combating grapevine pathogens. Six different wine yeast species were tested in fifteen fermentation schemes under monoculture and mixed-culture conditions. Fermentations were conducted in a laboratory medium that mimicked wine conditions (grape juice medium). The fermentation rate was monitored daily using an enzymatic method (Glucose/Fructose) following the OIV official protocol along with CO_2 emission measurements. Following fermentation, yeast biomass was autolyzed and digested to produce High Molecular Weight Biomolecule Mixtures (HMW-BM) and Low Molecular Weight Biomolecule Mixtures (LMW-BM). These biomolecule mixtures were then evaluated in vitro for their ability to inhibit the growth of *Botrytis cinerea*, *Aspergillus carbonarius*, *Phaeomoniella chlamydospora*, and *Phaeoacremonium minimum*. Our results indicate that the most effective biomolecule mixture with a protective mode of action against grapevine pathogens was LMW-BM.

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POSTER

Grapes aminoacidic profile: impact of abiotic factors in a climate change scenario

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Keywords: aminoacids, heat, drought, 'Monastrell'

ABSTRACT

Amino acids play a crucial role in determining grape and wine quality [1]. Recently, research has suggested their metabolism is key to plant abiotic stress tolerance [2]. Therefore, the study of amino acid accumulation in grape berries and its response to environmental factors is of both scientific and economic importance. This study investigates the influence of increased temperature, reduced rainfall and the combination of both effects on the content and amino acidic profile of grapes cv. Monastrell from a goblet-trained conventional managed and rainfed vineyard located in Jumilla, (Murcia, southeastern Spain). For this purpose, open top chambers and rainout shelters simulated warming (~2-7 ºC, W) and rainfall reduction (~30%, RR). A combination of both treatments (W+RR) was also used. Vines without top chambers or rainout shelters were considered as control (C). The experiment was established in February of 2023, and all vines were manually harvested at 28-09-2023. The aminoacidic identification and quantification were performed by HPLC analysis [3]. Total free (FAN), yeast-assimilable (YAN) and aromatic precursor (PAN) nitrogen content were calculated according to Valdés et al. [3]. The results were subjected to one-way (C *vs* W *vs*, RR *vs* C+W-RR) and two-way ANOVA (W, R and W*R effect) and Tukey's test for comparison of means. No changes in the amino acid profile were found, and high proline and arginine levels, specially in W treatments, were observed, as previously was reported [4]. In fact, these compounds were the predominant amino acids in all treatments. Their concentrations reached 116.85, 96.26, 33.19, and 24.52 mgN/L, as well as 76.27, 55.77, 16.57, and 8.3 mgN/L in W-RR, W, C, and RR, respectively, accounting for about 50 % and 25 % of the total FAN. The concentrations of the remaining identified and quantified amino acids were far below of these two and lower than 2 mgN/L in all cases. FAN, YAN, PAN and Ammonia contents followed the WRR > W > C > RR trend, with significant differences observed between the first two treatments and the rest in all cases. The analysis of the combined effects of increase of temperature and rainfall reduction indicated a significant effect of these environmental factors on the contents of the parameters analyzed. W caused the highest percentage of differences between samples (more than 80% in all cases). However, probably due to the low rainfall during the season, the RR treatment resulted in minimal differences.

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POSTER

Impact of dried stems in winemaking on Veneto Passito wines

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Keywords: withered grapes, volatile compounds, Valpolicella, GC-MS

ABSTRACT

The use of stems during fermentation is generally avoided due to the herbaceous off-odors they can impart to the wine. [1]. On the other hand, nowadays some researchers and winemakers are re-evaluating their use with the aim first of all to reduce the alcohol content of wines, and secondly to enrich the wine in phenolic compounds and complexity. [1,2]. While most of the studies focused on fresh stems, this study aimed to investigate the impact of withered stems on the chemical and sensory profile of 4 Veneto *passito* wines, 3 red and 1 white. The grapes Corvina, Corvinone, Rondinella and Garganega were harvested in 2022 and fermented in presence of withered stems. Total polyphenols and pH were influenced by the use of stems. Nevertheless, the red wines fermented with stems presented a lower content of ethanol, probably due to the absorption of these molecules on the stems surface [3], even if only one of them was a significative difference. Regarding volatile compounds, dried stems significantly decreased methanethiol content, likely due to adsorption phenomena. Minor differences were observed in acetate esters, terpenes, and norisoprenoids, though these were not consistent across all wine types. Methoxypyrazine were found in wine in concentration well below the odor threshold, suggesting a limited release of these compounds from dried stems. Thus, this work demonstrated the potential to use withered stems on the vinification of Passito wines, on the oenological and volatile parameters.

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POSTER

Evaluation of consumer behaviour, acceptance and willingness to return of faulty wines

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Keywords: consumer behaviour, wine faults, sensory acceptance, product returns

ABSTRACT

The analysis of consumer attitudes towards wine, especially towards wines perceived as faulty, is an aspect that requires more research than has been carried out so far [1]. This study aims to analyse consumer behaviour in situations involving the consumption of faulty wines and to assess the level of acceptance of such wines.

An online survey with 193 respondents included questions about consumers' reaction to faulty wines. The study explored factors affecting wine returns depending on consumers' trust level in sellers, their propensity to return products, after-sales behaviour and tolerance to sensory faults. Additionally subjective [2] and objective knowledge, about these faults were assessed. In addition, 100 people carried out home-use test (HUT) in order to evaluate sensory acceptance and the willingness to return spiked wines containing seven compounds designed to simulate wine-related faults: 2,4,6-Trichloroanisole, Dimethyl Sulfide, 4-Ethylphenol and 4-Ethylguaiacol, Acetic Acid and Ethyl Acetate, 2-Isobutyl-3-methoxypyrazine, Acetaldehyde, and Ellagic Tannin.

Consumers were shown to have a greater willingness to return a faulty wine, particularly among men aged 51 to 65 with higher education, regarding a situation with a high level of confidence with the seller. On the other hand, in a situation with less confidence with the seller, there is greater indecision among the participants. In relation to after-sales behaviour, consumers would not buy wine again if they considered it to suppose a risk to health, was a low-quality wine or did not like the wine. On the other hand, if the wine has any fault, they may eventually end up purchasing it again. Eventually, no significant differences were observed according to the level of subjective knowledge (Cronbach's $\alpha = 0.85$) or objective.

Results from sensory evaluation showed that the level of acceptance of the samples with faults were significantly different with regarding the level of acceptance and the predisposition to return to the control samples.

In this study, a vision of the perception of different defects of wine by consumers has been obtained, as well as a better interpretation of their behaviour in the situation of returning the product.

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POSTER

Effect of maceration conditions during the winemaking of withered Corvina grapes on wine polyphenols and anthocyanins

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Keywords: design of experiment, cold soak, temperature, polyphenols

ABSTRACT

Amarone is an Italian red wine with worldwide recognition and high added value. In Amarone wines, grapes undergo a withering process before vinification; this leads to a modification in the concentrations of sugars, acids, and secondary metabolites. Most of the research has focused on the influence of yeasts and the drying process on Amarone quality [1-4], but little has been done on the influence of maceration during vinification on this type of wine. Therefore, a design of experiment approach was used to investigate the impact of cold soak, fermentation temperature (20 ºC or 27 ºC), and maceration time (skin and seed contact for 10 or 30 days) on the winemaking of withered 'Corvina' grapes. Fermentation was carried out with *Saccharomyces cerevisiae* EC1118 strain, and each experiment was performed in triplicate. Chemical and oenological parameters were evaluated on the 3rd, 10th, and 30th day, as well as at bottling. The Principal Component Analysis (PCA)showed that the samples differed mainly based on maceration time and, to a lesser extent, on maceration temperature. Fermentation at 27 ºC allowed for greater extraction of polyphenolic compounds, in line with previous literature [5-7]. Besides maceration time and temperature, another possible explanation for the higher polyphenol content could be the ethanol content in these samples (above 15% v/v). Apart from phenolic compounds, anthocyanin concentration, colour intensity, and shade are important parameters that impact sensory properties [6]. Longer maceration time is the main factor that negatively affects anthocyanins, but it has a positive impact on the wine shade. For colour intensity, the 48-hour cold soak had a huge impact on the increase of this parameter. The initial data of this work provide interesting insights into improving the quality of Amarone wines. Further analysis will focus on profiling polyphenolic and aromatic compounds.

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POSTER

Comparison of the aroma profile in total and partial dealcoholisation of white and red wines by reverse osmosis

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Keywords: dealcoholisation, reverse osmosis, aroma profile, wine

ABSTRACT

The increasing demand for low-alcohol and non-alcoholic wines has led to the development of advanced dealcoholisation techniques aimed at preserving wine quality while reducing ethanol content. Reverse osmosis is one of the most widely used membrane-based processes for the selective removal of ethanol [1]. This separation technique uses a semi-permeable membrane to create an osmotic pressure gradient between two solutions. Normally, water moves through the membrane from a low to a high concentration solution to maintain equilibrium. However, applying sufficient pressure to the high-concentration side reverses this flow, allowing the solvent to move to the lower concentration side [2].

This study investigates the impact of total and partial dealcoholisation on the aroma profile of white and red wines treated by reverse osmosis. Wines were subjected to two levels of dealcoholisation: partial dealcoholisation, in which ethanol content was reduced by approximately 50%, and total dealcoholisation, in which ethanol content was reduced to approximately 0.5% v/v in white wine and 2% v/v in red wine. The volatile compound composition of treated and untreated wines was analysed using gas chromatography-mass spectrometry (GC-MS) coupled with multiple headspace solid-phase microextraction (MHS-SPME) [3]. The analysis focused on key aroma compounds, including esters, alcohols, and acids, which contribute to the wine's overall sensory characteristics.

The results showed that partial dealcoholisation retained a higher concentration of volatile aroma compounds compared to total dealcoholisation. While reverse osmosis effectively removed ethanol, it also led to the loss of key aroma compounds, with total dealcoholisation resulting in a more pronounced decrease in esters. These compounds, responsible for fruity and floral aromas, were significantly reduced, altering the wine's aromatic profile.

This study highlights the influence of the degree of dealcoholisation on wine aroma and demonstrates that partial dealcoholisation better preserves the volatile compounds essential for aromatic complexity. These findings improve the understanding of how the extent of dealcoholisation affects the aromatic composition of wine and provide valuable insights for winemakers seeking to develop reduced-alcohol wines with minimal losses of aromatic quality. Further research should explore optimisation strategies to enhance the retention of key aroma compounds during the dealcoholisation process.

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POSTER

Impact of GoLo technology on the aroma profile of red and white wines after total and partial dealcoholisation

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Keywords: dealcoholisation, GoLo technology, aroma profile, wine

ABSTRACT

Wine dealcoholisation has been practised since the early 1900s and has gained importance due to climate change and shifting consumer preferences for lower-alcohol beverages. Rising temperatures are accelerating grape ripening, increasing sugar content and, consequently, raising the alcohol strength of wines. In addition, health concerns related to alcohol consumption have also contributed to the growing demand for dealcoholised wines [1].

Dealcoholisation techniques can be applied at different stages of winemaking. Post-fermentation techniques physically remove alcohol and include membrane-based methods such as nanofiltration, reverse osmosis, and osmotic distillation, as well as non-filtration techniques such as vacuum distillation, spinning cone columns, and multi-stage membrane systems [2]. GoLo, a low-temperature vacuum distillation technology, operates similarly to the spinning cone column but integrates multiple separation steps into a continuous system. It efficiently removes nearly 100% of the volatile aroma compounds—allowing their reintegration—and reduces the alcohol strength to as low as 0.05% (v/v) [3].

This study investigates the effects of total and partial dealcoholisation using GoLo technology on the aromatic composition of both red and white wines. The wines underwent two levels of dealcoholisation: partial dealcoholisation, reducing the alcohol strength to approximately 7.5% v/v, and total dealcoholisation, lowering the alcohol strength to 0.5% v/v. The volatile compound profile of both treated and untreated wines was analysed using gas chromatography-mass spectrometry (GC-MS) combined with multiple headspace solid-phase microextraction (MHS-SPME) [4]. The analysis focused on key aroma compounds, including esters, alcohols, and acids, which play a crucial role in the wine's aromatic profile.

The results showed that GoLo technology was effective in reducing alcohol strength; however, total dealcoholisation led to a significant loss of aroma compounds. Partial dealcoholisation consistently preserved more of the original aromatic complexity in both wines.

This study emphasises the impact of ethanol removal on wine aroma and underscores the benefits of partial dealcoholisation in preserving sensory characteristics.

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FLASH TALK

On the impact of preformed α-dicarbonyls in the production of Strecker aldehydes. Exploring the addition of sacrificial amino acids as a tool to reduce Strecker aldehydes production

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Keywords: wine oxidation, preformed α-dicarbonyls, Strecker aldehydes, key formation parameters, sacrificial amino acids

ABSTRACT

The reaction between Strecker amino acids and α-dicarbonyls is a key pathway in the formation of Strecker aldehydes (SA), which are crucial oxidation-related odorants in wine [1]. While most α-dicarbonyls result from phenolic compound oxidation, others, such as diacetyl and methylglyoxal, are present in wine regardless oxidation and their role in SA production is not well understood. Additionally, the influence of specific metal ions on SA production via these preformed dicarbonyls remains unclear. Meanwhile, strategies to reduce SA formation based on the addition of naturally-occurring amino acids in wine that could deplete those α-dicarbonyls reacting in Strecker reaction would be promising which is particularly relevant in the context of the growing demand for minimal-intervention wines.

For this purpose, several accelerated oxidation procedures were applied in both synthetic and real wine matrices to analyse the reaction rates of diacetyl and methylglyoxal in anoxic conditions, evaluate the impact of Mn^{2+}, Cu^{2+} and Fe^{2+} on their reactivity as well as to compare them with quinones formed from 4-methylcatechol and gallic acid. In the meanwhile, the reduction of SA by the addition of sacrificial amino acids was explored for alanine, tyrosine, aspartic acid, glutamic acid, serine, glycine, and threonine.

In synthetic wine under anoxic conditions, the reaction rates of diacetyl and methylglyoxal are significantly enhanced by Mn^{2+} ($p<0.05$), while Cu^{2+} has no effect. However, the production of SA from these compounds is still 2-3 orders of magnitude lower compared to phenolic-derived α-dicarbonyls, even when reactivity is higher in real wine. The addition of specific sacrificial amino acids to real wine results in small, but significant ($p<0.05$), changes in SA production.

Key findings of this research on SA production by preformed α-dicarbonyls include: first, these dicarbonyls are less reactive than those formed from phenolic compounds; secondly, their reactivity increases significantly in real wine, indicating substantial SA production even under anoxic conditions; finally, their reactivity can be influenced by metal ions in ways that differ from phenolic compounds.

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FLASH TALK

New insights of translocation of smoke-related volatile phenols in vivo grapevines

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Keywords: volatile phenols, smoke taint, translocation, wildfires-climate change

ABSTRACT

The increasing frequency of wildfires in grape-growing regions is seen as a significant risk for the grape and wine industry. Volatile phenols (VP) are taken up by grapevines during wildfires and contribute to the perception of smoke taint in wine. Seven VPs -guaiacol, 4-methylguaiacol, *o*-, *p*-, *m*-cresol, syringol and 4-methylsyringol- have been identified as the main predictors of smoke taint development in wine. A previous study using an isotope tracer technique with guaiacol and d_3-guaiacol demonstrated that it is possible for this compound to be absorbed by the leaves and transported to the bunches [1]. However, the mechanism of translocation of other VPs have not been extensively investigated. The aim of this study was to investigate VP absorption into bunches and leaves and their potential translocation to grape berries.

Leaves and berries of potted grapevines were placed in contact with an aqueous mixture of deuterated VPs (d_3-guaiacol, d_7-*o*-cresol, d_3-syringol and d_6-4-methylsyringol at 24 mg/L) at two different phenological stages (pre-*veraison* and post-*veraison*). Leaves, bunches, or leaves and bunches of one shoot were treated, while the second shoot was isolated with plastic bags and left untreated. Grape samples (exposed and non-exposed to the labelled volatile phenols) were taken after 1 and 7 days of treatment, as well as at ripeness (20º Brix) in triplicated. The free plus bound forms of VPs in grape were analyzed by GC-MS.

Data showed that not only guaiacyl type VPs can translocate from leaves to berries, but also *p*-coumaryl and syringyl type VPs. This process can occur from leaf to grape and even from bunch to bunch to a very limited extent. The concentration of deuterated VPs was higher in the grapes untreated at the post-*veraison* stage. However, the concentration of labeled VPs was higher in the grapes treated at the pre-*veraison* stage, which is in agreement with what other researchers have found [2].

Levels of labeled VPs decrease with sampling time in both pre-*veraison* and post-*veraison* samples. This may be due to multiple factors, from degradation-evaporation of the compounds remaining in the grape skin, translocation to other parts of the plant, dilution, and/or inclusion in metabolomic pathways to form more stable compounds. This study confirmed that several types of VPs can be translocated from leaves to berries as well as from bunch to bunch. Although translocation is fast (1 day), it was also limited with only very low quantities observed in non-exposed grape berries.

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POSTER

Flavonol and anthocyanin potential of Spanish minority grapes and its relationship with wine colour

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Keywords: flavonol composition, minority grape varieties, CIELAB colour parameters, wine

ABSTRACT

Global climate change is currently affecting vine phenology and causing a decoupling between technological and phenolic maturity of the grapes [1]. Wine industry has to face the challenge of making quality wines from grapes with an unbalanced phenolic composition. Minority autochthonous grape varieties are nowadays attracting the attention of scientists and oenologists due to their greater adaptation potential to the changing environmental conditions [2]. In the Spanish "Castilla y León" region, a significant number of minority grape varieties have been properly identified and conserved in a Germplasm Bank [3]. Among them, some show a good oenological potential [4]. However, their recovery to produce quality wines must be supported by a deep knowledge of their phenolic composition, since these compounds are directly related to wine colour and astringency. Regarding colour, the anthocyanin potential of 7 of these minority varieties has been recently studied in our laboratory. However, wine colour will also depend on the copigmentation interactions occurring between these anthocyanins and copigments present in wine, among which, the flavonols are the most effective ones. Thus, the main objective of the present study was to determine the skin's flavonol composition of these varieties by means of HPLC-DAD-MS^n and to find if there is any relationship between this composition, the grape anthocyanin composition and the colour expressed by the wines made from these grapes. Furthermore, this study also aims at establishing if the varietal typicity is maintained when the grapes are grown in regions different from their native ones. Total flavonol contents ranged from 80 to 300 mg/kg of grape and were, in most cases, greater than the contents reported for common varieties such as Tempranillo or Syrah [5]. The growing location affected flavonol total content and profile, but varietal typicity was quite maintained among locations. The ratio methoxylated/non-methoxylated flavonols was found to be a useful varietal marker. The results of the CIELAB colour measurements in the wines made from these grapes showed that the darkest wines with the greatest bluish hues were not those elaborated with the grapes with the greatest anthocyanin potential, but those showing greater percentages of methoxylated flavonols. These results highlight the usefulness of studying the flavonol composition along with that of anthocyanins in grape skins to reach a deeper knowledge of the potential of grapes to produce wines with better colour characteristics.

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POSTER

Exploring microbial interactions between *Saccharomyces cerevisiae* and non-*Saccharomyces* yeast starters in vinification

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Keywords: yeast interactions, non-*Saccharomyces*, *Saccharomyces cerevisiae*, Greek wines

ABSTRACT

Winemaking is a complex microbial process involving the co-existence and interactions of various microorganisms [1]. Although, commercially available *Saccharomyces cerevisiae* strains could be inoculated and accomplish a well-controlled must fermentation, the growing recognition of the role of non-*Saccharomyces* yeasts, increases the interest in using diverse species in mixed inoculated fermentations, where yeast interactions are crucial [2]. The aim of this study was to investigate the microbial interactions between indigenous and commercial *S. cerevisiae* strains and two commercial and one indigenous non-*Saccharomyces* species used as fermentation starters under laboratory conditions. The microbial combinations were assessed for their fermentation kinetics and population dynamics. Subsequently, fermentations were conducted using three monovarietal grape musts from Greek varieties, monitoring CO_2 emissions and microbial population dynamics throughout the process [3]. The resulting wines were analyzed for their oenological properties and evaluated through sensory descriptive analysis [4]. Overall, all fermentation were completed successfully. More specifically, sequential inoculation with the first commercial non-*Saccharomyces* exhibited a significantly lower fermentation rate (~0.4 g/L/h) and rapid population reduction within 24 hours, while the other two strains enhanced fermentation rates and persisted until the completion of the process. Notably, sequential inoculation with the indigenous non-*Saccharomyces* strain resulted in the predominance of this species (~8.5 log CFU/mL), followed by *S. cerevisiae* population (~8 log CFU/mL). The second commercial non-*Saccharomyces* strain exhibited neutral interactions with *S. cerevisiae*, making it the most promising for further study. Moreover, wines fermented with the latter non-*Saccharomyces* strain maintained neutral interactions with *S. cerevisiae* strains and showed no significant differences in oenological properties, including total acidity, volatile acidity, ethanol yield and pH values, compared to those fermented with *S. cerevisiae* monocultures. Sensory analysis revealed that the inoculation strategy influenced the aromatic profile, with co-inoculated fermentations enhancing floral attributes.

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POSTER

Peptidomics in the wine industry: literature perspectives on functional importance and analytical methods

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Keywords: lees, metabolomic, peptidomic, by-product reuse, sustainable winemaking

ABSTRACT

Winemaking is a globally significant industry in the field of food technology (218 mhL of wine estimated for 2024 harvest) [1], which activity produces tons of by-products annually, including pomace (pulp, stems, seeds, skins), lees, organic acids, CO_2, and water [2]. Wine lees represent between 2% and 6% of the produced wine volume and between 14% and 25% of all winery by-products and, if utilized, could contribute to improving the economic and environmental sustainability of winemaking activities [3]. Therefore, there is a great need and interest in the management and further utilization of these by-products towards pollution reduction and the design of novel bioresources. At the same time, these by-products are mainly composed of value-added compounds, such as vitamins, complex polysaccharides, polyphenolic compounds, proteins, and peptides.

Peptides are the least known nitrogen-containing compounds of the wine industry, despite their diverse properties. Nonetheless, peptides are implicated in several important functions, ranging from defending grapevines against pathogens and shaping wine flavor, and acting as nutrients for yeasts and bacteria [4] during fermentation. Some peptides, particularly those recovered from winemaking by-products, have been linked to health-related properties like lowering blood pressure, slowing skin aging, and even antimicrobial activity against *Oenococcus oeni* and other wine-associated bacteria.

Peptidomics is a promising discipline that draws inspiration from proteomics and exploits separation, analytical, and computational technological advances. It involves a comprehensive, qualitative, and quantitative examination of all peptides present in a given biological sample. Peptidomics enables a comprehensive analysis of endogenous peptides, representing a relatively novel area of research distinct from its predecessor, proteomics, to progress our comprehension of signalling pathways and introduce a fresh layer of analysis in the realm of systems biology.

This work aimed to study the strategies to analyze different grape-derived and yeast-derived peptides to have a better understanding of their different functionalities.

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POSTER

Eliminating *Brettanomyces* and lactic acid bacteria in wine: the potential of Ultra-High Pressure Homogenization (UHPH)

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Keywords: UHPH, *Brettanomyces*, lactic acid bacteria, wine, inactivation

ABSTRACT

Ultra-High Pressure Homogenization (UHPH) is an innovative technology that can be seamlessly integrated at various stages of winemaking. Its application helps minimize or even eliminate the need for sulphites and other antimicrobial or antioxidant treatments, offering a faster and more sustainable alternative. Recently, the OIV has approved UHPH among the recommended practices in the international oenological code [1]. UHPH is a continuous, high-pressure process applied directly to the wine, which is pumped into the equipment at a pressure of 200 MPa or higher and then rapidly depressurized through a high-resistance valve. As wine passes through the valve, it undergoes intense mechanical forces, primarily impact and shear, along with cavitation and friction. These forces generate a potent antimicrobial effect by effectively eliminating microorganisms such as yeasts and bacteria [2, 3, 4]. This study explores the potential of UHPH as an effective technique for the inactivation of *Brettanomyces sp.*, a spoilage yeast in winemaking. Additionally, in base wine intended for sparkling wine production, UHPH is evaluated as a preventive solution against a common challenge faced by some producers: the occurrence of malolactic fermentation (MLF) in the bottle, which compromises the sensory quality of the final product. So, the study also aims to assess the effectiveness of UHPH in eliminating lactic acid bacteria (LAB). Red wines naturally contaminated with *Brettanomyces* were treated with UHPH at 300 MPa and compared to untreated control wines and treated with chitosan. The evolution of this yeast population, volatile phenols, and acetic acid in bottled wines was monitored over time. The UHPH treatment effectively inactivated *Brettanomyces*, resulting in a >5 log reduction in the population of this spoilage yeast after 6 months of aging. To study the inhibitory effect of UHPH on lactic acid bacteria in base wines, MLF was induced, and three conditions were analysed: a control condition (C -), where MLF was not induced in the base wine; a second control condition (C +), where MLF in the bottle was not stopped by any method; and a third condition with UHPH treatment at 300 MPa and an inlet tª of 30ºC (UHPH), aimed at eliminating LAB present in the base wines to prevent MLF. The population of LAB, along with malic and lactic acid levels, was measured at 0 and 42 days, and after 5 months of sparkling wine aging. The UHPH treatment achieved >7 log reduction in LAB cells, effectively preventing MLF.

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POSTER

Effect of ozone treatments in wine production of young and short-term aged white wines: destructive and non-destructive evaluation of main quality attributes

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Keywords: ozone, white wines, NIRs, E-nose, oeno-chemical attributes, polyphenols, VOCs

ABSTRACT

The main aim of WiSSaTech project (PRIN P2022LXY3A), supported by Italian Ministero dell'Università e della Ricerca and NextGenerationEU program, is to investigate eco-friendly and safe alternatives to sulphur dioxide (SO_2) in wine production. Three treatments were compared on two Italian white wines produced from grapes cv. Fiano and Vermentino as follow: by ozone treatment of grapes and cellar equipment either alone (O_3) [1], or used into the Purovino® method [2], (PV), and by conventional use of SO_2. All analyses were carried out on the obtained wines (T0), after accelerated aging at 35 °C for one week (T1), and after six months of conventional aging at 18 °C (T6). Non-destructive analyses were performed on the wine samples through NIR-AOTF [3] and E-nose [4] measurements together with destructive ones, FT-NIR detected and associated with the main oeno-chemical parameters, with detailed polyphenols analysed by HPLC-HRMS [5], and VOCs [6]. Results coming from both analytical approaches were subjected to chemometric analyses with the aim to appreciate combinate behaviours of wine samples with respect to the employed grape variety, the vinification process, and the timing of the wine aging. PLS-DA modelling performed on NIR data revealed that Vermentino wine samples exhibit a good classification performance (96%) based on the ageing time of sampling (T0, T1, and T6), otherwise observed as lower in Fiano wines (74%). Statistical performances were reduced when single wine samples (O_3, PV, and SO_2) were considered as discriminative variables of classification (47% and 63% for Fiano and Vermentino wines, respectively). PLS-DA computed on E-nose data lead to similar results, showing a discrimination among T0, T1 and T6 (92%, and 76% for Vermentino and Fiano, respectively), regardless the single wine samples associated with the treatments. Conversely, the segregation among these last looked less evident (50%, and 41% for Vermentino e Fiano, respectively), being probably affected by an overlapping of the samples at T6. PCA computation performed on destructive data revealed a clear sample segregation between T0 and T6 times, for both the variety and the treatments. A significant correlation was found about the stability of the wines between accelerated aging (T1) and T6, based on the ΔE. Wine samples with no added sulphites showed the lower stability, particularly in Fiano, due to the highest catechin index values and Cu^{++} concentrations.

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POSTER

Development of novel drought-tolerant grape cultivars from Monastrell: enhancing anthocyanin and flavonol content under elevated temperatures

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Keywords: climate change, drought, *Vitis vinifera*, polyphenols

ABSTRACT

The ongoing challenge of climate change is driving the need for novel oenological approaches aimed at finding effective environmental solutions. While warmer temperatures may benefit viticulture in cooler climates by reducing fungal infections, the impact on regions characterized by arid conditions is potentially harmful. These changes can significantly influence the quality of wines and their organoleptic profiles, making it essential to adapt both viticultural and winemaking practices to mitigate these effects.

Given the persistent nature of climate change, there is an urgent need to continuously explore and implement viticultural strategies that can alleviate its consequences. In this context, it has initiated a long-term breeding program aimed at developing grape varieties more resilient to climate change. Through targeted crosses involving the Monastrell variety and other cultivars such as Cabernet Sauvignon and Syrah, new grape varieties, namely MC16, MC80, and MS104, have been created.

The performance of these new varieties has been assessed over three consecutive seasons (2022–2024) under both strictly dry conditions and those supplemented with irrigation. This study focuses particularly on the macromolecules of interest—anthocyanins and flavonols—which play a critical role in determining the color, stability, and sensory properties of wine. Following the methodology outlined by Pérez-Porras *et al*. [1], the results indicate that the newly developed varieties exhibited significantly higher anthocyanin content than their parent varieties (Monastrell, Cabernet Sauvignon, and Syrah), with some varieties showing a two- to threefold increase, especially during the 2022 season. Moreover, it was observed that the highest anthocyanin concentrations were found in grapevines grown under rainfed conditions, as opposed to those subjected to deficit irrigation.

In contrast, the variations in flavonol concentrations were less pronounced than those observed for anthocyanins, suggesting that flavonol content might be influenced by other environmental factors or genetic aspects not yet fully understood.

In conclusion, the findings of this study offer valuable insights into the potential for developing grapevine varieties better suited to the challenges posed by climate change in arid and semi-arid regions. These results underscore the importance of key macromolecules, such as anthocyanins and flavonols, in shaping wine quality and highlight the potential of these new varieties as a critical tool for the wine industry to address the impacts of climate change.

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POSTER

Release and perception of γ-nonalactone and massoia lactone in the red wine matrix: impact of ethanol and acidity

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Keywords: climate change, interactions, alcohol, pH/total acidity, sensory quality

ABSTRACT

Climate change (CC) is altering grape/wine composition, challenging wine sensory quality. Rising temperatures increase grape sugar levels, with higher wine ethanol (EtOH) contents, reduce total acidity (TA) converging with increased pH and lead to the accumulation of CC odorous markers such as γ-nonalactone (γ-C9) and massoia lactone (ML). These alterations often require acidification to preserve microbial and chemical stability, and taste balance of wines. The objective of this study is to investigate for the first time the sensory impact of matrix-aromas interactions in wines representative of the main CC compositional effects in their whole.

Model wine matrices (9) were reconstituted from deodorized red wine, using a full factorial design based on 3 ethanol levels (12, 14, 16%), 3 pH/TA ratios (3.2/8=0.4, 3.6/6.5=0.55, 4/5=0.8) and spiked with γ-C9 (155 ppb) and ML (26.8 ppb). The combinations simulated progressive CC impact from proper (12%, pH/TA=0.4, no CC effects), to alarm (14%, pH/TA=0.4, CC influencing EtOH levels with TA corrected by acidification) till dangerous (14%, pH/TA=0.8, CC affecting TA without correction; 16%, pH/TA=0.8, extreme CC effects) scenarios of wine quality.

Discriminating (triangle test: TT) and descriptive (RATA) sensory tests and SPME/GC-MS quantitative analyses, were carried out to test the impact of compositional changes applied to the matrix on the perception and release of γ-C9 and ML and to explore perceptual interactions.

TT showed significant differences in γ-C9 and ML perception in wine with 16% of EtOH and corrected by acidification (pH/TA=0.4), indicating in this condition a combined effect of EtOH and acidic profile on their perception likely driven by physical-chemical phenomena. GC-MS analysis of wine headspace confirmed the highest release of γ-C9 and ML in this condition. Moreover, RATA results showed that in extreme CC conditions (16% EtOH, pH/TA=0.8), the addition of γ-C9 and ML led to a shift in aroma profile: red fruit notes, characteristic of the whole wine, were no longer perceived, while sweet notes became dominant, suggesting a significant matrix effect on the olfactory impact of these compounds.

These findings highlight that CC and corrective actions can significantly impact wine sensory quality. Our study points out that adjusting the acidic profile of wine may favor γ-C9 and ML perception linked to CC and premature aroma aging. These results suggest that in a complex matrix like red wine, adjusting a single parameter may be not enough, and a holistic approach should be adopted.

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POSTER

Characterization of intact glycoside aroma precursors of recovered minority Spanish red grape varieties by High-Resolution Mass Spectrometry

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Keywords: Moravia Agria, glycosidic compounds, recovered cultivars, Tinto Fragoso, water stress

ABSTRACT

In Spain, the wide diversity of red grapevine varieties represents an advantage when choosing the most suitable one for cultivation based on different climatic conditions, without implying a loss of their enological potential. In response to this climatic variability, research is focused on adapting minority varieties, which could be more resistant to water and thermal stress, while maintaining the quality and aromatic complexity of the wines. In this context, Tinto Fragoso and Moravia Agria grapevine varieties have attracted the interest of researchers due to their attractive enological properties, according to preliminary studies.

Among the components that define wine quality, the grapes glycosidic aroma compounds have a significant importance. Such compounds are characterized by a structure with two different parts, a sugar moiety, and an active molecule (aglycone), linked by a glycosidic bond. The varietal aroma of wines is mainly due to the glycosidic aroma precursors of grapes, even though such compounds aren't odorous, the release of their volatile aglycones throughout vinification or wine aging, affect to their aroma and sensory profile. The indirect analysis of this fraction, through determination of the volatile aglycones by hydrolyzing their precursors, may result in chemical artifacts. Additionally, the use of glycosidic enzymes can cause alterations in the sample profile due to their inherent specificity.

The study of the intact glycosidic aroma precursor profile of grape would allow to know the enological potential of recovery varieties. The aim of this work was to study such profile of Moravia Agria and Tinto Fragoso grapes collected from plants cultivated under two water regimes (drought with survival irrigation and deficit irrigation, 20% ETo). The identification and structural characterization of glycosides were performed by high-resolution mass spectrometry using an UHPLC/QTOF analytical system. Compound identification was achieved utilizing a custom-built database (GrapeAroma), and the structures identified were validated through MS/MS fragmentation experiments [1]. The main aroma glycosides detected were pentosyl-hexoside derivatives, with the aglycones of belonging to the chemical classes of benzenoids, aliphatic alcohols, monoterpenols, norisoprenoids, and geranic acid. In general, the two varieties accumulated greater levels of glycosidic aroma precursors under water stress conditions, indicating their adaptability to semi-arid environments.

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POSTER

White wine lees: unlocking the relationship between chemical composition and antioxidant potential

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Keywords: white wine lees, antioxidant capacity, polyphenols, sulfhydryl compounds

ABSTRACT

The wine-making process generates numerous by-products at each stage (crushing, fermentation, ageing), including wine lees, which account for almost 25% of the total quantity [1]. Despite their well-recognized oenological properties, such as stabilizing the physico-chemical properties of wine [2], few studies have focused on white wine lees. Our recent work demonstrates their interesting antioxidant potential, as evaluated by the DPPH assay [3], though the compounds responsible remain unclear. While the antioxidant potential of lees during ageing appears linked to GSH and sulfhydryl compounds [4], specific compounds responsible for this potential are still under investigation.

To improve the understanding of the antioxidant properties of white wine lees, a set of 41 white wine lees was collected after alcoholic fermentation (different grape variety, yeast strain, condition of fermentation). A full characterisation of the composition was then carried out for the first time. These included tartaric acid, lipids, proteins, polysaccharides, polyphenols and total sulfhydryl compounds. Then, a targeted quantification of polyphenols (phenolic acids, flavanols, flavonols, stilbenoids) and glutathione (reduced and oxidised form) was performed by UHPLC-HRMS. In parallel, the free radical scavenging capacity of white wine lees was evaluated using the DPPH method.

The results revealed significant variability in composition and antioxidant capacity, highlighting the diversity of our collection of white wine lees obtained under different conditions. Subsequently, a Spearman correlation analysis was conducted to study the impact of composition on the radical-scavenging potential of white wine lees. Concerning the global compositional parameters, correlation analysis showed a significant positive impact of total polyphenols ($\rho = 0.66$) and total sulfhydryl compounds ($\rho = 0.53$) on the antioxidant potential. Targeted analysis of polyphenols and glutathione by UHPLC-HRMS confirmed the importance of polyphenols in the antiradical capacity of white wine lees, with a strong correlation observed for phenolic acids and in particular hydroxycinnamic acids ($\rho = .80$). However, the absence of a significant correlation with glutathione ($\rho = 0.23$) suggests that other sulfhydryl compounds contribute to the antioxidant potential.

These findings provide valuable insights into the bioactivity of white wine lees. From a valorization perspective, this by-product could be a new source of high added-value antioxidant compounds with promising applications across various industries.

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POSTER

Evaluating the greenness of wine analytical chemistry: A new metric approach

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Keywords: greenness metric, environmental impact, sustainability, wine analysis

ABSTRACT

Wine is a complex matrix whose composition depends on climatic, agricultural, and winemaking factors, making quality control and authenticity assessment critical in the global market. To meet the increasing demand for high-quality wines, a range of analytical methodologies has been developed and employed. Simultaneously, sustainability concerns have taken attention, with the International Organisation of Vine and Wine (OIV) demanding scientific innovation aligned with environmental awareness [1]. Detailed frameworks like Life Cycle Assessment (LCA) are already employed to evaluate the environmental impacts associated with all stages of a product's life, special attention is required to the analytical procedures in use, as they play a pivotal role in ensuring sustainability within the wine sector. Existing green analytical metrics, such as Analytical Eco-Scale [2], GAPI [3], and AGREE [4], present limitations in quantifying the environmental impact of analytical procedures, when applied to wine analysis. To bridge these gaps, this study proposes the Green Wine Analytical Procedure Evaluation (GWAPE), a novel framework designed to assess the greenness of wine analytical methods. The GWAPE tool was developed by refining and integrating key aspects of existing greenness metrics to provide quantitative assessments. Some of the previous green criteria of analytical chemistry not applicable to wine analysis were excluded and new principles tailored to enological analysis were introduced. GWAPE metric is structured around 10 principles and includes a Python-based software tool to facilitate its application [5]. The tool was tested on three key analytical procedures in wine analysis: the enzymatic determination of glucose and fructose (OIV-MA-AS311-02, Type II), the determination of reducing substances (OIV-MA-AS311-01A, Type IV), and the FTIR-based determination of glucose and fructose. The GWAPE evaluation revealed significant differences in the environmental impact of these methods, with FTIR emerging as the most eco-friendly (3.5/5) due to its minimal reagent consumption and reduced waste generation. The enzymatic determination of glucose and fructose received a score of 2.5/5, while the determination of reducing substances was the least environmentally friendly approach (1.8/5). By providing a practical and discriminatory assessment of analytical procedures, GWAPE facilitates the adoption of greener practices in wine analysis. Its ability to quantitatively classify and compare methods enhances decision-making for laboratories and regulatory bodies, promoting environmentally responsible analytical approaches in the wine sector.

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POSTER

Exploring the physico-chemical modification of grape seed extracts to improve their clarifying effect in red wine

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Keywords: turbidity, grape seed extracts, physico-chemical modification, phenolic compounds

ABSTRACT

During winemaking, some byproducts are obtained, such as grape pomace, which represent 13% of winery byproducts [1]. Among grape pomace we can found grape seeds, which have showed promising results in reducing wine turbidity, since they have proteins [2] which interact with turbidity-forming compounds as such polysaccharides [3], polyphenols [4] and other proteins [5] through primarily hydrophobic interactions [6] accelerating their precipitation. However, these seed extracts do not achieve the clarification effect obtained with other commercial clarifying agents frequently used in winery. For that, in this study, white grape seed extracts were enzymatically, physically and chemically modified and applied on a red wine after malolactic fermentation with the objective of verifying if their effectiveness in the clarification process and in the maintenance of wine quality was improved. The determination of turbidity, chromatic parameters and phenolic content, carried out in wines after a period of contact with different clarifiers, showed that extracts treated with cellulase, ultrasounds and HCl improved its performance in comparison with grape seed extract without treatment, the results being very similar to that obtained with commercial clarifying agents commonly used in wineries. It is clear that some of the treatments carried out on grape seed extracts produced important changes at structural and composition level, making them more reactive and improving their clarifying capacity without affecting red wine quality. Their implementation as new clarifying agents in wine industry would promote the circular economy in the oenological sector.

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POSTER

Exploring the use of high-power ultrasound in white and rosé winemaking

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Keywords: volatile, polyphenolic profile, polysaccharides, sensorial analysis

ABSTRACT

Since the approval in 2019 of the use of high-power ultrasound (US) in winemaking to support extractive processes from grape to must [1], the study of this technology in red winemaking has increased significantly, with laboratory and semi-industrial scale studies [2]. Ultrasound in winemaking can be applied as a continuous pretreatment of crushed grapes, the improvement of extraction being the main interest of its use, favouring a more intense wine colour profile [3]. However, the use of this technology in white and rosé winemaking, which has been less studied, shows great promise for reducing or eliminating pre-fermentative maceration processes without losing the high organoleptic quality of the wines [4]. This possibility would not only reduce production time and cost but also ensure that the wines most susceptible to oxidation (those with a high hydrocynnamic acid and flavanol content) suffer less risk of being affected.

High-power ultrasound application essays were conducted on a semi-industrial scale and using a frequency of 30 kHz on crushed grape from Monastrell (for rosé wine) and Viognier (for white wine) varieties, studying the effect on vinifications carried out without pre-fermentation maceration (CPD), with 8 hours of pre-fermentation maceration (CM) and with US application after crushing the grapes and just before pressing (US). These trials showed that the rosé wine made with US had a profile rich in terpenes and norisoprenoids, compounds linked to the floral profile observed in the sensory analysis, as well as red fruit aroma. It also had higher colour intensity, higher presence of phenolic compounds and of polysaccharides rich in arabinose and galactose (PRAG) and homogalacturonans (HL). In white wine, in addition to these compounds, a higher presence of rhamnogalacturonans type II (RG-II) was observed, together with a stronger varietal aromatic profile (increasing the concentration of α-terpineol and linalool in free form) intensified thanks to the extraction benefited by the US, even without any prefermentative contact time, which resulted in raised scores in attributes such as floral, peach and sweet apricot.

Thus, the use of high-power ultrasound not only results in the possibility of reducing the winemaking time without loss of quality, but also in the possible improvement of the colour and varietal aromatic profile of the wines produced.

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POSTER

Colour, phenolic, and sensory characteristics of commercial monovarietal white wines produced with maceration

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Keywords: white wine, maceration, RATA, sensory analysis

ABSTRACT

White wines produced with skin and seed contact are of great interest in the wine sector. Maceration, whether performed prior to or concurrently with alcoholic fermentation, or even extended beyond its completion, significantly impacts the chromatic, mouthfeel, and aroma characteristics of these wines [1]. However, little information is available in the scientific literature on macerated white wine characteristics. This research is a descriptive study of the physicochemical and sensory parameters of 36 commercial Italian monovarietal white wines (cv. 'Arneis', 'Catarratto', 'Erbaluce', 'Malvasia Istriana', 'Vermentino') produced with different maceration times: short (≤3 days), medium (4-7 days), long (8-30 days), «orange wine» style (>1 month), and non-macerated controls (2 for each cultivar). The sensory analysis was conducted with an expert panel that generated the terminology and was trained on 20 aroma and 5 mouthfeel descriptors. The formal evaluation was performed using the Rate-All-That-Apply (RATA) technique [2]. Panellists also evaluated turbidity, colour intensity and hue. Instrumental analysis involved basic composition parameters, total polyphenols index (TPI), condensed tannins (methylcellulose precipitation assay, MCP), and colour by CIELab coordinates [3]. Among the investigated aroma descriptors, 15 differentiated the samples. The intensity of *Citrus*, *Pineapple*, and *White flowers* was evaluated higher in control samples compared to macerated ones, regardless of the variety. In contrast, *Prune*, *Dry figs*, *Clove*, and *Liqueur* were rated higher in macerated wines. *White pepper* was a characterising note of "orange wines". Varietal effects were significant for *Vanilla*, *Toasted*, and *Kerosene* descriptors. The effect of maceration time on aroma descriptor intensity was variable, with wines presenting the longest maceration time showing non-linear changes. This pattern was also observed in mouthfeel descriptors, where *Astringency* increased from non-macerated to long-macerated wines but was lower in "orange wines". Sensory results were supported by instrumental TPI and MCP. The same tendency was observed in *Colour hue*, evaluated from straw (0) to brown (10), and a*, b*, and absorbance at 420 nm instrumental parameters, with "orange wines" showing decreasing trend when compared to medium and long macerated samples. These first outcomes will be supplemented with volatile organic compounds analysis by GC-MS and individual phenolic composition by HPLC-UV, providing further insights into the changes occurring with maceration of different lengths.

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FLASH TALK

Wine tartaric stability based on hydrogel application

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Keywords: tartaric acid, stabilization, gels, mini-contact test

ABSTRACT

Tartrates are salts of tartaric acid that occur naturally in wine and lead to sediments that cause consumers' rejection [1]. There are currently different treatments to prevent its occurrence, with cold stabilization being the most traditional and well-known method [2]. Other ways to prevent the formation of these crystals consist of the addition of stabilizing agents such as metatartaric acid, capable of binding to the nucleation sites and preventing crystal structure expansion, thus increasing the solubility of these salts [3].

The aim of this work was to compare different tartaric stabilization treatments (cold stabilization and metatartaric acid) with the application of hydrogels (three-dimensional polymers capable of responding to different stimuli of the medium [4]) made with maleic and hyaluronic acids, which possess ion-exchange properties. Wine tartaric stability was tested by the mini-contact test [5]. In addition, the main physicochemical and colorimetric parameters were determined to evaluate the influence of the different treatments on wine quality [6]. These assays were performed in triplicate on red and white wines made from Bobal and Airen varieties respectively.

The results showed that maleic and hyaluronic acid hydrogels were efficient stabilisers of red and white wines with tartrate instability due to the ion exchange properties of these materials, removing potassium from wines and obtaining similar stabilization results to those of metatartaric acid and cold treatments in a shorter period of time. In general, no significant changes were observed between wines treated with hydrogels and the other tartaric stabilization treatments in the physicochemical and chromatic characteristics. However, lower pH values were determined in wines treated with hydrogels, that may be attributable to the ion exchange mechanism.

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FLASH TALK

Influence of harvest time and withering length combination on reinforced Nebbiolo wines: phenolic composition, colour traits, and sensory profile

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Keywords: withering process, polyphenolic profile, sensory analysis, reinforced wine

ABSTRACT

Sforzato di Valtellina DOCG is a reinforced dry red wine produced in the mountain area of Valtellina alpine valley (North Italy), using 'Nebbiolo' grapes that undergo a withering process [1]. This process impacts on the grape composition due to a sugar concentration and changes in secondary metabolism influencing volatile organic compounds (VOCs) and polyphenols [2]. The ripeness degree of the grapes at the harvest time and the withering process length are key factors in modulating these changes. Therefore, the aim of this work was to evaluate the combined effects of these two variables on phenolic components, colour features, VOCs composition and sensory profile of wines produced with 'Nebbiolo' withered grapes. During three consecutive vintages (2019, 2020 and 2021), grapes were harvested from two vineyards, then three different binomials were tested: early harvest/long withering (EL), medium-term harvest/medium-term withering (MM) and late harvest/short withering (LS). The end of withering was set at 1st December of the harvest year for all conditions, and the grapes were subjected to winemaking in two independent replicates each. Basic wine parameters, total phenolic compounds (TPI), colour traits [3, 4] and VOCs were determined [5]. The results were supported by sensory analysis. LS samples, in both vineyards, had higher pH and lower acidity values compared to an earlier harvest. In addition, LS samples showed more stress compounds such as volatile acidity. In most cases, a reduction of TPI was observed in LS samples, specifically in 2019 for both vineyards. EL and MM wines displayed the darkest colour, with lower orange components compared to the LS. EL samples, in most years, showed highest content of terpenes, resulting in higher sensory perceived *fruity* and *flower* characters on average. LS samples presented a higher content of total benzenoids and lactones, that may have contributed to the lower liking of these samples, in which jam, *hay*, *leather* and *caramel* notes were perceived. Moreover, in some of LS sample a high concentration of N-(3-Methylbutyl)acetamide was detected, presumably influenced by a low grape health status [6]. A vintage effect was registered in mouth-feel sensations, in accordance with phenolic composition. In conclusion, EL and MM wines resulted in a higher phenolic content, with positive colour characters, and they were more appreciated by sensory analysis. Indeed, LS combination did not give advantages on final wine, particularly in total VOCs, and in some samples, it caused a decrease in health grape status.

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POSTER

A facile and robust method for the quantification of polyphenols in red wine *via* NMR

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Keywords: polyphenols, nuclear magnetic resonance spectroscopy, Pinot noir, method development

ABSTRACT

Nuclear magnetic resonance spectroscopy (NMR) is a high-tech analytical method that recently found its way into the field of wine analysis with special focus on wine authentication.[1] NMR has several advantages including a strictly linear relationship between signal intensity and concentration, fast sample preparation, fast measurement and high repeatability. The biggest disadvantage of NMR in comparison to other analytical techniques is its relatively low sensitivity. Mostly untargeted NMR approaches are used and the obtained results lack cross-validation with established methods such as GC- and HPLC-MS.[2] Very few studies for the quantification of wine analytes via NMR have been reported and focused on main wine analytes, such as diols, triols, main acids, amino acids and monomeric sugars present in the 100 to 10,000 ppm range.[3,4] This study aims to develop a quantitative NMR based method for the compound class of polyphenols. Polyphenols (e.g. flavonoids such as catechin, benzoic acid derivatives such as gallic acid, cinnamic acid derivatives such as caffeic acid) are present in wine at concentration below 100 ppm (with some exceptions), therefore the wine needs to be concentrated before NMR measurement. An extraction method based on diethyl ether has been developed in this context. The novel method is easy to use and very robust, with a reliable standard deviation typically in the scale of 3% to 6% for the concentration of many analytes. The recovery rate of the method has been tested against an inhouse prepared standard reference material, emulating the composition of a typical Pinot Noir wine. Quantitative and near quantitative recovery rates (> 80 %) have been reached for many analytes.

A total of 20 Pinot Noir wines from South Tyrol, Italy, of different origins and, in some cases, different vintages from the same provenance, have been analysed to test the capacity of the method for the determination of significant differences. Additionally, the method was tested against an already established HPLC-MS methodology. Method parameters are evaluated to identify strengths and weaknesses of the new method. The method can be used in a variety of contexts such as control of authenticity and quality amongst others.

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POSTER

Integrated approach to grape stalks valorization: Sustainable recovery of bioactive compounds and biofuel production

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Keywords: grape stalks, polyphenols, recovery, hydrothermal carbonization, biofuels

ABSTRACT

Grape stalks are a byproduct of the winemaking process and represent a valuable and inexpensive source of bioactive compounds. While their direct use in whole bunch fermentation is known [1, 2], the majority of grape stalks are discarded, posing environmental and economic challenges. Notably, this byproduct contains a diverse array of extractable polyphenolic compounds, including phenolic acids, flavanols, flavonols, and condensed tannins [3]. Among polyphenols, quercetin-3-glucuronide, catechin, caftaric acid, and astilbin have been identified [4]. However, the high lignocellulosic content in grape stalks limits the direct extraction of a large portion of the polyphenolic component just by conventional methods. Lignin, a major structural component, consists in fact of a complex network of polymerized phenolic units. Structural analysis of grapes lignin revealed a predominance of β-O-4′ structures, with moderate amounts of β-5′, β-β, β-1′, 5-5′, and 4-O-5′ structures. The condensation degree in grape stalks is higher than that of other lignin from other agricultural residues. Grape stalks lignin was shown to contain on average a 3:71:26 molar proportion of *p*-hydroxyphenyl, guaiacyl, and syringyl phenolic units [5]. Several strategies have been investigated to yield a partial or even total breakdown of the lignocellulosic fraction, with subsequent extraction of the depolymerization products, providing an inexhaustible source of phenolic compounds from a practically inexpensive source material.

In this contribution, we are presenting preliminary results from an integrated approach based on tuning hydrothermal carbonization (HTC) conditions to facilitate a partial breakdown of lignin, then to increase the efficiency of extraction of polyphenolic compounds. HTC was further tested to investigate the application of grape stalks residues for producing hydrochar, also testing the process for the valorization of unextracted residues as biofuels, contributing to a fully circular bioeconomy. Our approach highlights the potential for grape stalks applications, demonstrating a sustainable approach to repurposing this underutilized resource.

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POSTER

The use of pulsed fluorescence detector to quantify free SO_2 in wines *via* the headspace

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Keywords: sulfur dioxide, headspace analysis, pulsed fluorescence detector, free SO_2

ABSTRACT

Pulsed fluorescence SO_2 analyzers are widely used for atmospheric monitoring [1]. They are accurate, portable, sensitive and their price are reduced compared to advanced techniques like gas chromatography with sulfur chemiluminescence detection (GC-SCD). These instruments also allow for continuous and non-destructive measurements. In this study, we explored the potential of pulsed fluorescence detection to quantify free SO_2 in wine via the headspace (HS-PFD) and developed a method to minimize disturbances to SO_2 equilibrium.

Our approach involves injecting wine into a syringe, adding nitrogen to create a headspace, and gradually releasing the gas phase into the SO_2 analyzer. Molecular SO_2 levels are determined using a calibration curve based on model wine spiked with potassium metabisulfite, while free SO_2 is calculated considering temperature, pH, and alcohol by volume (ABV) with the equations described in [2]. The method demonstrated high sensitivity, with detection and quantification limits of 0.012 mg/L and 0.032 mg/L, respectively—equivalent to roughly 0.5 and 1.3 mg/L of free SO_2 in a wine with pH 3.5 and 10% ABV. The coefficients of determination of calibration curves ranged from 0.99 to 0.999, and the method's precision, assessed across 18 wines measured in triplicate, yielded an average relative standard deviation of 3.5% (ranging from 1.2% to 8%).

We analyzed 81 Swiss commercial wines using HS-PFD and corrected iodometric titration (CIT). Results from both methods were comparable for white and rosé wines (white: N = 29, slope = 0.9, R^2 = 0.96; rosé: N = 9, slope = 0.98, R^2 = 0.95). However, HS-PFD consistently measured lower free SO_2 in red wines compared to CIT (N = 43, slope = 0.61, R^2 = 0.85). Further analysis of 20 selected wines using CIT, aeration-oxidation (A-O), HS-PFD and acidification-HS-PFD (Acid-HS-PFD) demonstrated that methods acidifying wine samples (CIT, A-O and Acid-HS-PFD) overestimate free SO_2 in red wines, as acidification released weakly bound SO_2. The amount of released SO_2 correlated positively with the total and SO_2-bleachable anthocyanin content of wines.

Our results align with previous literature [2,3,4,5] and demonstrate that the HS-PFD method delivers performance comparable to high-end analytical techniques like GC-SCD and GC-MS, but at a significantly lower cost. Future developments and automation possibilities will be discussed.

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POSTER

Assessing the potential of fermentative skin contact in white winemaking on phenolic, colour, and sensory traits

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Keywords: white wine, maceration, oxidation, polyphenols

ABSTRACT

Fermentative maceration in white wine production, involving extended contact with grape skins and seeds, has gained interest in recent years [1]. The impact of this winemaking technique on wine composition and sensory properties remains underexplored. This study investigates the influence of maceration time on the basic parameters, phenolic composition, colour, and sensory attributes of white wines from two Italian autochthonous varieties, 'Arneis' and 'Erbaluce'. Laboratory-scale fermentations were conducted at 18 °C with maceration lasting 0 (control), 2, 7, and 14 days. After maceration, wines were analysed and subjected to oxygenation via air saturation followed by 1-month storage to evaluate oxygen exposure effects. Phenolic compounds were monitored using spectrophotometric and HPLC analyses, focusing on (+)-catechin, (–)-epicatechin, quercetin, quercetin-3-glucoside, condensed tannins, and polymeric flavanol structure. Wine sensory analysis was performed using the Rate-All-That-Apply (RATA) technique [2].

Wine colour was significantly influenced, with increased absorbance at 420 nm in wines subjected to prolonged maceration and air saturation. Total phenolic content increased with maceration time, as previously found [3], doubling after 2 days and quadrupling after 14 days compared to the control, with no significant variations post-oxygenation. The concentrations of (+)-catechin and (–)-epicatechin increased with maceration, while monomeric flavan-3-ols were not detected in control wines. Wine condensed tannins were found only in 7 and 14-day macerated samples, reaching 513 mg/L in Arneis and 708 mg/L in Erbaluce wines for the longest maceration time tested. Although the mean degree of polymerization (mDP) was unaffected by maceration, galloylation significantly increased in Arneis wines with longer maceration time. At the end of fermentation, free acetaldehyde levels were highest in control wines, decreasing with maceration and further declining after air saturation. Oxygenation notably increased condensed tannins (+20.3% on average) accompanied by a decrease in monomeric flavan-3-ols, thus suggesting the possible formation of polymeric flavanols [4] but no mDP differences were found. Sensory evaluation confirmed that longer maceration increased colour intensity, hue, and astringency, while a decline in white and yellow pulp fruit aroma descriptors was observed. These findings improve the understanding of maceration impact on white wine phenolics and sensory traits, offering insights for optimizing maceration to achieve desired wine profiles.

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POSTER

Chemical characterization of distinctive aroma profiles of Valpolicella and Amarone wines

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Keywords: aromatic profile, typicality, wine aging, sensorial analyses

ABSTRACT

Valpolicella is an Italian wine producing region, famous for the production of high-quality red wines. A distinctive characteristic of this region is the extensive use of post-harvest withering. The Valpolicella PDOs include different wine styles based on this technique, with two opposite interpretations being "Valpolicella", a dry red wine for which no grape withering is foreseen, and "Amarone della Valpolicella", a dry red wine obtained by the same grape varieties submitted to withering up to a weight loss of about 30% (Paronetto & Dellaglio, 2011). Moreover, the production regulations for Valpolicella PDOs divide the region in three areas: Valpolicella Classica, Valpolicella orientale and Valpantena (Consorzio Tutela Vini Valpolicella, 2014).

The present study had different aims: first to evaluate the differences among the chemical volatile profile of Valpolicella and Amarone; second, to identify, within each PDO, different styles according to chemical and sensory features of the wines. Finally, to evaluate the impact of grape origin on aroma profile of studied wines. Free volatile compounds were analyzed with gas chromatography mass spectrometry (GC-MS) analysis coupled with different SPE and SPME extractions techniques. Enological parameters and phenolic composition were analyzed with different spectrophotometry techniques. Sensory characteristics of the wines have been investigated through sorting tasks conducted by a semi-trained panel.

Amarone and Valpolicella showed major differences due to the different production techniques, vintages and aging periods. Amarone showed higher concentration of cyclic terpenes, branched esters, and lactones, while Valpolicella, resulted richer in linear terpenes (Accordini, 2013; Luzzini *et al.*, 2022). Concerning stylistic differentiation, the application of multivariate data analysis allowed the identification of volatile chemical profiles that defined the distinct enological styles of the two Valpolicella production areas. Differences were particularly evident in Valpolicella wines, where Valpolicella Classica wines showed the presence of higher alcohols, fatty acids and sulphur compounds, while Valpolicella orientale wines were higher in terpenes and norisoprenoids. The sorting task identified two clusters, one representative of Valpolicella Classica. with wines primarily described as green, fruity, tobacco and red fruit, descriptors linked to esters, fatty acids and higher alcohols, while the other cluster was described as floral, balsamic and spicy, with higher content of terpenes.

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FLASH TALK

Novel insights into Passito wines aroma typicality. Rationalizing the markers of varietal and geographical origin of Amarone DOCG

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Keywords: cineoles, DMS, whitered grapes, typicality

ABSTRACT

Valpolicella is a famous Italian wine-producing region (Paronetto & Dellaglio, 2011), whose main characteristic is the extensive use of the post-harvest withering technique, which takes place in naturally ventilated rooms called '*fruttai'* (Bellincontro *et al*., 2016). With this technique, three PDO red wines are produced: '*Ripasso della Valpolicella'*, '*Recioto della Valpolicella'*, and the most famous '*Amarone della Valpolicella'*. The withering process involves a range of physical, physiological, and biochemical changes that significantly impact the final quality of the grapes and the consequently wine (Barbanti *et al*., 2008; Zenoni *et al*., 2016). The aim of this study was to identify chemical volatile patterns of varietal and geographical typicality of Amarone wines. This study considers different sample sets: a set of experimental wines produced from withered grapes of different origins and vintages (2017-2019), a large dataset of 45 commercial Amarone wines from different vintages (2015, 2016, and 2019), and a data set of 33 samples from two commercial Amarone labels of the same winery from old vintages (1974 to 2016). An accelerated aging treatment protocol was employed: samples were stored at 40°C and 16°C for 30 days. Free volatile compounds and glycosidic precursors were analysed with different GC-MS techniques. Enological parameters of wines were analyzed by the mean of multiparametric analyzer with specific enzymatic kits. Sensory characteristics of the wines have been investigated through sorting tasks performed with semi-trained panel.

This study highlighted the importance of certain volatile compounds of different biochemical origins, including fermentative and varietal origins such as 1,4- and 1,8-cineole, norisoprenoids, esters and DMS. The occurrence of these compounds has been attributed to specific compositional parameters of grapes and wine, such as terpinen-4-ol, pH, and PAN (Primary Amino Nitrogen).

Concerning geographical typicality, application of multivariate data analysis techniques allowed to identify volatile chemical profile representing the chemical signature of the geographical origin. Main drivers of the geographical pattern were norisoprenoids and terpenes. The latter, showed different patterns of typicality according to wine aging periods. Also, Amarone wines from older vintages (1974-2016), despite the impact of different vintages and aging periods, showed specific volatile chemical patterns for each wine, even after major chemical modifications due prolonged aging treatments.

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FLASH TALK

Enhancing sustainability in winemaking: the role of PIWI in South Tyrol

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Keywords: PIWI, sustainable winemaking, wine quality, market adaptation

ABSTRACT

The adoption of PIWI (*Pilzwiderstandsfähige*) grape cultivars, bred for resistance to fungal diseases, is a transformative step towards sustainable winemaking[1]. In South Tyrol, where mountainous landscapes make vineyard work demanding, PIWI cultivars benefit wineries by reducing pesticide treatments, labor intensity, and environmental impact.

This study, part of the *Sustainable Wine Production with Innovative Resistant Varieties (SUWIR)* interdisciplinary project at the Free University of Bozen-Bolzano, uses a holistic approach to evaluate the environmental, economic, and social impact of PIWI wine production. PIWI cultivars require fewer treatments than *Vitis vinifera* cultivars[2]—often fewer than conventional organic farming—leading to healthier soils, cleaner water, and lower CO_2 emissions. However, the adoption of PIWI cultivars does not always imply organic practices, though it generally aligns with organic principles by reducing synthetic treatments.

For small wineries, especially in mountain regions like South Tyrol, PIWI cultivars offer an economically and environmentally sustainable option. Small wineries struggle to find laborers to work in isolated, steep, and difficult terrains. Since PIWI vines demand less manual intervention than conventional organic viticulture, they offer an advantage by reducing reliance on seasonal labor while ensuring quality.

PIWI wines are gaining traction with consumers who value sustainability. A survey conducted among 1,500 wine enthusiasts across Italy, Germany, and Austria showed growing curiosity and appreciation for PIWI wines. However, their market presence faces challenges, particularly due to regulatory restrictions. To overcome these, education and storytelling will be key, highlighting the ecological benefits of PIWI and their unique sensory profiles.

To establish PIWI wines in the mainstream, collaboration between researchers, policymakers, and the wine industry is essential. Restaurants and wine bars can participate by adding PIWI wines to their wine lists, allowing consumers to discover them in different gastronomic settings. Increasing their presence in dining establishments will not only enhance familiarity but also foster greater consumer trust and enthusiasm, increasing market acceptance.

PIWI grape varieties are not just a technical innovation; they symbolize a new philosophy in winemaking—one that balances sustainability, economic resilience, and quality. By integrating PIWI wines into gastronomy, competitions, and wine education, the industry can make a lasting impact on the future of winemaking.

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POSTER

Comparison between non-*Saccharomyces* yeasts for the production of Nero d'Avola wine

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Keywords: Nero d'Avola wine, non-*Saccharomyces* yeasts, fermentation, wine composition

ABSTRACT

Wine production with non-*Saccharomyces* yeasts is getting larger application due to the positive impact of these yeasts on wine composition. Previous studies showed notably differences in chemical composition of Merlot wines obtained with *Torulaspora delbrueckii* [1]. Similarly, *Lachancea thermotolerans* led to produce Tempranillo wines with lower ethanol content and enhanced wine structure [2]. This study investigated the chemical composition and sensory attributes of Nero d'Avola wines produced by sequential inoculum with *T. delbrueckii* (TD), *Metschnikowia pulcherrima* (MP) and *L. thermotolerans* (LT). Four batches of Nero d'Avola grape were collected in three different areas of Sicily (Palermo, Catania, Caltanissetta) in harvest 2024 and vinified separately. The must fermentation was carried out with sequential inoculum of non-*Saccharomyces* starter yeasts and *S. cerevisiae*, the latter being inoculated 48 hours after the non-*Saccharomyces* strains. Microvinifications with maceration were performed monitoring the microbial population during the alcoholic fermentation (AF), every day up to day 5th, and every two days till the end of AF. Once AF was completed, the experimental wines were racked, stabilized, and bottled. The wines were characterised for general chemical parameters (residual sugars, titratable acidity, acetic acid, malic acid, lactic acid, acetaldehyde, glycerol), flavonoids and anthocyanins, colour index, monomers (vanillin index) and tannins (methylcellulose index). The sensory analysis and the aroma profiles were also assessed. The sugar consumption during the first two days of AF was higher for TD and LT in comparison to MP. As expected, the sugar consumption rate increased when the *S. cerevisiae* strain was inoculated in all the winemaking conditions adopted. The wines obtained with LT showed the highest amounts of lactic acid as well as, in most of the cases, of acetic acid. Differences of phenolic composition were also revealed with higher content of flavonoids and anthocyanins, and lower content of monomers in wines produced with MP and TD. These wines showed also a higher colour intensity in most of the cases. From the sensory point of view, the descriptors mostly affected by the investigated non-*Saccharomyces* strains were 'ripe fruits' and 'floral' for the olfactory sensations, 'body' and 'sour' for the mouthfeel sensations and 'floral' for aftertaste sensations. The study provides further evidences of the impact of non-*Saccharomyces* yeasts on wine composition and their possible use for the differentiation of the Nero d'Avola style.

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POSTER

Towards faultless Grenache wines: impact of climate and maturity

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Keywords: Grenache wine, aroma composition, maturity stages, climatic influence

ABSTRACT

Climate change is affecting wine production and inducing significant variability in wine composition between vintages. These effects are often seen in altered precipitation patterns and higher temperatures during maturation, leading to a decoupling between technological and phenolic maturations, which results in delays, high sugar concentrations and aromatic defects at harvest. Such phenomena are particularly evident in Grenache, a cultivar well-represented in France and Spain within the POCTEFA Pyrenean foothills. The aim of this study was to investigate over two consecutive seasons, the impact of climate and maturity on the aroma of wines made from this cultivar.

For the main Protected Designation of Origin (PDO) areas with Grenache cultivars located in the POCTEFA region (Aragn, La Rioja, Navarra, País Vasco, Cataluña and Pyrénées-Orientales), climatic data from 1981 to 2010 were collected and used to calculate several bioclimatic variables. Data were analysed using k-means clustering to identify three homogenous climatic zones. A stratified sampling approach was employed to select 30 Grenache vineyards across Spain and France (20/10), corresponding to the three previously identified climatic zones (10/10/10). For each site, grape samples were harvested at three maturity stages: the first at a sugar concentration of 21.0 ± 2.0 °Brix (P1), the second one (P2) 12 ± 2 days after P1, and the third (P3) 12 ± 2 days after P2. These grapes were used to determine classical oenological parameters, to monitor phenolic composition according to the Cromoenos® method, to obtain a berry volatile fingerprint through SIFT-MS analysis and to produce hydrolysed mistelle – a model to predict the aroma potential of grapes by GC-MS [1]. At P1 and P2, experimental wines were produced under minivinification techniques to analyse wine aroma composition using GC-MS techniques and to perform sensory analysis.

Currently, only data from the 2024 harvest are available. The findings emphasize the importance of climate and maturity on aroma composition and enable to determine optimal climatic conditions to avoid the appearance of aromatic defects. In a future, these findings will also be useful to identify new viticultural regions, more suitable for the future production of faultless wines in a context of changing climate.

FUNDING

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POSTER

Aroma compounds and physical-chemical characterization of grapes and wines from Mount Etna "relic-jewels" vine genotypes

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Keywords: autochthonous genotypes, grapes and wines, volatile aroma compounds, physical-chemical parameter

ABSTRACT

In the last few decades, minor vine genotypes traditionally cultivated on the Mount Etna slopes, have attracted the interest of both researchers and vine growers, as they offer an interesting oenological profile. At the same time, they represent a genetic resource well adapted to the territories of origin, potentially able to face global warming. The research activity on some of these genotypes, referred to as "relic-jewels", started in the mid-2000s, and in 2022 some wineries, located on three slopes of Mount Etna, were involved in assessing their agronomic potential.

In 2024, five red-berried genotypes (Barbarossa, Madama Nera, Terribile, Moscatella Nera, Minnella Nera) and three white-berried genotypes (Bianchetta, Madama Bianca, and Virdisi), were analyzed to assess their productive and oenological performance. Additionally, five traditional varieties (Nerello Mascalese, Nerello Cappuccio, Carricante, Grillo and Insolia) commonly cultivated on Mount Etna were used as controls. At harvest, for each genotype (relic-jewels and controls), the bunch and berry morphological traits, total soluble solids (TSS), titratable acidity, pH, anthocyanin, and polyphenol content were determined. Subsequently, the grapes underwent vinification and physicochemical analyses were carried out on the resulting wines. Particular attention was also given to the volatile aroma profile of the grapes and wines as they are one of the most important intrinsic factors influencing wine quality and consumer preferences. Headspace Solid-Phase Microextraction Gas Chromatography/Mass Spectrometry (HS-SPME-GC/MS) technique was used for the volatile aroma compounds analysis as it has a high sensitivity and allows a solvent-free analyte extraction minimizing artifact formation and allowing a direct correlation between volatile composition and consumer sensory perception. Multivariate statistical approaches were used to investigate the relationship between volatile aroma compounds in grapes and their corresponding wines.

Statistically significant differences were observed among the different genotypes. The physicochemical analysis highlighted medium-high sugar contents and moderate titratable acidity, with an important phenolic profile of grapes. The analysis of volatile aroma compounds revealed a diverse and complex aromatic profile of the grapes and the obtained wines, highlighting the presence of key varietal aroma compounds that contribute to distinctive sensory attributes. These findings underscore their potential for producing high-quality wines that are well accepted by consumers.

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POSTER

Predicting oxygen consumption rate by tannins through sweep linear voltammetry and machine learning models

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Keywords: linear voltammetry, enological tannins, oxygen consumption

ABSTRACT

Nowadays, it is well known that oxygen significantly impacts wine quality. The amount of oxygen wine consumes during the winemaking process depends on several factors, such as storage conditions, the number of rackings, the materials used for aging, and the type of closure chosen for bottling. The primary substrate for oxidation is polyphenols, whose oxidation leads to the formation of quinones. These quinones, in turn, can react with numerous compounds in wine, causing changes of varying depth depending on its chemical composition (Ugliano, 2013). For this reason, tools capable of assessing the oxidative potential of wine are essential for improved winemaking management.

To address this, linear voltammetry was employed to determine the potential oxygen consumption of wine in which tannins were added. The experiment provided 43 enological tannins from three different botanical sources: oak, grapeseed, and gallnut. 500 mg/L of each tannin was added to a Corvina red wine without sulfur dioxide and with 25 mg/L of free sulfur dioxide, respectively, for a total of 86 samples. After tannins addition, the sample was saturated by handshaking up to 7,5 mg/L of oxygen. Samples were kept in an oven at 25 °C. Oxygen consumption was monitored every 24 hours, and the experiment was concluded when the samples contained less than 1 mg/L of oxygen.

The oxygen consumption data were subjected to clustering analysis, which divided the samples into two groups based on their hourly oxygen consumption rates, which have been called "Fast" and "Slow". A Kruskal-Wallis test was performed to verify that the oxygen consumption rate between the two groups was statistically different. The voltammograms of the samples were used to train machine learning models to predict whether a sample would consume oxygen at a fast or slow rate based on these initial measurements. Voltammetry is a quick, simple, and cost-effective analytical technique. However, its primary drawback lies in the interpretability of voltammograms. In studies like Ugliano et al., 2020, a convolutional analytical approach was applied to accentuate differences in voltammograms that might hold crucial interpretive information.

A single dataset was created, combining the linear voltammetry data with their first and second derivatives of themselves. A Random Forest was employed to avoid feature redundancy during training, followed by Recursive Feature Elimination (RFE) for precise feature selection. The resulting dataset was used to train a Support Vector Machine (SVM).

The SVM model achieved an overall accuracy of 94% on the test set, with mean precision and recall of 96% and 92%, respectively. The AUC-ROC score was 1.00, indicating perfect discrimination between the "Fast" and "Low" oxygen consumption classes. These results demonstrate the effectiveness of the feature selection and hyperparameter optimization approach in this context. The study highlights the potential of voltammetry, combined with advanced machine learning techniques, to provide valuable insights into the oxidative potential of wine.

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POSTER

Rationalising the impact of time, light, temperature, and oxygen on the evolution of rosé wines by means of a surface response methodology approach

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Keywords: light-strike, oxidation, thermal stress, rosé wine, stress resistance

ABSTRACT

The widespread use of flint glass bottles for rosé wines is driven by consumer preference for color as a key choice factor. However, these bottles do not offer protection to light exposure that, along with temperature and oxygen, is the key factor affecting wine evolution, making rosé wines particularly prone to rapid degradation during storage. While the impact of light-struck fault has been extensively studied in white wines, research on rosé wines remains limited.

This study aimed to evaluate the relative effects of light, temperature, and oxygen on the color and volatile composition of rosé wines, employing a Response Surface Methodology (RSM) approach. Two different wines were subjected to varying levels of oxygen (1-5 mg/L), temperature (15-40°C), light (0-4000 lux), and time (15-60 days), resulting in 31 experimental points per wine. Key variables analyzed were free and total SO_2, catechins, polyphenols, CIELAB color parameters, and 40 volatile organic compounds (VOCs), including low molecular weight sulfur compounds (LMWSCs), polyfunctional thiols (PFTs), terpenes, and norisoprenoids.

Results showed that free and total SO_2 were primarily affected by oxygen, while color parameters were influenced by light (L* and b*), temperature (b*), and oxygen (a*). LMWSCs were influenced by light, time, and temperature, with light affecting methanethiol and dimethyl disulfide, and temperature influencing dimethyl sulfide. PFTs and norisoprenoids were significantly influenced by light exposure, with TDN and vitispirane also affected by temperature, and β-damascenone by oxygen. Temperature also influenced the concentration of various terpenes, including nerol, linalool, β-myrcene, and β-pinene.

Within the experimental range studied, light exposure had the greatest impact on color, LMWSCs, PFTs, and norisoprenoids. Temperature played a key role in modulating the evolution of several volatile compounds over time, with its effect always associated with time, indicating a progressive impact throughout storage. In contrast, no interaction between light or oxygen and time was observed, suggesting that their effects were already completed before the minimum time assessed (15 days). These results provide an insight into the mechanisms involved in the evolution of rosé wines under different storage conditions.

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FLASH TALK

Consumer perception of wine bottle weight and its impact on sustainability

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Keywords: sustainability, consumer research, wine packaging, bottle weigh

ABSTRACT

In the context of sustainability, this study evaluated consumer perception regarding the impact of glass bottle weight on wine valuation. One of the key factors to address in oenology, from a more environmentally sustainable perspective and in alignment with the European Green Deal and integrated with the Sustainable Development Goals (SDGs), is the reduction of the carbon footprint [1]. Within the viticultural production process, the glass used in wine bottles is a significant contributor to CO_2 emissions [2]. Reducing the amount of glass in bottles is technologically feasible; however, the challenge lies in aligning this technological viability with consumer acceptance [3].

The research aimed to understand whether lighter bottles are associated with greater environmental benefits and how bottle weight influences consumer expectations of wine quality and price. An online survey was conducted with 232 participants, alongside an in-person tasting session involving 93 consumers.

The online questionnaire included a Likert scale to assess different statements related to sustainability and bottle weight, as well as bipolar linear scales with «Light Bottles» on one end and «Heavy Bottles» on the other [2][3]. In the in-person test, a realistic purchasing and consumption scenario was recreated by presenting consumers with an industrial-style shelf containing 80 nearly identical bottles—40 lightweight and 40 heavier. Their selections were analysed based on purchase intention, perceived price, and wine quality.

The results indicate that while consumers do not directly associate a lower glass weight with greater sustainability, heavier bottles are generally perceived as indicative of higher quality and price. Consumers were mostly «neither agree nor disagree» or only «somewhat agree» when asked whether lighter bottles were associated with greater sustainability, a higher environmental contribution, or the requirement for eco-labelling. A slight positive correlation was found between heavier bottles and the perception of more expensive, higher-quality wines. However, the in-person test revealed that these perceptions did not significantly influence purchase decisions or hedonic evaluations of the wine.

Overall, consumer perception of lighter wine bottles in relation to sustainability remains ambivalent. While heavier bottles are seen as a marker of premium wines, this perception does not necessarily translate into purchasing behaviour. The acceptance of lighter bottles may require additional marketing and communication strategies to help shift consumer attitudes and align perceptions with sustainable practices in the wine industry.

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POSTER

Sensory analysis in oenology: the role of methodological differences in expert panel evaluations

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Keywords: sensory analysis, wine quality assessment, tasting panels, methodological standardization

ABSTRACT

Sensory analysis is an essential component of oenology, offering valuable insights into wine quality that influence decision-making in viticulture and winemaking. Its ability to detect and assess organoleptic characteristics is directly linked to the expertise of the professionals performing the analysis. However, the lack of a universally accepted standard for descriptors, scales, and thresholds presents a challenge for the comparison and interpretation of sensory data across different contexts [1].

A comprehensive understanding of the methodological variations in sensory analysis is crucial for moving toward a more unified system of evaluation. By coordinating sensory tests across different expert panels, it is possible to evaluate their performance, refine techniques, and ultimately increase the reliability and consistency of sensory data [2]. Such an approach not only improves the accuracy of wine evaluations but also enhances quality control. and consequently, the validity of results and issued reports.

To explore these differences, a network of thirteen expert panels in Spain, each comprising between 6 and 15 tasters, participated in sensory evaluations of wine samples using three distinct but commonly applied methods [3] [4]. These methods, grounded in established interlaboratory sensory exercises, were tested over three separate sessions throughout 2024. The objective was to investigate the impact of methodological differences on the results and assess how these variations might influence the consistency of wine evaluation across panels.

The results revealed notable discrepancies in the application of intensity scales and defect identification. While panels generally agreed on the detection of common wine faults, the concentration levels at which these defects were identified varied significantly. Additionally, while there was some consistency in recognizing specific aromatic families, the identification of individual aromas was much more variable across panels. These findings highlight the inherent challenges in sensory analysis and the importance of standardizing evaluation criteria to ensure comparability and enhance the reliability of wine assessments.

The study underscores the need for a more cohesive approach in sensory oenology. Standardized descriptors, scales, and thresholds would not only improve the consistency of sensory data but also support quality assurance measures and foster greater confidence among consumers and industry stakeholders alike.

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FLASH TALK

An alternative for reducing calcium in wine and lowering the risk of insoluble salt formation

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Keywords: calcium, tartrate, stability, alginic acid

ABSTRACT

Wine minerals, including calcium, derive mainly from grape berry extraction, but they could also arise from winemaking additives, processing aids, and other sources [1]. Wine calcium concentration can vary widely (7-310 mg/L [1]), and contents above 60 mg/L for reds and 70-80 mg/L for whites and rose have been linked with elevated risk of calcium tartrate instability [2-3]. The formation of calcium tartrate does not respond to treatments involving low temperatures [1,3], and traditional protective colloids have been found to be either ineffective or to produce inconsistent results [4-5]. Instead, recent research on algae-derived polysaccharides suggests that they should be further studied as potentially effective solutions for calcium tartrate instability [5-6]. In this study, the use of alginic acid sodium salt is proposed as an aid capable of partially removing calcium from wines, thus reducing the risks of calcium tartrate precipitation. So far, alginates have been studied as immobilization matrices for yeast or bacteria during wine production [7-8], but no studies appear to have evaluated sodium alginate for tartrate stability. Therefore, the dose of alginate, contact time, and wine pH were preliminary tested, followed by a series of trials in which white, rosé, and red wines were treated under the optimized conditions. Calcium content was analyzed colorimetrically and with atomic absorption spectroscopy [9], tartrate stability was checked with the method of Abguéguen and Boulton [10], and the wine's general composition (*e.g.*, pH, tartaric acid, free SO_2, phenolics, etc.) was characterized with various methods. Depending on the treatment conditions used, calcium concentration reductions ranging from 5 and 25% were observed, leading to enhanced calcium tartrate stability in the samples with the greatest calcium removal, while other compositional parameters analyzed remain constant or showed small variations. The study confirms that this approach effectively reduces calcium levels and potentially minimizes the formation of insoluble salts in wine.

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POSTER

Sensory changes in wines associated with the ripening of Grenache grapes from vineyards in different climatic zones

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Keywords: *Vitis vinifera* L. cv Grenache, maturity, climate change, sensory analysis

ABSTRACT

Climate change is introducing a high variability on grape ripening, causing uncertainty, excessive spending on pesticides and eventually frustrating results in terms of the quality of the vintage, with the increasingly frequent appearance of aromatic problems associated with overripeness, raisining and greenness, which sometimes only appear in bottled wines. These effects are particularly evident in Grenache, a variety widely grown in France and Spain. This study aimed to explore the effects of climate and maturity on the sensory characteristics of wines made from Grenache over two consecutive harvests of the Pyrenean foothills.

Firstly, historical climatic data (1981 – 2010) were gathered to calculate various bioclimatic variables. The data was analysed using k-means clustering to identify three distinct climatic areas. Then, 28 Grenache vineyards (20 from Spain and 8 from France) were selected, ensuring representation across the three identified climatic zones. At each vineyard, grape samples were collected at two maturation stages: the first when sugar concentration reached 21.0 ± 2.0 °Brix (P1), and the second 10-14 days later (P2). Microvinification of the collected grapes followed the same fermentation protocol. To explore the sensory space of the wines, two Sorting Tasks were carried out, one per ripening. MultiDimensional Scaling (MDS), Agglomerative Hierarchical Clustering (AHC) and Corresponding Analysis (CA) were used to manage the sensory data. The most different wines were selected to carry out a Descriptive Analysis (DA). In order to interpretate sensory data, analysis aroma compounds in wine were carried out. The preliminary results of year 2024 indicate that wines from grapes from different climatic zones evolve differently with ripening. Descriptors with vegetal and oxidative notes are found in the cooler climatic zones, specially at point 1. This could be related to a lack of phenolic maturity and an increase in oxidation-linked compounds such as aldehydes, as previously described in the literature [1]. Whereas more fruity and overripe aromas are found in warmer areas. These attributes have been found in all climate zones at maturity point 2. The outcomes of this research will highlight the influence of climate and maturity on wine aroma composition, help determinate the ideal climatic conditions and create tools to mitigate the effects of climate change.

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POSTER

The economic impact of drones on viticultural processes

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Keywords: climate change, winegrowers, drones, precision agriculture

ABSTRACT

Nowadays there are many challenges facing both winegrowers and workers, in other agricultural practices, related to the growing demand for food products, the safety and quality of these products, and the preservation of the environment… [1]. In addition to these concerns, it is also possible to notice the occurrence of climate change, where temperatures have risen, rainfall has become more irregular, atmospheric CO_2 has increased, leading to soil degradation and desertification [2]. In case the negative impact of climate change is not properly mitigated, crop productivity and berry quality are affected, vine growth stages are prejudiced, leading to greater fragility in the plant, enhancing the occurrence of pests and diseases. Consequently, technologies began to emerge, in order to enable grape producers to continue with their practices while dealing with climate change, without harming the environment and well managing the rise in production costs. Precision agriculture thus emerged as the answer to optimizing processes, assisting in making them faster, cutting production costs and reducing input waste, to decrease the environmental impact of agricultural practices [3]. Therefore, drones (unmanned aerial vehicles) are playing an important role in precision agriculture, starting to become essential for decision support in viticulture processes. Specifically, in the processes of monitoring irrigation and controlling pests and diseases. This study aimed to assess the economic effectiveness of drones in these processes, to quantify the costs of incorporating drones in them. In order to carry out this research, flowcharts were used to design the two processes, allocating costs to each stage of the process. For the analysis, the costs of each process were compared without and with the inclusion of these technologies. In conclusion, we seek to show winegrowers the economic impact that the use of drones can have when inserted into grape growing processes. This could lead to greater adherence to these technologies, contributing to the adaptation of producers to the innovations that lead to the development of the wine sector

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POSTER

Oenological potential of cv. Tortojona: A minority grape variety from Extremadura, southwest Spain

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Keywords: rosé wine, red wine, polyphenol, anthocyanin, tannin

ABSTRACT

This work, included in the VAVEGEX project, aims to evaluate the oenological, phenolic, chromatic and sensory characteristics of the grapes, must and wines produced from cv. Tortojona, minority variety grown in Extremadura region (Southwest, Spain). For this purpose, in 2024 season, four types of wines were performed following the traditional methods: (i) red wine, spontaneous fermentation (RWE); (ii) red wine, inoculation with Saccharomyces cerevisiae (RWSC); (iii) red wine, co-inoculation (mixed culture of *Saccharomyces cerevisiae* and *Torulaspora delbrueckii* (RWMix) and (iv) rosé wines (PWMix), inoculation with the mixed culture. Total polyphenol and anthocyanin (TPG, TAntG) were determined in grapes and additionally, in the must, total soluble solids (TSS) and yeast assimilable nitrogen (YAN). pH, titratable acidity (TA) and tartaric and malic acid (TAR, MAL) were analyzed in must and wines [1,2]. The characterization of wines included the determination of alcoholic strength (AS), volatile acidity, dry extract, total polyphenols, anthocyanins, catechins, tannins, and co-pigmented anthocyanins (TPP, Ant, Cat, Tan, and %C-Ant) and color intensity (CI) and hue [1,2]. When TSS of cv. Tortojona grapes reached 24.2 ºBrix, (typical harvest criterion for this region), YAN, TAR and MAL values reached 252.2 mg/L, 4.25 and 2.6 g/L respectively. These values are suitable for the production of both red and rosé wines. However, the pH (3.8) exceeded the optimal range (3.4–3.6), and the TPG (<1000 mg/L) and TAntG)(<150 mg/L) were lower than that observed in other cultivars grown in the area [1]. The AS values were from 12.9 (RWSC) to 13.7 %v/v (RWMix and PWMix) and the volatile acidity was <0.3 g acetic/L in all cases. In red wines, the mean values of TPP, Ant, Cat, and Tan for red wines were 1280, 194, 573, and 1308 mg/L, respectively. In general, these values are lower than those observed in wines produced from other widely cultivated grape varieties and, in consequence the IC values were low. All of the red wines received a positive evaluation from the judges, the most appreciated was RWMix for the highest intensity and aromatic complexity. The values of phenolic parameters or rosé monovarietal cv. Tortojona wine were characteristics of this type of wine [2]. It was highly appreciated by the judges for their colour and particularly by the complexity of their aromas. They identified certain aromatic descriptors characteristic and very appreciated in rosé wines as raspberry strawberry. The results of this research are very promising for the wine industry in Extremadura and further studies are needed to validate these findings.

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POSTER

Development of an analytical method for the quantification of compounds responsible for the green character of wines: influence of ripeness on their levels

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Keywords: gas chromatography, carbonyl compounds, green character, ripeness

ABSTRACT

Red wines can sometimes exhibit undesirable green, herbaceous, and vegetative aromas, negatively impacting their sensory profile and consumer acceptance. While certain grape varieties, such as Cabernet Sauvignon, are known for their green pepper notes due to the presence of pyrazines, these aromas are increasingly appearing in non-pyrazinic grape varieties with each vintage. This phenomenon may be linked to climate change and winemaking decisions aimed at avoiding excessively high alcohol levels. Beyond pyrazines, some studies have associated these green notes with the presence of specific carbonyl compounds [1, 2]. Traditionally, due to their poor chromatographic and spectrometric properties, these compounds have been analyzed using derivatizing agents [3], which require tedious analytical procedures. Furthermore, these methods shorten the operational lifetime of chromatographic columns. To address this, the objective of this work was to develop an analytical method to quantify carbonyl compounds while avoiding any derivatization steps. The proposed method includes a first extraction step using solid-phase extraction (SPE) prior to injection into a two-dimensional gas chromatographic system coupled with a mass spectrometer. Two different strategies for extracting the compounds were studied: deposition of 100 µL into Tenax tubes or the use of stir bar sorptive extraction (SBSE). Several parameters have been optimized, including breakthrough volume, elution conditions, solvent purge with Tenax tubes, and extraction conditions with SBSE. Good repeatability values, around 10% relative standard deviation, were found with both strategies. However, the repeatability worsened with the repeated use of the same Tenax tubes. This issue, along with the fact that better detection limits were achieved with SBSE, led to the decision to analyze real wine samples exclusively with this last strategy. Several wines made from the same grapes harvested at different ripeness levels were analyzed to study the evolution of carbonyl compounds with ripeness.

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POSTER

Evaluating the effectiveness of alginic acid, sodium carboxymethylcellulose, and potassium polyaspartate in preventing calcium tartrate instability in wines

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Keywords: wine, tartaric instability, calcium tartrate instability, alginic acid

ABSTRACT

Calcium-induced instabilities present a major challenge in bottled wines, with calcium tartrate (CaT) precipitation becoming increasingly common due to rising calcium levels in grape must, largely driven by climate change. Although CaT is an insoluble salt, its instability— although less frequent than potassium hydrogen tartrate (KHT) precipitation—is more difficult to predict and control, as it develops gradually over time [1]. Spontaneous nucleation of CaT takes significantly longer than that of KHT, resulting in delayed precipitation, often occurring years after aging and typically post-bottling [2,3]. CaT instability occurs when ion concentrations exceed the solubility threshold, resulting in crystal formation. Unlike KHT, CaT precipitation is minimally affected by temperature, making cold stabilization ineffective [4]. Various additives, such as metatartaric acid and carboxymethylcellulose (CMC), have been used to mitigate this problem. However, the long-term effectiveness of metatartaric acid is limited due to hydrolysis [5]. In addition, potassium polyaspartate (KPA), commonly used as a KHT stabilizer, has been suggested to potentially reduce CaT stability in some cases. Given the need for effective and sustainable stabilization methods, research into alternative tartrate stabilizers is essential. Alginic acid, an approved processing aid in winemaking, represents a promising alternative to CMC and metatartaric acid due to its strong negative charge and ability to bind calcium ions. Already approved by the OIV [5], for wine clarification with no restrictions on use, alginic acid represents a clean-label solution for CaT stabilization. This study aim to evaluate the efficacy of alginic acid as a CaT stabilizer compared to CMC and to assess the effect of KPA on CaT instability. The stability of CaT was evaluated using the method described by Abguéguen and Boulton [1]. The degree of CaT instability in wine was determined according to Triulzi et al. [6] based on the decrease in calcium concentration after the addition of micronized calcium tartrate. The results showed that KPA did not increase CaT instability and, in some cases, even enhanced stability. Alginic acid demonstrated superior performance over both CMC and KPA, likely due to its higher zeta potential and stronger calcium ion complexation capacity. While these findings are highly promising, they primarily reflect short-term stabilization effects, highlighting the need for further long-term studies.

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FLASH TALK

Market analysis of Chilean Pinot noir, Carménère, and Cabernet-Sauvignon wines: A comparative study of chemical parameters across low, medium, and high price segments

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Keywords: phenolic composition, polysaccharide fractions, anthocyanins, color intensity

ABSTRACT

Wine quality is a complex concept determined by multiple factors, including vineyard management, winemaking operations, and the sensory perception of key attributes. Phenolic compounds and polysaccharides play a fundamental role in the expression of these attributes, as they directly influence characteristics such as color, flavor, and texture [1, 2]. In this context, recent studies have focused on the identification and quantification of these compounds to establish relations between chemical analyses and sensory perceptions, in an approach to quality concept. This approach helps expand the understanding of wine commercial categories in the Chilean market, such as varietal (young), reserve, and gran reserve, by providing a general profile of the composition of the country's main red wine varieties.

This research aimed to quantify the phenolic and polysaccharide composition of Chilean Pinot Noir, Carménère and Cabernet Sauvignon wines from three different commercial price segments. A total of 45 wines (15 per variety) were analysed, assessing pH, titratable acidity, total phenols, tannins, anthocyanins, color intensity, hue, anthocyanin profile (according to OIV protocols [3]), and the total content of polysaccharide fractions from different mass by using HPLC-IR [4].

Overall, differences in the concentration of these compounds were observed across the commercial price segments for all varieties. In Carménère, higher-priced wines showed the highest values for color intensity and total polysaccharide concentration. In Cabernet Sauvignon, higher concentrations of phenols and total tannins were observed as commercial price increased, whereas in Pinot Noir, the trend was completely opposite.

FUNDING

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