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**Sustainability of wine production
and food systems in the
Mediterranean region**

ABSTRACT BOOK



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and food systems in the
Mediterranean region**

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Presentation

The Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development aim to complement policy with scientific knowledge and orient government strategies toward a new development paradigm that improves the well-being of future generations while ensuring the sustainable management of the planet's natural resources. All this is even more important if viewed in the context of food systems, whose sustainability is paramount for sustainable development.

Food sustainability for humans involves the ability, sustained over time, to produce or procure enough food to meet an individual's or a population's nutritional requirements, using production, distribution, and disposal systems that have a neutral or beneficial impact on the environment and ecosystems, and that ideally are underpinned by forms of social justice that can ensure equitable access to food.

In this congress, we will discuss some of those variables and discuss the interrelationships and interactions between them through our application of a multidisciplinary lens on human food (including wine) and sustainability in the Mediterranean region. The scientific program will be divided in the following 4 sections:

1. Sustainable Viticulture & Winemaking Practices
2. Sustainable Food Systems & the Mediterranean Diet
3. Sustainable Wine Tourism & Mediterranean Gastronomy
4. Sustainable Mediterranean diet: the interaction between food industry and tourism, nutrition, health, and the environment



Paula Cristina Paulo Videira da Silva

President of Science & Wine 2023

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Invited Speakers

(In alphabetical order)



Exploring winery by-products as a novel resource in the fight against antibiotic resistance



Ana Novo Barros

Centre for the Research and Technology of Agro-Environmental and Biological Sciences, University of Trás-os-Montes and Alto Douro (CITAB)/ Institute for Innovation, Capacity Building and Sustainability of Agri-Food Production (Inov4Agro), 5000-801 Vila Real, Portugal

abarros@utad.pt

In the ongoing fight against antibiotic resistance, a growing concern among healthcare professionals and researchers, there is a need to explore innovative strategies. One promising avenue that has gained attention is the revitalization of winery by-products. These remnants of the winemaking process, which are often discarded or underutilized, possess the potential to contribute significantly to the battle against antibiotic resistance. By harnessing the power of winery by-products, we can not only address the environmental challenges associated with their disposal but also tap into a rich source of natural compounds with antimicrobial properties. Revitalizing winery by-products presents a promising opportunity in the fight against antibiotic resistance. By harnessing the natural compounds within these by-products, we can unlock their antimicrobial potential and develop alternative treatment options. This approach not only contributes to environmental sustainability but also offers economic opportunities for wineries. Through collaboration and innovation, we can embrace winery by-products as a valuable resource, paving the way for a future where antibiotic resistance is effectively addressed while supporting the growth of the wine industry.



A new life of micronutrients from the Mediterranean diet in health: polyphenols from grape wine / omega-3 fatty acids association and red wine extract to counteract ocular degenerative diseases



Dominique Delmas^{1,2,3}

¹Université de Bourgogne Franche-Comté, 21000 Dijon, France

²INSERM Research Center U1231- Cancer and Adaptive Immune Response Team, Bioactive Molecules and Health Research Group, 21000 Dijon, France

³Centre Anticancéreux Georges François Leclerc Center, 21000 Dijon, France

dominique.delmas@u-bourgogne.fr

A More recently, studies have shown that polyphenols could also prevent or improve vision in patients with ocular diseases and especially Age-related macular degeneration (AMD) which is an eye disease characterized by damage to the central part of the retina, the macula, and that affects millions of people worldwide. Despite therapeutic advances thanks to the use of anti-vascular endothelial growth factor (VEGF), many resistance mechanisms have been found to accentuate the visual deficit. In the present study, we explored whether a supplementation based on Mediterranean diet associating polyphenols from red wine and omega-3 fatty acids was able to counteract laser-induced choroidal neovascularization (CNV) in mice and molecular mechanism involved in neovascularization of AMD. We highlight that the formulation, Resvega®, composed of DHA/EPA and resveratrol, significantly reduced CNV in mice and a proteomic approach confirmed that Resvega® could counteract the progression of AMD through a pleiotropic effect targeting key regulators of neoangiogenesis in retina cells in vivo. These events were associated with an accumulation of resveratrol metabolites within the retina. A molecular analysis revealed that Resvega®, inhibited VEGF-A secretion in vitro by disrupting the dissociation of the VEGF-R2/Cav-1 complex into rafts and subsequently preventing MAPK activation and inhibits the phosphorylation of the inhibitor of NFκB, IκB, which can bound NFκB dimers and sequester them in the cytoplasm. Moreover, DNA ChIP analysis reveals that this combination prevents the interaction between AP-1 and vegf-a and vegf-r2 gene promoters. Very interestingly, we highlight that Resvega® could prolong the anti-angiogenic effect of Avastin®, which is an anti-VEGF agent typically used in clinical practice. Furthermore, recent results have shown that a mixture of red wine extract present same effects to counteract the over secretion of VEGF in human retina cells. Therefore, a supplementation of omega-3/resveratrol or with red wine extract could improve the management or slow the



progression of AMD in patients with this condition.

This work was supported by grants from the ANRT N°2016/0003, by a French Government grant managed by the French National Research Agency under the program "Investissements d'Avenir", reference ANR-11-LABX-0021, the Conseil Régional Bourgogne, Franche-Comte (PARI grant) and the FEDER (European Funding for Regional Economic Development) and the Bureau Interprofessionnel des Vins de Bourgogne (BIVB).the Mediterranean diet is rich in fruits, legumes and vegetables that are major sources of flavonoids and other phytochemicals and lack the risks of alcohol. All these aspects will be carefully examined in this lecture.

How do visitors experience Portuguese wine routes? Lessons for more appealing and sustainable wine route development



Elisabeth Kastenholz

University of Aveiro- DEGEIT, Department of Economics, Management, Industrial Engineering and Tourism; Research Unit GOVCOPP (Governance, Competitiveness and Public Policies)

elisabethk@ua.pt

Wine regions increasingly attract visitors for a diversity of reasons, with studies worldwide revealing a growing interest in wine and terroir experiences (Hall et al, 2000). Portugal has been increasingly recognized as a country with high quality wines, being however still not well-known as a wine tourism destination. To enhance its appeal, wine tourism businesses and destinations, sometimes developed along routes, need to better understand visitors' motivations, travel context, experiences lived at the destination, to increase their success as well as sustainability through well-designed experience products (Kastenholz & Lane, 2021). After a brief conceptualization of the wine tourist experience, this communication presents survey results from the research project TWINE, undertaken in three Portuguese wine routes (Bairrada, Dão and Beira Interior), between 2018 and 2022 (N=1591). Results permit an assessment of the visitor profile, the nature and dimensionality of visitor experiences, considering Pine & Gilmore's experience realms adapted to the wine tourism context, visitors' wine involvement and patterns of interaction with staff, residents, and other visitors, as well as their satisfaction and, importantly, their loyalty to the visited destination and respective wines and local products. Since the latter is most relevant to economically and culturally sustainable destination development, a multiple regression analysis is applied to identify the determinants of destination and product loyalty (dependent variable), based on the previously mentioned independent variables (experience dimensions, wine involvement and interaction patterns). Results are finally discussed as potential input to more successful and sustainable wine route development.

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The water status of the vine as an indicator of the evolution of the quality of the grapes in a context of climate change



Sébastien Nicolas^{1,3}, Benjamin Bois^{2,3}, Mourad Harir⁴, Marianna Lucio⁴, Roy Urvieta⁵, Fernando Buscema⁵, Olivier Mathieu², Anne-Lise Santoni², Philippe Schmitt-kopplin³, **Régis D. Gougeon**^{1,3}

¹UMR Procédés Alimentaires et Microbiologiques, PAM UMR A 02.102, Université Bourgogne Franche-Comté, AgroSup Dijon, 6, Bd Gabriel, 21000 Dijon, France
²UMR Biogeosciences, Université Bourgogne Franche-Comté / CNRS, 6, Bd Gabriel, 21000 Dijon, France

³Institut Universitaire de la Vigne et du Vin – Jules Guyot, Université Bourgogne Franche-Comté, rue Claude Ladrey, 21000 Dijon, France

⁴Research Unit Analytical BioGeoChemistry, Helmholtz Zentrum München, Ingolstaedter Landstrasse 1, 85764 Neuherberg, Germany

⁵Catena Institute of Wine, Bodega Catena Zapata, Mendoza, Argentina

regis.gougeon@u-bourgogne.fr

The water status of the vine has been widely explored, as it strongly affects the physiology of the vine and the metabolic composition of the grape. Many studies have focused on its impact either on the physiological characteristics of the vine, or on the concentration in major metabolites of the berries, or on the quality of the wine as well. In this study, the hydric status of the vine was evaluated by isotopic discrimination of carbon, on juices of berries of *Vitis vinifera* cv. Pinot noir (PN) and Chardonnay (CH), during 3 vintages (2019, 2020 & 2021). A total of 220 samples were taken from 5 wine-growing countries around the world. The same grape juices were analysed by Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) leading to the detection of thousands of elemental compositions. Multivariate statistical analyses revealed hundreds of elemental compositions significantly related to observed gradients in water status. Abscisic acid (ABA) and various derivatives are examples of chemical markers, which are part of complex fingerprints, whatever the variety. These results provide an unprecedented representation of the grape juice chemical diversity related to the vine water status. They could contribute to a better knowledge of the mitigation strategy of the vine in a context of climate change.



General Presentation of the Manual of Sustainability in the Douro Wine Region



Jorge Queiroz¹, Joaquim Esteves-da-Silva², Teresa Mota¹, Conceição Santos³

¹GreenUPorto – Sustainable Agrifood Production Research Centre / Inov4Agro, DGAOT, Faculty of Sciences of University of Porto, Campus de Vairão, Rua da Agrária, 747, 4485-646 Vairão, Portugal

²Chemistry Research Unit (CIQUP), Institute of Molecular Sciences (IMS), Department of Geosciences, Environment and Territorial Planning, Faculty of Sciences, University of Porto, Rua do Campo Alegre s/n, 4169-007 Porto, Portugal

³IB2 Lab, Department of Biology & LAQV/REQUIMTE, Faculty of Sciences, Rua do Campo, Alegre, University of Porto, 4169-007 Porto, Portugal

jqueiroz@fc.up.pt

The Demarcated Douro Region (DDR) with a total area of 250.000 ha of which 43.845 ha planted with vines, was responsible for the sale of EUR 623.4 million (IVDP, 2022). With centuries-old viticulture, the Douro is the oldest Demarcated and Regulated Region in the world, (1756, Marquês de Pombal). Considering that grape and wine production in the Demarcated Douro Region has to adapt to climate change (with dramatic effects on the 2022 vegetative cycle), the Douro is a region that is almost totally dependent on the viticulture sector, that has the responsibility of a "Cultural Heritage of Humanity" classification by UNESCO, has a winegrowing industry that was sustainable over centuries, it became necessary to create a document, based on scientific and technical knowledge, that would enable each player in the region (winegrower, viticulturist or winemaker) to assess their degree of sustainability in the region's production chain. Based on these assumptions, the IVDP decided, in collaboration with the Faculty of Science of the University of Porto, to draw up a "Manual de Sustentabilidade da Região do Douro Vinhateiro" (Winegrowing Douro Region Sustainability Manual) that would be adequate to the unique characteristics of the region. The "Manual", which is presented, was produced by a multidisciplinary team from the University of Porto in collaboration with the IVDP. Two Focus Groups were set up for discussion, made up of members of Independent Institutions and Entities in the Vitiviniculture Sector and members of Business Associations in the DDR. In its elaboration the following factors were taken into account: (a) most of the ancestral vitiviniculture practices in the DDR are sustainable; (b) the development of the DDR has to go through strategies aligned with the United Nations Sustainable Development Goals (UN-SDGs), and with the European Ecological Pact; (c) be aligned with OIV-CST Resolutions 518-2016 (General principles of sustainable viticulture) and OIV-VITI 641-2020 (Guide for the implementation of the principles of sustainable viticulture) (d) the Manual has to be based on existing scientific technical knowledge. In this way, a Manual was prepared in an educational manner to enable economic operators in the DDR to assess their current level of sustainability, as well as to acquire knowledge that will enable them to increase their sustainability, always taking into account the specific characteristics of the Demarcated Douro Region.



Climate change and the challenges of a rapid ecological transitions of Mediterranean agriculture

Riccardo Valentini

University of Tuscia, Viterbo, Italy

rik@unitus.it



The increasing population, food consumption and greenhouse gas emissions are pushing our planet through a transformation never experienced before. By 2050 more than 9 billion of people will be in search of food and most of them (80%) will be living in Mega-Cities. The food supply chain must be completely reinvented since new urban poors will be exposed to food scarcity and accessibility. At the same time in some regions of the world (i.e., tropics and part of temperate regions) increasing of climate extremes will produce adverse effects on agriculture, forestry, and fisheries sectors with yield reduction of 35% in African countries and 2% globally per decade, despite the increasing food demand. It is time to act urgent and fast pushing high level governmental agenda (SDGs, Climate Paris agreement) as well as food industry sector and citizens in the most difficult and challenging transformation of our society to feed the new 2 billion of people expected by 2050 and at same time stabilize climate below 2.0° (possibly 1.5°) and reducing the pressures on natural resources. Agriculture should become an important element of climate mitigation and adaptation strategies. Carbon stored in agriculture soil is an important value which should be reflected in monetary and non-monetary values. Protection and conservation of carbon stocks is more important than carbon emissions. On the other hand, Mediterranean is at the centre of an unprecedented climate change. Currently, the average terrestrial temperature of the region has exceeded 1.5 ° C, intensifying on one hand extremes of summer heat and drought and the other increasing the temperature of the Mediterranean Sea and the dynamics of extra-tropical cyclones, including early frost events and excess of hydrological extremes. In this context, the climatic scenarios foresee already in 2030, the exceeding of the 2 ° C threshold in the Mediterranean and therefore an intensification of the climatic risks. How the Mediterranean food system from farm to fork will adapt to the new scenarios? What systemic and/or technological solutions should we put in place to increase our resilience? What the role of innovation and science in this transition? These questions will be analysed and links with the current European Agricultural policies will be highlighted.



Dietary Bioactives including Polyphenols and Cardiometabolic Risk: Rethinking Wine Beyond Alcohol...

Sumantra Ray

NNEdPro Founding Chair and Executive Director
University affiliations: University of Cambridge | Ulster University | Imperial College London | University of Wollongong



s.ray@nnedpro.org.uk

Beverages such as wine are often thought of synonymously with the Mediterranean Diet. However, the seven emblematic regions of this diet and lifestyle pattern also includes countries such as the Kingdom of Morocco which enjoys the dietary bioactives and potential health benefits associated with the Mediterranean Diet in the absence of alcohol consumption. One of the common denominators between beverages such as wine and other aspects of cardioprotective diets are bioactive compounds and 'phytoprotectants' such as polyphenols which are abundantly found in not only grapes but a variety of fruit, vegetables, and related foods. Over the past two decades the science underpinning the measurement of blood vessel function and cardiometabolic risk relating to dietary bioactives has developed significantly and can be combined with a multilevel approach to research linking polyphenol consumption to human health outcomes. We present research models which can be applied to the field of science and wine looking beyond alcohol.





Oral Communications

VINE AND WINE SUSTAINABILITY IN A COOPERATIVE ECOSYSTEM - COOPERATIVE MEMBERS' RESPONSE TO CHALLENGES IN THE WINE GLOBAL MARKET

Agostinha G.S. Marques^{1,2}, Carlos A. Teixeira¹, Mariana Guerra¹, Francisco Pinheiro¹

¹Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB)/Institute for Innovation, Capacity Building and Sustainability of Agri-Food Production (Inov4Agro), University of Trás-os-Montes and Alto Douro (UTAD), 5000-801 Vila Real, Portugal

²Adega Cooperativa de Favaíós, CRL, Lugar de Pousados, 5070-265 Favaíós, Portugal
agostinhamarques@adegadefavaios.com.pt

Sustainability and the efficient use of environmental, social, and economic resources are increasingly important for the world of wine consumers. This can be seen clearly in the way in which foreign markets privilege products produced according to sustainability indicators. The search for sustainable products has created the need in wine organizations to develop indicators aimed at the efficient use of water, mode of production, use of phytopharmaceuticals, energy efficiency in the vineyard and winery, encouraging clean energy to the detriment of fossil fuels, waste management, impact on the community, the well-being of the employees... (1). This led to the emergence of several models of Sustainable certification in viticulture. The diversity of certifications created some confusion among consumers, as they were not informed and were unable to interpret the label (2). So, some markets created a set of rules, where these indicators fit with more or less importance, such as the SystemBolarget created in Sweden (3). To regularize the sector in 2020, the OIV (International Organization of Vine and Wine) worked on a guide for the implementation of Sustainability principles in viticulture (4). The sustainable certification that emerged later use the OIV guidelines in this document as a base. Diversification of certifications, guidelines and market directives leave the producer wondering which indicators are essential to understand their company's level of sustainability and respond to market demands (5).



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EFFECT OF THE GRAPE CULTIVAR ON THE CONDENSED TANNINS IN SEEDS POWDER, A RENEWABLE RESOURCE FOR PROTEIN HAZE PREVENTION IN WINE

Aakriti Darnal^{1,2}, Edoardo Longo^{1,2}, Milena Lambri³, Vakare Merkytė^{1,2}, Elia Romanini³, Emanuele Boselli^{1,2}

¹Oenolab, NOI TechPark Alto Adige/Südtirol, Via A. Volta 13B, 39100 Bolzano, Italy

²Faculty of Agricultural, Environmental and Food Sciences, Free University of Bozen-Bolzano, Piazza Università 5, 39100 Bolzano, Italy

³Department for Sustainable Food Process (DiSTAS), Università Cattolica del Sacro Cuore, DiSTAS, via Emilia Parmense 84, 29122 Piacenza (Italy)

aakriti.darnal@student.unibz.it

Grape seed powders (GSP) have demonstrated the ability of preventing protein instability in wine by pre-emptive precipitation. Condensed tannins, an important component of grape seeds, are well-known protein binders, and allow this powder to be used for protein stabilization. This ability of GSP is usually enhanced by roasting treatment, which causes the heavier fractions to be broken down into smaller oligomers. We present the characterization of extractable condensed tannins in grape seed powders according to the degree of polymerization (DP from 2 to 10) for seeds of the cultivars Sangiovese, Croatina, and Ortrugo. Roasting of the seeds caused higher abundances of almost all DP, despite the overall effect was cultivar dependent. Grape seed powder from the grape cultivars Croatina and Sangiovese showed increasing condensed tannins for almost all DP upon roasting. The white cultivar Ortrugo did not show clear effects upon roasting.



THE TEMPORALITY OF PORT WINES SENSATIONS WHEN TASTING PORTS AND CHOCOLATES TOGETHER

Alice Vilela¹, Maria Gabriela Santos², Gonçalo Rijo³, Elisete Correia⁴

¹Chemistry Research Centre (CQ-VR), Dep. of Agronomy (DAgro), School of Agrarian and Veterinary Sciences (ECAV), University of Trás-os-Montes e Alto Douro, 5001-801 Vila Real, Portugal

²University of Trás-os-Montes and Alto Douro, Apt. 1013, 5001-801 Vila Real, Portugal

³Neoception, Unipessoal, Lda. Vila Real, Portugal

⁴Center for Computational and Stochastic Mathematics (CEMAT), Dep. of Mathematics, University of Trás-os-Montes and Alto Douro, Apt. 1013, 5001-801 Vila Real, Portugal

avimoura@utad.pt

This study aimed to evaluate, through Quantitative Descriptive Analysis (ADQ) and Temporal Dominance of Sensations (TDS), the impact that different chocolates have on the sensory perception of assorted styles of Port wines. The panel of tasters was composed of twelve expert tasters who performed the sensory analysis of three Port wines (white reserve Port, 20-year-old Tawny Port, and LBV 2015 Port wine) before and after tasting the chocolates (chocolate with salt flower, chocolate with almonds and cranberries and 70% cocoa chocolate) by two different methods – ADQ and TDS. The ADQ method provides a complete description of the expressions used as the samples' sensory properties. The TDS method makes it possible to evaluate the progress of sensory perceptions that were more dominant during a given moment of the tasting, for each type of wine and chocolate. The results obtained by the ADQ method showed that chocolate had significant effects on the flavour of some of the wines, namely on the bitterness, alcohol, floral, and honey attributes. The results obtained by the temporal method showed that the Temporal Dominance of Sensations (TDS) method was sensitive to assessing the impact that different chocolates have on the sensory perception of Port wines.

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APPLICATION OF NONTHERMAL HIGH PRESSURE PROCESSING TO ACCELERATE THE MACERATION PROCESS IN RED WINE

Natacha Barreto¹, Álvaro Tomaz Lemos², Carlos Alberto Cruz Pinto², Carlos Manuel Pereira Rodrigues¹, Jorge Manuel Alexandre Saraiva²

¹Magnum- Carlos Lucas Vinhos, Lda. Quinta do Ribeiro Santo, Avenida Estádio Pina Ferraz 3430-038, Carregal do Sal, Portugal

²LAQV-REQUIMTE, Chemistry Department, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

alvarotomaz@ua.pt

High-pressure processing (HPP) is gaining a significant interest in the food industry as a nonthermal food pasteurization method. Apart from pasteurization, HPP has other applications as well. Recently, the International Organization of Vine and Wine (OIV) approved the use of HPP in white wine to reduce the use of sulphites in white wines, and to accelerate the maceration process in red wines. In the present study, red wine must (45 L) was subjected to HPP at 4000 bar for 10 minutes at 10 °C before maceration, to improve the extraction of compounds from the grape skins. The effects of HPP on the physicochemical and sensory properties of the wine were evaluated throughout the winemaking process and in resulting wine. The application of HPP had a notable positive impact on the physicochemical and sensory characteristics of red wine. The maceration process resulted in a greater extraction of phenolic compounds, leading to an increase in total polyphenolic indexes in both the wine right after maceration and the final bottled wine. The HPP-treated wine also exhibited a more intense colour, likely due to increased anthocyanidin and total proanthocyanin content. The changes in phenolic compounds' indexes caused by HPP positively affected the organoleptic impression of the resulting wine. The sensorial analysis revealed that the HPP-treated wine had more intense aromas, good fruitiness, and complexity, indicating a higher-quality product. The study suggests that nonthermal HPP can enhance the extractability of compounds from grape skins, significantly reducing the maceration process time (4000 bar for 10 minutes) and resulting in a distinctive wine with superior quality. Further evaluation of the effects of HPP on wine aging in bottles is underway.



SUSTAINABLE WINE TOURISM: RECOMMENDATIONS AND STRATEGIES FOR THE DOURO WINE REGION

Ana Trigo¹, Paula Silva^{2,3}

¹Centre for Transdisciplinary Development Studies (CETRAD), University of Trás-os-Montes e Alto Douro (UTAD), 5000-801 Vila Real, Portugal

²Laboratory of Histology and Embryology, Institute of Biomedical Sciences Abel Salazar (ICBAS), Rua de Jorge Viterbo Ferreira nº228, 4050-313 Porto, Portugal

³NOVA Institute of Communication (ICNOVA), NOVA School of Social Sciences and Humanities, Universidade NOVA de Lisboa, 1069-061 Lisbon, Portugal

anatrigo@utad.pt

Wine tourism brings together wine, food, and culture. It can utterly benefit wine regions and its local communities if managed with due care and consideration for the region's carrying capacity. Regardless being one of the hottest topics of the moment and used today by several winegrowers as part of their business strategy, there is still a considerable knowledge gap concerning means to properly implement sustainable wine tourism (SWT) initiatives. As research on SWT remains limited and is still in its beginning, the aim of this work is to clarify this matter by providing a comprehensive examination of both the wine industry's sustainability issues, and SWT trends or opportunities, offering at the same time practical recommendations for the Portuguese Douro wine region. With winegrowing activity deeply rooted in the cultural, social, economic, and environmental history of the Douro Valley, and wine tourism booming around Douro as one of the most recognized Portuguese wine regions, practical implications and business strategies in line with general sustainability principles are highlighted in this work. Based on the need to minimize negative impacts on the environment, to protect local communities' well-being and cultural heritage, while providing visitors with an authentic and educational wine experience, several directives for the Douro region are suggested. Additionally, the need for better partnerships and innovative models of collaboration between local actors is also stressed, emphasizing the importance to invest in co-optative networks and cooperative marketing. Bottom line, it is established that any given initiative for the development of SWT in the Douro wine region asks for careful planning and integrated management. It is critical to incorporate all interested parties and consider their needs, in particular residents' needs to avoid local resentment.

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DYNAMICS OF TOTAL ANTIOXIDANT STATUS THROUGHOUT THE WINE PRODUCTION PROCESS: FROM JUICE TO FINISHED NON-ALCOHOLIC WINE PRODUCT

Andrejs Skesters¹, Anna Lece¹, Dmitrijs Kustovs¹, Daina Garokalna²

¹Scientific laboratory of Biochemistry, Institute of Occupational and Environmental Health, Riga Stradiņš University, Riga, Latvia

²"Garkalnes mājas vīni", Ltd, Garkalne, Ropaži parish, Latvia

andrejs.Skesters@rsu.lv

In European "wine countries" such as France, Italy, Portugal, and Spain, where inhabitants have been observed to have significantly longer life expectancies compared to Northern, Central, and Eastern Europe, there is a growing trend to reduce alcohol content in beverages like beer and wine. This shift is driven by medical concerns related to various health conditions including cardiovascular diseases, breast and bowel cancers, Diabetes mellitus, and pre-pathological conditions, which have been associated with long-term consumption of alcoholic beverages. Non-alcoholic wines (<0.5% alcohol content), as well as low-alcohol (0.5-1.2%) and reduced-alcohol (1.2-4.5%) wines, have gained importance among residents of Northern, Central, and Eastern European countries who consume substantial amounts of high-alcohol beverages (38%+) alongside traditional beers. The objective of our study, in collaboration with winemakers, was to investigate whether the original antioxidant capacity is maintained throughout the production process of non-alcoholic wine. The most employed technologies for alcohol (ethanol) separation from wine include membrane separation, nanofiltration, reverse osmosis, spinning cone column, and thermal distillation with or without vacuum assistance. In our experiment, the wine was subjected to heat treatment at a temperature below 40°C, with durations of 30, 60, 90, or 120 minutes. At each stage, we assessed the total antioxidant capacity (TAC) and antiradical activity (AA) of the wine. Our findings demonstrated that, within the specified temperature limit, neither TAC nor AA exhibited any significant decline at any of the stages. This suggests that non-alcoholic wine can serve as an effective means to modulate the body's redox status by participating in the regulation of free radicals, active oxygen species, and nitrogen species, consequently mitigating the impact of free radicals on the aging processes within the body.



VULNERABILITY OF PORTUGUESE VINEYARD SOILS TO COPPER CONTAMINATION AND ITS TOXICITY TOWARDS ECOSYSTEM ORGANISMS

Beatriz Fernandes^{1,2,3,4}, Cristiana Paiva^{1,2}, Diogo Machado^{1,2}, Anabela Cachada^{2,4}, Ruth Pereira^{1,2}

¹GreenUPorto/INOV4Agro, Campus de Vairão, Rua da Agrária 747, 4485 646 Vairão, Portugal

²Departamento de Biologia da Faculdade de Ciências, Rua do Campo Alegre s/n, 4169-007 Porto, Portugal

³Departamento de Geociências, Ambiente e Ordenamento do Território, Faculdade de Ciências de Universidade do Porto, Rua do Campo Alegre, s/n, 4169 007 Porto, Portugal

⁴CIIMAR, Novo Edifício do Terminal de Cruzeiros do Porto de Leixões, Avenida General Norton de Matos, S/N, 4450 208 Matosinhos, Portugal

up201503352@edu.fc.up.pt

The ecosystem of vineyard soils is currently under threat due to copper contamination. As Cu-based fungicides have been applied since the 19th century, its constant use led to an accumulation of this element in the soils, with the capacity of causing negative effects on non-target organisms. However, since Cu mobility and availability may depend on the soil type and its physical and chemical properties, it is expected that the vulnerability of soils to contamination will be different in each wine region. To understand how soil properties contribute to this vulnerability, five soils from Portuguese wine regions (Vinho Verde, Douro, Dão, Bairrada and Alentejo) were selected. After a first characterization of the soils in terms of physical and chemical properties, a contamination with Cu in the form of Bordeaux mixture, at different concentrations (0 to 1000 mg kg⁻¹), was conducted under laboratory conditions. After a month of incubation, ecotoxicological assays were performed with both terrestrial (*Eisenia fetida* and *Medicago sativa*) and aquatic (*Aliivibrio fischeri*, *Lemna minor* and *Raphidocelis subcapitata*) species and copper bioaccumulation in the terrestrial species was also analysed. Considering the results obtained, the soil from Vinho Verde region seems to be the most vulnerable to Cu contamination as when contaminated with the lowest concentrations of this metal, the tested species were already negatively affected. This may be related to the fact that this soil was the one with the lowest pH, which seems to be the soil property that most contributes to Cu vulnerability.

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GIVING A SECOND LIFE TO WINERY BY-PRODUCTS: DEVELOPMENT OF NEW BREAD FORMULATION AS A HEALTH PROMOTER

Estevan Versolato Carballo¹, Carlos Eduardo Moreira Pinto¹, José Miguel Lemos¹, Marcelo Sequeira¹, Sofia Mariana Saavedra Silva ¹, Ana Novo Barros²

¹Oenology Students in UTAD (University of Trás-os-Montes and Alto Douro

²Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB)/Institute for Innovation, Capacity Building and Sustainability of Agri-Food Production (Inov4Agro), University of Trás-os-Montes and Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal

evcarballo37@gmail.com

The winery industry generates a significant amount of by-products such as grape pomace, seeds, stems, and lees [1]. These by-products have been traditionally used as animal feed or for composting. However, due to their high content of bioactive compounds, they have gained interest in the food industry for their potential use as functional ingredients in the development of new foods with nutraceutical properties. The bioactive compounds present in this industry's by-products include phenolic compounds, that have been associated with several health benefits such as antioxidant, anti-inflammatory, anti-cancer, and cardio protective effects. In fact, several in vitro, in vivo, and clinical studies have demonstrated that food products enriched with wine industry by-products possess even cardio protective properties [2]. Therefore, the inclusion of these by-products in food production has many health benefits and represents an excellent opportunity to recycle waste streams and add value to the wine industry. In this context, the aim of this study was to evaluate the effects of the incorporation of wine lees from the Douro region in the formulation of a new bread, regarding the taste, appearance, and functional properties since bread is one of the most consumed bakery products. The development of a new bread formulation, using winery by-products as a health promotor, offers a second life to something that is usually considered waste [3]. Based on previous studies, it is expected that the incorporation of lees into bread formulations will increase the antioxidant capacity of the product. Moreover, this study will also assess the taste, appearance, and functional properties of the bread to determine its overall quality [4].



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GEO-ECOLOGICAL DYNAMICS IN VITICULTURE: PREDICTING RELATIONSHIPS BETWEEN VINEYARD TERROIR AND WINE QUALITY

Carlo G. Ferretti^{1,2}

GIR | Geo Identity Research, Bolzano, Italy, Alto Adige-Südtirol
carlo.ferretti@geoproject.it

Sustainable viticulture revolves around the natural characteristics and terroir potential of our wine estates, including predicting the intricate relationships between the vine's physical environment and the resulting wine. The goal is to determine the appropriate varieties and suitable cultivation practices that harmonize wine quality with the geo-ecological background of our vineyards. This is increasingly vital with the rise of climate change, where finding advanced viticultural solutions or new winegrowing regions is paramount. Therefore, a clear awareness regarding what our terroir and its intrinsic value is, as well as the importance of its preservation, is necessary. In nature, the quality and style of wines are shaped during plant growth by intricate physiological processes, terroir sub-factors that influence the grapes biochemical composition. Soil, geomorphology, and climate play pivotal roles in shaping the sensory attributes, quality and wine style. However, these geo-ecological elements can be challenging to quantify and relate with scientific precision. Furthermore, employing new precise and codified research frameworks can shed more light on the intricate network of factors that shape terroirs. In geo-ecological research, multifaceted geographical mountainous locations provide an ideal setting for interdisciplinary analysis of the contrasting environmental factors that result in abiotic stresses on grapevines. These environmental conditions enhance the diverse stylistic identities and evident intra-varietal wine quality. Thus, significant new scientific information about terroir factors can be collected in these regions and shared globally. The presentation will give an overview of new ways to pinpoint the science of terroir and the results of our recent research, unveiling geo-ecological evidence measured in a mountainous wine region in the Alps. Our findings encompass the traceability of the mineral footprint from soil to wines, as well as the technical maturity of grapes. We also explore the relationship between terroir and wine quality, focusing on biochemical composition and sensory properties.



SUSTAINABLE MANAGEMENT PRACTICES IN THE VINEYARDS OF PIEMONTE, ITALY

Udaya Sekhar Nagothu¹, Enrico Rivella²

¹Centre for International Development, Norwegian Institute of Bioeconomy Research, Norway

²Rural landscape consultant, National Rural Network, Italy

enririve@arpa.piemonte.it

Piedmont (Piemonte) is one of the Italy's most acclaimed wine growing regions, known for high quality wines. Vineyard monocultures in general have negative effects on the environment and biodiversity. In response, a new generation of wine producers in this region are diverting to sustainable (organic viticulture) that is assumed to bring multiple benefits to the landscape, environment, and biodiversity. With minimum labour-intensive cultivation, managing borders with flower strips and cover crops between rows, reduced mowing, and tillage, regulated chemical use, and protecting native flora that host bees and beneficial insects, vineyards can evolve as a refuge for species of conservative value and especially for pollinators that need good habitat quality in terms of food availability (nectar and pollen) and larval host plants. The results from a study coordinated by the Italian Institute for Environmental Protection and Research (ISPRA) demonstrated in different vineyards of the hilly region of Piedmont how agroecology based sustainable management practices have positively influenced the biodiversity and the vineyard ecosystem in general. In comparison with this study, we tested three further vineyards using two of the most performant bioindicators: butterflies and soil fauna. Butterflies demonstrated high richness of the community composed by dominance of low mobility species and high trophic specialization. The increase in butterflies' diversity is considered a good bioindicator of a well-managed ecosystem potentially stable and rich, with a permanent herbaceous cover in the interrow and the presence of natural habitat nearby (either woods, shrubby or prairies). Soil fauna has also improved after application of organic compost with minimum tillage even though a severe drought, demonstrating that such vineyards can perform better during climate extremities.



WINE WITHOUT SULFITE ADDITION PRODUCED IN A SUSTAINABLE WAY: USE OF RESONANCE WAVES

Stefano Pettinelli¹, Andrea Uliva², Giuseppe Florida², Fabio Mencarelli¹

¹Department of Agriculture, Food and Environment (DAFE), University of Pisa, Via del Borghetto 80, Pisa, 56124, Italy

²Parsec srl, Via Tevere, 54, 50019 loc. Osmannoro, Sesto F.no, Firenze (Italy)

fabio.mencarelli@unipi.it

Today the keywords in the wine process are healthy and sustainability. This is the reason of the success of the so called “natural wine”. Decompacting waves in the wine process is a technique (AirMixing M.I.) developed by Parsec srl to save energy and labour and, at the same time, offering high quality extraction during fermentation. In this experimental work, this technique has been adopted to produce red wine without addition of sulphites, based on the hypothesis that the decompacting waves, produced by programmed sequential pulsed air/nitrogen, in a closed stainless-steel tank, avoiding pump-over, permits to reduce bacteria development by increasing antioxidant compounds.

AirMixing M.I. Sangiovese wine without sulphite addition had higher content in stilbenes and anthocyanins (total and specific ones), compounds with antibiotic (stilbenes) or antioxidant (anthocyanins) effect, than of a wine, without addition of sulphites, but produced with the used process with pump-over and delestage. Phenolic acids were in similar concentration between the two wines. In Control wine the class of terpenes and nor-isoprenoids were higher while in AirMixing M.I. wine the class of alcohols, volatile phenols, sulphide, thiols and mercaptans were higher. In the glycosylated volatiles, terpenes, nor-isoprenoids, and thiols were higher in Air Mixing M.I.. Sensory evaluation revealed a fruity taste in AirMixing M.I. wine which, moreover, consumed more than 60 % less energy and, no personnel was requested.



SUSTAINABLE WINE PRODUCTION USING DISEASE RESISTANT HYBRID GRAPE CULTIVARS IN SOUTH TYROL

Gavin Duley^{1,2}, Adriana Teresa Ceci^{1,2}, Edoardo Longo^{1,2}, Emanuele Boselli^{1,2}

¹Oenolab, NOI TechPark Alto Adige/Südtirol, Via A. Volta 13B, 39100 Bolzano, Italy

² Faculty of Agricultural, Environmental and Food Sciences, Free University of Bozen-Bolzano, Piazza Università 5, 39100 Bolzano, Italy

gavin.duley@student.unibz.it

Climate change and EU legislation regarding the reduction of pesticide usage pose challenges to winemakers across Europe, including those at the edge of the Mediterranean region such as South Tyrol (Italy). In addition, consumers and producers are increasingly conscious of environmental issues, meaning that sustainable wine production has become critical. Disease resistant hybrid grape cultivars (DRHGC), such as 'PIWI' grapes (German, *Pilzwidestandsfähige Rebsorten*), offer a potential solution to both issues. However, these grapes differ from conventional *Vitis vinifera* cultivars in terms of chemistry and flavour profile and thus targeted winemaking methods are often needed, as has been recently discussed in Duley et al. (2023). Although modern DRHGCs have been bred to avoid many of the issues that plagued earlier hybrid cultivars, many are still low in tannins and high in proteins, leading to wines with low astringency, and high in pH and titratable acidity, leading to problems with microbial stability that cannot easily be solved via acidification. Additionally, both consumers and producers can be resistant to PIWI wines simply because they do not have familiar cultivar names. This report will discuss the literature on DRHGC chemistry, potential winemaking methods to produce high-quality wines from DRHGCs, and some preliminary data from chemical and sensory analysis of DRHGC and conventional wines from South Tyrol. The applicability of methods such as pre-fermentation drying of grapes, bentonite fining, thermovinification, and addition of exogenous tannins will be discussed. It will also address the potential for DRHGCs to address issues relating to climate change and sustainability in winemaking and viticulture.

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WINES OF ALENTEJO SUSTAINABILITY PROGRAMME – 10 YEARS IN THE MAKING

João Barroso¹,

Comissão Vitivinícola Regional Alentejana

joao.barroso@vinhosdoalentejo.pt

The Alentejo Regional Wine Growing Commission - the body that controls, protects and certifies Alentejo wines - decided to develop the Wines of Alentejo Sustainability Programme to make Alentejo a sustainable wine growing region. This Sustainability Programme initiated in 2013, a pioneer in Portugal, free and voluntary, aims to provide its members with a tool to assess the current state of their activities and provide recommendations for using best practices to increase the competitiveness and sustainability of Alentejo wines. The challenge ahead is to produce quality grapes and wine in a cost-effective manner, whilst protecting the environment and improving relations with employees and neighbours.

The programme follows the standard method of continuous improvement by being an organised system in three distinct sectors (Viticulture; Cellar; Viticulture & Cellar). This distinction between sectors relates to the type of members present in the Alentejo Regional Wine Growing Commission. The Sustainability Programme consists of thematic chapters with various associated criteria. In 2020 was launched a certification of sustainable wine production, that is the guarantee that an independent evaluation, by a third party credentialled according to the Portuguese Quality System, confirms that good sustainability practices have been implemented. It is an important source of information to assess, guarantee and improve the environmental and socio-economic conditions of the industry.



ALGORITHM FOR THE CALCULATION OF THE CARBON FOOTPRINT IN THE DOURO DEMARCATED REGION (PORTUGAL)

Luís Pinto da Silva, Joaquim C.G. Esteves da Silva

Chemistry Research Unit (CIQUP), Institute of Molecular Sciences (IMS), Department of Geosciences, Environment and Territorial Planning, Faculty of Sciences, University of Porto, Rua do Campo Alegre s/n, 4169-007 Porto, Portugal

luis.silva@fc.up.pt

Consumers have been showing increasing concerns regarding environmental issues, while demanding more information about the impacts associated with purchased products and services. Given this, different stakeholders have started to focus on the identification and dissemination of environmental relevant topics, with the aim of increasing their competitiveness and consumer satisfaction. One of the sectors that contributes relevantly for greenhouse gas (GHG) emissions is that of agriculture, forestry, and other land use, among which the wine industry is among the most relevant.¹ So, the wine industry should be able to identify and reduce environmental impacts to mitigate GHG emissions that lead to climate change. To achieve these objectives, it is then essential that the wine industry possesses appropriated procedures to estimate its GHG emissions.² The most suitable indicator for this is the carbon footprint, which quantifies the direct/indirect GHG emissions and removals during the life cycle of a given product or activity.² Herein, we have developed a publicly available algorithm for the carbon footprint of wine production, which was purposely designed for the wine industry in the Douro Demarcated Region in Portugal.³ This algorithm was constructed to calculate carbon footprints during the production and distribution of wine, based on four main life cycle stages: viticulture, winemaking, bottling, and distribution. So, this algorithm provides an important and easy-to-use tool for the various players and stakeholders in different steps of wine production, to calculate and evaluate carbon footprints in a standardized way.

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CHANGES IN FASHION AND IN CLIMATE: THE MEETING POINT WHERE TO REDISCOVER PORTUGUESE GRAPE VARIETIES

Manuel Malfeito-Ferreira

Linking Environment Agriculture and Food (LEAF) Research Center, Instituto Superior de Agronomia, University of Lisbon, Tapada da Ajuda, 1349-017 Lisboa, Portugal
mmalfeito@isa.ulisboa.pt

The most prized wine styles among specialized media have swiftly changed in the last years. The once valued exuberant aroma and full mouthfeel wines popularly known as “fruit bombs” have suddenly given place to wines with discrete aroma and elegant character. The fashion may not yet have arrived to the overall consumer but this change appears as an opportunity for the latter style, typical of the so-called classical European wines, to return to the spotlight. In Portugal, the commercial-driven character fostered the use of international varieties more adapted to cooler climates that have pushed the harvest period to earlier dates. As an example, Chardonnay or Merlot grapes are frequently harvested by the first days of August or even sooner. The harvest is expected to be even more advanced due to occasional heat waves. Then, it would appear advantageous to have grapes with longer growth periods and more resistant to warmer and drier climate. Indeed, many traditional Portuguese varieties are ripening by the end of September or October. Coincidentally, these varieties meet the present demand for fresher, lighter and more elegant wines. The purpose of this tasting session is to showcase the sensory features of late-ripening white and red varieties in several Portuguese wine regions. In addition, field and winery blends characteristic of Portuguese oenology will also be tasted to demonstrate that the climate and fashion challenges might be answered by the rediscovery of ancestral grape varieties and winemaking techniques.



THERMAL EFFECTS ON THE QUALITY PARAMETERS OF EXTRA VIRGIN OLIVE OIL USING FLUORESCENCE SPECTROSCOPY

Naveed Ahamd

Mirpur University of Science & Technology, Pakistan
nveed24@gmail.com

Extra virgin olive oil is one of the superlative due to its health benefits. In this work, the Fluorescence spectra of extra virgin olive oil (EVOO) from different olive growing regions of Pakistan and Al-Jouf region from the Kingdom of Saudi Arabia (KSA) were obtained. The emission bands depicted relative intensity variations in all non-heated and heated EVOO samples. Prominent emission bands at 385, 400, 435 and 470 nm represent oxidized products of fatty acids, bands at 520 and 673 nm has been assigned to beta carotene and chlorophyll isomers respectively. All EVOO samples collected from Al-Jouf region, KSA and from Pakistan (Loralai Baluchistan, Barani Agricultural Research Institute, Chakwal and Morgha Biodiversity Park, Rawalpindi) regions showed thermal stability. Other EVOO samples from Chaman Baluchistan and one sample from wild species (Baluchistan) bought directly from farmers showed denatured spectra even without heating. Chemical characteristics of all EVOO samples changed significantly at 200 °C. Relatively, EVOO samples from Al-Jouf showed more thermal stability which might be due to geographical distribution, environmental effects, genetic background and processing or storage conditions. These results demonstrated fluorescence spectroscopy as a quick, cost-effective, and reliable approach to assess the quality and thermal stability of EVOO. These characteristics of fluorescence spectroscopy may lead to the development of portable device for the onsite monitoring of EVOO.



PHYTOCHEMICAL AND OENOLOGICAL PROFILE AND FRUIT QUALITY OF THREE RED GRAPE VARIETIES (VITIS VINIFERA L.) IN DEMARCATED DOURO REGION: A COMPARATIVE STUDY

Sandra Pereira^{1,2}, Ana Monteiro^{1,2}, José Moutinho-Pereira^{1,2} and Lia-Tânia Dinis^{1,2}

¹CITAB - Centre for the Research and Technology of Agro-Environmental and Biological Sciences, University of Trás-os-Montes and Alto Douro (UTAD), Quinta de Prados, 5000-801, Vila Real, Portugal

²Inov4Agro - Institute for Innovation, Capacity Building and Sustainability of Agri-Food Production, University of Trás-os-Montes and Alto Douro (UTAD), Quinta de Prados, 5000-801, Vila Real, Portugal

sirp@utad.pt

The diversity of grape varieties in Demarcated Douro Region (DDR) is remarkable. Among the three varieties under study, Aragonez (AR) has the highest expression in the DDR (16.4%), with Touriga Nacional (TN) also having a big impact (10.6%). Despite its high potential for wine production and great tolerance to high temperatures and diseases, Tinto Cão (TC) still has a smaller expression in the region (<1%). This work aimed to evaluate and compare the phytochemical, oenological, biometric, and colorimetric attributes of these varieties. The experiment carried out in 2019, in the ampelographic field of the Professional School of Rodo, located in Baixo Corgo Sub-Region, in the DDR. Berries were collected, at veraison and maturation, from vines with 8 years old, grafted on 1103 P, conducted in a double Guyot system, without irrigation. At maturation, AR presented bigger and heavier fruits, higher pH and probable alcohol. TC stood out for the highest organic acid concentration and consequently the highest acidity. Furthermore, this variety also presented the highest phenol, flavonoid, tannin and protein content, and the highest L* and chroma. L* values are usually higher in cultivars with low anthocyanins, as observed in this study. On the contrary, TN had the highest content of this secondary metabolite, simultaneously with the highest a*, b* and hue angle. Negative values of b* were observed in all fruits, indicating a blue colour. In relation to a*, AR and TC presented negative values, representative of greenish color, while TN presented a positive value (reddish colour). An increase in anthocyanin, protein and sugar content, probable alcohol and pH was observed during berry maturation, while a decrease in the other secondary metabolites, acid concentrations and acidity was observed. This study is important to assess the characteristics of each variety, considering the soil and climate conditions of this sub-region.



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VINEYARD ECOSYSTEM MANAGEMENT: IN PRACTICE

Paulo Carvalho Pereira, Nuno Gaspar de Oliveira

NBI – Natural Business Intelligence, Regia Douro Park, 5000-033 Andrães
paulo.pereira@nbi.pt

A vineyard ecosystem is a complex and dynamic landscape of components that interact to sustain grape and wine production. Several features in a vineyard ecosystem contribute to its ecological complexity and health, such as the proximity of woodlands and wetlands, vineyard heterogeneity and ecological elements like hedgerows, meadows, slopes, rocks, and streamlines, as well as the soil geomorphological and microbiological characteristics. The above-ground vegetation, including cover crops and annual wild plant covers, also plays a vital role. All elements are critical for implementing ecosystem management practices focused on a) soil capacity for supporting the growth of grapevines, improving nutrient cycling, retaining water, and preventing erosion, b) water regulation, including quality management, intercepting and reducing stormwater runoff, promoting infiltration, and mitigating erosion and flooding risks, c) functional biodiversity of beneficial insects, birds, and other wildlife that promote natural pest control, d) carbon sequestration, contributing to climate change mitigation and enhancing soil organic matter and its corresponding fertility and microbiome richness, e) cultural and aesthetic values, particularly in renowned regions like the Douro Valley, creating tourism opportunities, and f) pollination services which extend beyond the vineyard and can contribute to maintaining the diversity of bees, butterflies, and other insects in the broader mosaic of orchards and gardens. Understanding and promoting these ecosystem services are crucial for sustainable vineyard management and the long-term viability of grape production. NBI has been developing biodiversity and ecosystem management plans in vineyards for the past decade, spanning regions such as Alentejo and the Douro Valley. Their experience involves multiple approaches and operational plans, including enhancing natural biological control, restoring habitats, improving soil health, promoting carbon sequestration, and enhancing amenities in over 4,500 hectares of vineyard landscapes. The ongoing results demonstrate the commitment to sustainable practices and the positive impact of ecosystem management on vineyard ecosystems. These practices foster ecological resilience, optimize production, and conserve valuable landscapes for future generations.



COVER CROPS PROMOTED A BALANCE BETWEEN SOIL QUALITY, GRAPEVINE PHYSIOLOGY AND MUST ATTRIBUTES IN A SEMI-ARID STEEP SLOPE FARMING

Sandra Martins¹, Cátia Brito^{1,2}, Manuel Ângelo Rodrigues³, Adelaide Perdigão¹, Lia-Tânia Dinis^{1,2}, José Moutinho-Pereira^{1,2}, Carlos Manuel Correia^{1,2}

¹CITAB - Centre for the Research and Technology of Agro-Environmental and Biological Sciences, University of Trás-os-Montes and Alto Douro (UTAD), Quinta de Prados, 5000-801, Vila Real, Portugal

²Inov4Agro - Institute for Innovation, Capacity Building and Sustainability of Agri-Food Production, University of Trás-os-Montes and Alto Douro (UTAD), Quinta de Prados, 5000-801, Vila Real, Portugal

³Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, 5300-253 Bragança, Portugal

scpmartins@utad.pt

Climate change and the susceptibility to soil degradation represents major challenges for the sustainability of Mediterranean viticulture. The implementation of sustainable soil management strategies such as cover crops has emerged as alternative practices to conventional management, in order to preserve soil health, while ensure grapevine performance and must quality. Three soil management systems, soil tillage (T), ground cover with natural vegetation (NV) and with a commercial mixture of annual legume species (LC), were studied for two years, and their effects on soil quality indicators, photosynthetic performance, growth, yield and must attributes were evaluated. Leguminous cover crop enhanced soil organic matter and the contents of P, K and Zn, while Cu availability was higher in tilled soil. The total glomalin-related soil protein content was increased by both LC and NV treatments. A positive influence of LC was verified on plant photosynthetic performance, mainly in the second year. Crop yield varied significantly only in the second year of experiment with an increase of 97% and 99% in LC and NV plants, respectively. The higher Ravaz Index was obtained in NV plants. Considering the effects of treatments on must attributes, probable alcohol contents were consistently higher in LC and NV treatments in both years, while yeast assimilable nitrogen was higher in LC. Overall, both LC and NV ground cover soil systems appear to confer advantages when compared to T, although LC was able to promote a better balance between soil health, plant performance and must attributes.

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RECENT APPLICATIONS OF STABLE ISOTOPE RATIO ANALYSIS IN THE STUDY OF WINE AND WINE PRODUCTS

Silvia Pianezze¹, Perini M.¹, Paolini, M.¹, Allari, L.², Tonidandel, L.¹, Finato, F.², Guardini, K.², Traldi, U.³, Larcher, R.¹

¹Technology Transfer Centre, Fondazione Edmund Mach, San Michele all'Adige, Italy

²Unione Italiana Vini Servizi (UIV), Verona, Italy

³Thermo Fisher Sci, Bremen, Germany

matteo.perini@fmach.it

Traceability can verify some sustainability claims about commodities and products, such as the geographical origin of raw materials, helping to fight counterfeits and to ensure the respect for people and environment in the supply chains. In the last decades, to allow an effective traceability, several analytical techniques have been proposed, including the stable isotopes analysis of the major bio elements (SIRA) and the quantification of minor tracers. Based on the measurement of the ratio between the heaviest and the lightest isotope of an element (such as carbon or oxygen), SIRA has proved to be an effective technique for the traceability and the authentication of wine [1-3] and wine products [4,5]. Recently, new methods based on this technique have been developed. A liquid chromatographer coupled with an isotope ratio mass spectrometer (LC-co-IRMS), measuring the carbon isotopic ratio ($\delta^{13}\text{C}$) of the major sugars of Italian musts, made it possible to detect fraudulent addition of exogenous glucose and fructose deriving from C4 plants and to characterise the product based on its geographical origin [6].

Furthermore, a recent study based on the use of a continuous-flow isotope ratio mass spectrometer (CF-IRMS) GasBench II (Thermo Fisher Sci, Bremen, Germany) allowed to improve the analysis of the oxygen isotopic ratio ($\delta^{18}\text{O}$) of wine, must, vinegar and balsamic vinegar by optimising analytical conditions such as temperature and run duration. The improvement of the working condition results in a more efficient analytical procedure, helping in the reduction of analysis time and waste. Finally, new tracers like polyalcohol's (e.g., myo-inositol and scyllo-inositol) or minor sugars (e.g., lactose) characteristic of grape must, have been recently used to detect the fraudulent addition of sugar syrups to concentrated musts. To this purpose, 450 authentic Italian grape musts of different varieties and coming from different Italian regions have been considered [7].



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SUSTAINABILITY EVALUATION OF ORGANIC VS. INTEGRATED MANAGEMENT IN ITALIAN VINEYARDS WITH A MULTI FOOTPRINT APPROACH

Simona Castaldi¹, Nicola Formicola¹, Micol Mastrocicco¹, Carmen Morales Rodríguez², Raffaella Morelli³, Daniele Prodrutti³, Andrea Vannini², Roberto Zanzotti³

¹Dipartimento di Scienze e Tecnologie Ambientali Biologiche e Farmaceutiche, Università degli studi della Campania "Luigi Vanvitelli", via Vivaldi 43, 81100 Caserta, Italia

²Dipartimento per la Innovazione nei sistemi Biologici, Agroalimentari e Forestali, Università degli Studi della Tuscia, via San Camillo de Lellis snc, 01100 Viterbo, Italia

³Unità Agricoltura Biologica, Centro Trasferimento Tecnologico, Fondazione Edmund Mach, Via E. Mach, 1 - 38098 San Michele all'Adige (TN), Italia

simona.castaldi@unicampania.it

Sustainability is becoming an indispensable attribute of production systems, in particular agroecosystems, as the impacts generated by land management are multiple and have long term implications for present and future generation and the natural capital. Among the different sustainable strategies EU aims at increasing the share of organic farming as it is supposedly beneficial for many environmental targets. The choice of sustainability indicators for a meaningful representation of these target is quite challenging so often sustainability is represented using single indicator. In the present work, we compared the sustainability of grape production, in vineyard trials of Pinot blanc and Rhine Riesling managed with integrated (INT) and organic managements (ORG 1 and 2) using a multi-indicator approach on a trial set in 2011 in Trento, Italy. The carbon footprint (CF), nitrogen footprint (NF), water footprint (WF), soil microbial diversity (alpha diversity indexes of bacteria, fungi, oomycetes communities) and soil C (stock and fractions), were evaluated after 8 years since the beginning of the three experimental managements. Overall, the multi-indicator approach allowed to demonstrate that the organic management was more beneficial than integrated management for most of the environmental target analysed and ameliorated both the land quality and the environmental footprints of products.



QUALITY OF SANGIOVESE GRAPES AND WINES PRODUCED BY THE USE OF DIFFERENT ELICITOR PRODUCTS IN VINEYARD FOR ORGANIC PRODUCTION

Valentina Canuti¹, Francesco Maioli¹, Paola Domizio¹, Monica Picchi¹, Francesco Taschini²

¹Department of Agricultural, Food and Forestry Systems Management (DAGRI), University of Florence, Piazzale Delle Cascine 16, 50144, Florence, Italy.

²Gowan Italia S.r.l., Via Giovan Battista Morgagni, 68, 48018 Faenza, Italy
valentina.canuti@unifi.it

Elicitors are a specific class of purified molecules originating from microorganisms or plants which can trigger an innate immune response in plant cultures. It is known that elicitation in grapevines has allowed to improve the quality of grape berries, leading to the accumulation of phenolic compounds and varietal volatiles. For these reasons, this research aimed to study the effect on the chemical characteristics of Sangiovese grapes and wines when subjected to different elicitor treatments in vineyard according to the organic management. Different Sangiovese grapes from 2021 harvest were collected from a vineyard where three different treatments were applied: “conventional” based on sulfur-copper products and phytochemicals (STD), chitosan base (IBS), and a combination of the same product chitosan-base and an antagonist fungus (*Pythium oligandrum*) (IBP) with the aim of contrast grey mould (*Botrytis cinerea*). Grapes were chemically and microbiological analysed at harvest and then microvinified. The wines were chemically and sensorially characterized at the end of alcoholic fermentation/maceration, and after malolactic fermentation. The results showed that the use of different elicitor products in the vineyard had a significant effect both on the composition of the grapes and relative wines. The microbiological analysis evidenced a clear effect on the must obtained by the treated grapes with IBP product on enabling the mould growth over time, with the respect to both the control thesis (STD) and the chitosan-based treatment (IBS). However, the alcoholic fermentations were not affected by the different treatments in vineyards. Significant differences were found applying the combined product (IBP), especially on the phenolic composition and varietal volatiles of Sangiovese grapes and wines. The study highlights the wide range of effects of these natural products, not only on the main vineyard disease, but also positively affecting the characteristics of grapes and relative wines.





Poster Communications

DIFFERENTIAL BEHAVIOUR OF THREE RED GRAPEVINE VARIETIES CULTIVATED IN BAIXO CORGO SUB-REGION, DOURO

Ana Monteiro^{1,2}, Sandra Pereira^{1,2}, José Moutinho-Pereira^{1,2} and Lia-Tânia Dinis^{1,2}

¹Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB), University of Trás-os-Montes e Alto Douro (UTAD), Quinta de Prados, 5000-801, Vila Real, Portugal

²Inov4Agro - Institute for Innovation, Capacity building and sustainability of agri-food production. Agroalimentar, University of Trás-os-Montes e Alto Douro (UTAD), Quinta de Prados, 5000-801, Vila Real, Portugal

anamonteiro@utad.pt

The Touriga Nacional, Tinto Cão, and Aragonez (syn. Tinta Roriz) are three red emblematic grapevine varieties presented in the Demarcated Douro Region (DDR), recognized for their notable adaptability to the climatic conditions of the region and for their oenological potential to produce Douro and Porto wines. Grape quality is the result of a complex interaction between variety and the edaphoclimatic conditions, which influence the characteristics and quality of grapes and wine. For this purpose, phenolic compounds, photosynthetic pigments, antioxidant activity, and hormones in grapevine leaves from three red grapevine varieties were evaluated. Leaves were collected at different phenological stages, in an ampelographic field located in Peso da Régua, in the Baixo Corgo sub-region (DDR). As expected, the results showed that leaf metabolite contents depend on the variety and on grapevine development stage. From flowering to berry ripening, chlorophyll a and b and carotenoid levels decreased, whereas abscisic acid (ABA) concentration increased. In turn, the phenol content and the antioxidant activity present a distinct behaviour; increased until veraison and decreased after this stage. Aragonez stood out for the higher levels of photosynthetic pigments in all phenological stages, and for the higher phenolic compounds at maturation, while Tinto Cão presented the highest sugar, starch, and antioxidant activity at veraison. ABA content had tendency to increase until maturation, having Touriga Nacional the highest values. This research provides an overview of the agronomic and biochemical potential of different grape varieties in a specific climate such as Baixo Corgo sub-region.

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THE IMPACT OF ORGANIC AND CONVENTIONAL FARMING SYSTEMS ON THE NITROGEN CONTENT OF MUSTS IN TWO GRAPE VARIETIES GROWN IN WARM CLIMATES

Eva Valero¹, Marina Gonzalez-Ramirez², Soledad Romero¹, Pedro Garcia-Serrano², Belén Puertas³ and María Lourdes Morales²

¹Área de Nutrición y Bromatología, Dpto. Biología Molecular e Ingeniería Bioquímica, Universidad Pablo de Olavide, Ctra. Utrera, Km 1, 41013 Sevilla, España

²Área de Nutrición y Bromatología, Dpto. Nutrición y Bromatología, Toxicología y Medicina Legal, Facultad de Farmacia, Universidad de Sevilla, c/P. García González 2, 41012 Sevilla, España

³Instituto de Investigación y Formación Agraria y Pesquera (IFAPA), Rancho de la Merced. 11471, Jerez de la Frontera, España

evalero@upo.es

Nitrogenous compounds of grape must be essential for carrying out correct wine fermentations and obtaining aromatically balanced products. The must nitrogen content is variable and is conditioned by various factors, such as the grape variety, the degree of maturity, or the edaphoclimatic conditions of the vineyard. Furthermore, in the current context of climate change, excessive ripening of the grapes causes a decrease of nitrogen content and an increase of sugars in the must, which could potentially cause problems of stops or sluggish alcoholic fermentation. For this reason, in this study we aim to evaluate the impact of vineyard soil management on the assimilable nitrogen content of grape must in a warm climate (Jerez, Spain). For this purpose, the assimilable nitrogen content of grapes obtained from vines of Palomino and Syrah grape varieties grown on conventional and organic farms over three harvests (2019, 2020 and 2021) was determined. Twenty amino acids, as well as ammonium chloride, were identified and quantified, by UPLC-MS, in 36 grape must samples, using a commercially available amino acid analysis kit (Waters UPLC Amino Acid Analysis Solution, Milford, MA, USA). The amount of assimilable nitrogen and the amino acid profile were different in both grape varieties, with higher nitrogen content in the Syrah red variety. Differences were also observed between musts from grapes grown using organic and conventional farming systems, with higher nitrogen contents in organic musts, in both varieties. It was also observed that the longer the farming system has been in place, the more these differences increase, for the two grape varieties. A higher amino acid content was found in the organic grape musts in the 2020 and 2021 harvest compared to those grown using the conventional farming system, while the content was more similar in the musts from the 2019 harvest.



EXPLORING GRAPE AND BLUEBERRY SYNERGY: DEVELOPING THE POTENTIAL OF WINE PRODUCTION USING ALTERNATIVE DRYING TECHNIQUES

Juan Martín-Gómez, Maria P. Serratosa, Julieta Mérida, M. Ángeles Varo

Área Departamento de Química Agrícola, Edafología y Microbiología. Instituto Químico para la Energía y el Medioambiente (IQUEMA). Universidad de Córdoba. E-14014. Córdoba, Spain
q92magoj@uco.es

Red fruits, including grapes and blueberries, are remarkable for their high content of bioactive compounds and antioxidants. In Mediterranean regions, where sun-drying plays a key role in winemaking, it has proven possible to replace sun-drying with drying in a controlled air-flow chamber. This alternative method has achieved superior quality dried products, significantly increasing the phenolic content and antioxidant activity of the berries. In this study, fruits were dehydrated to increase the content of sugar and phenolic compounds in the must destined for fermentation. Dehydration was carried out until the fruits reached 50% of their original moisture content. By combining grapes and blueberries in a 1:1 ratio, two types of must were obtained: one type composed of fresh grapes and dehydrated blueberries with a sugar content of 21.2 °Brix, and the other composed of dehydrated grapes and fresh blueberries with a sugar content of 18 °Brix. Both musts were fermented at 25 °C using M05 Mead and X5 yeast strains. The use of pre-inoculums reduced the fermentation time, while the wines obtained by spontaneous fermentation had a longer fermentation process and presented lower values in terms of colour, phenolic compounds, antioxidant activity and sensory evaluations due to an increase in acetic acid. On the contrary, wines produced with pre-inoculation, despite different fermentation and maceration times, presented similar values of phenolic compounds and antioxidant activity, with the wines fermented with the commercial yeast M05 Mead being the most relevant. In sensory notes, colour was the most appreciated parameter in all wines, followed by aroma in wines fermented with X5 and M05 yeasts. However, flavour received lower values due to an excess of malic acid. Overall, the results emphasize the importance of alternative drying methods and the use of pre-inoculation to achieve wines with higher phenolic content and antioxidant activity, which ultimately contributes to a more favourable sensory experience.



CAN SUSTAINABLE WINEMAKING PRACTICES INFLUENCE THE CHARACTERISTICS OF WINE? A PRELIMINARY CASE STUDY OF THE BAGA VARIETY IN CANTANHEDE (BAIRRADA REGION)

Magda Silva¹, Artur Figueirinha^{1,2}, Fernando Ramos^{1,2}

¹University of Coimbra – Faculty of Pharmacy, Azinhaga de Santa Comba, 3000-548 Coimbra, Portugal

²LAQV/REQUIMTE – Associated Laboratory for Green Chemistry of the Network of Chemistry and Technology, Rua D. Manuel II, Apartado 55142, 4051-401 Porto, Portugal
magdaps@gmail.com

Consumers' growing concern for modern agricultural practices suggest a change in traditional wine production, without compromising its characteristics, namely maintaining beneficial effects due to the high antioxidant activity on the cardiovascular system of those who consume it regularly and moderately, as proposed by the Mediterranean diet. This preliminary study aims to characterize and evaluate 2 Baga wines, collected at two different production moments of the winemaking process, resulting from 2 different production modes: Integrated Protection and Biodynamics, and verify their influence on the characteristics of the final product. The samples were evaluated using physical-chemical and sensory tests (sight, smell and taste). High-performance liquid chromatography with photodiode detector (HPLCPDA) evaluated the phenolic profile. The quantification of total phenols was carried out using the Folin Ciocalteu method, while the method of the Portuguese Pharmacopoeia was used to determine the total tannin content. The diphenylpicrylhydrazyl (DPPH) method evaluated the antioxidant activity before and after tannin removal (detained samples). The Baga variety from biodynamic production showed a higher tannin content and antioxidant activity when compared to the integrated protection. Analysis of the phenolic profile revealed the presence of phenolic acids and anthocyanins, among other compounds, in both Baga production modes, at similar quantities. No differences were found in the organoleptic characteristics. The results suggest that the wine resulting from the biodynamic production method does not present different characteristics from those produced by integrated protection. Thus, it can be concluded that biodynamic production maintains the characteristics of Baga wine and could be used to change traditional wine agricultural production into a more environmentally friendly production, contributing to the general sustainability of the planet.



CAN UNLEASHING WINEMAKING'S HIDDEN POWER: BY-PRODUCTS AS ANTIOXIDANT-RICH BIOACTIVE SOURCES

Rui Dias Costa, Ana Abraão, Verónica Gomes, Irene Gouvinhas and Ana Novo Barros

Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB)/Institute for Innovation, Capacity Building and Sustainability of Agri-Food Production (Inov4Agro), University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal.

ruiacosta@utad.pt (R. D. C.); abarros@utad.pt (A.N.B.)

Although sometimes overlooked, the waste materials produced by wineries, such as pomace, stems, seeds, wine lees, and grapevine shoots, offer a promising source of bioactive compounds that can be utilized in various applications. These residues have been described as a natural source of polyphenols which are mainly responsible for several biological properties [1]. Numerous extraction techniques using different solvents are currently under investigation. Ethanol, owing to its natural occurrence in wines, safe handling, and low toxicity compared to other organic solvents, is widely implemented as an extracting agent. This study aims to evaluate and compare the extraction of polyphenols from different winery by-products in the Douro region, namely stems, pomace, seeds, wine lees, and grapevine shoots, using five ethanol: water ratios (0:100, 25:75, 50:50, 75:25, and 100:0 v/v). The extracts were then subjected to various analyses, such as Total Phenolic Content (TPC), Ortho-Diphenols Content (ODC), Flavonoid Content (FC) [2], and antioxidant capacity using three methodologies, namely 2,2-diphenyl-1-picrylhydrazyl (DPPH), Ferric Reducing Antioxidant Power (FRAP), and 2,2-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) diammonium salt (ABTS) [2–4]. Additionally, the anti-aging potential of the samples with the highest TPC value from each winery by-product was evaluated by measuring their ability to inhibit elastase [5]. The hydroalcoholic extracts prepared using 50:50 (v/v) ethanol: water ratio displayed the highest TPC, ODC, and FC values. The highest antioxidant capacity was observed in the 50:50 and 75:25 ethanol: water extracts. Furthermore, stems and seeds exhibited the highest values for all analyses among the various winery by-products. One grape seed sample demonstrated a maximum elastase inhibition activity of 74.17%. Overall, these results underscore the potential use of these winery by-products, particularly stems and seeds, in the cosmetic industry.

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α -AMYLASE ACTIVITY AND FLAVOUR EXPERIENCE ELICITED BY CASTANEA SATIVA CULTIVARS WITH DIFFERENT COOKING PROCESSES

Maria João Santos¹, Alice Vilela², Elisete Correia³, Gonçalo Rijo⁴, [Teresa Pinto](mailto:tpinto@utad.pt)⁵

¹University of Trás-os-Montes and Alto Douro, Apt. 1013, 5001-801 Vila Real, Portugal

²Chemistry Research Centre (CQ-VR), Dep. of Agronomy (DAgro), School of Agrarian and Veterinary Sciences (ECAV), University of Trás-os-Montes e Alto Douro, 5001-801 Vila Real, Portugal

³Center for Computational and Stochastic Mathematics (CEMAT), Department of Mathematics, University of Trás-os-Montes and Alto Douro, 5001-801 Vila Real, Portugal

⁴Neoception, Unipessoal, Lda. Vila Real, Portugal

⁵CITAB, Centre for the Research and Technology of Agro-Environmental and Biological Sciences and Inov4Agro, Institute for Innovation, Capacity Building and Sustainability of Agrifood Production, Dep. of Biology and Environmental, School of Life and Environmental, University of Trás-os-Montes and Alto Douro, Vila Real, Portugal

tpinto@utad.pt

Currently, consumers are paying more attention to the characteristics of the products they consume, prioritizing healthy food. This awareness of the impact of the characteristics of each product requires the development of reliable methods that allow a selection of products where chemical and sensory qualities are fundamental. Chestnut fruit has unique nutritional and sensory properties. Due to these characteristics, the chestnut enhances any dish where it is inserted being also very versatile when it comes to its use in Portuguese cuisine. Two cultivars of chestnuts - *Longal* and *Judia* - were chosen for this study. The objective was to evaluate the influence of cooking processes, on the chemical composition and sensory profile of chestnuts, in parallel the activity of saliva α -amylase was also evaluated. At the chemical level, the contents of starch, soluble sugars, crude protein, and crude fat were analysed and at the enzymatic level, the activity of the α -amylase enzyme was quantified in the taster's saliva after tasting the boiled chestnuts. At the sensory level, a QDA (quantitative descriptive analysis) test was performed.

The results reveal that both varieties of chestnuts are low in soluble sugar and fat, while abundant in starch. This observation was shown to have an impact on the enzymatic activity in the consumers' oral cavity. The sensory test revealed that roasted chestnuts were the most appreciated, which is to be expected since they are the most consumed by the Portuguese. The biochemical and sensory properties of nuts significantly influence consumer acceptance, especially if they contribute to health and well-being.



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ASSESSMENT OF KEY VOLATILE ORGANIC COMPOUNDS RESPONSIBLE FOR PORT WINE AROMA PROFILE

Isabel Furtado^{1,*}, Sara Moreira¹, Ana Silva¹, Agostinho Fernandes¹, Nuno Moreira¹, Ricardo Silva¹, Frank S. S. Rogerson¹, Fernando Alves¹

¹Symington Family Estates, Vinhos S.A. Travessa Barão de Forrester, 86, 4400-034 Vila Nova de Gaia, Portugal

isabel.furtado@symington.com

Port wine is a traditional Portuguese alcoholic beverage produced, exclusively, in the Douro Demarcated Region. The particular conditions in which they are produced lead to wines with unique aroma and flavour characteristics that are recognized around the world. Volatile organic compounds play a major role in the complex aroma profile of Port wines. Thus, it is important to study and identify the volatile compounds responsible for these distinctive aromas. To this study, Tawny, Ruby and White Port wines of different qualities were selected and their aroma profile determined. In order to identify the key volatile compounds with relevant contribution to their aroma, Port wine's volatile fraction was firstly separated by liquid-liquid extraction and then concentrated. These extracts were analyzed by Gas Chromatography-Olfactometry (GC-O), using the Aroma Extraction Dilution Analysis (AEDA) technique to determine the key aroma descriptors of each wine, and by Gas Chromatography coupled with Mass Spectrometry (GC-MS), for the identification of the volatile compounds responsible for the key aromas. The results showed that Tawny Port wines' aroma is significantly impacted by volatile organic compounds associated with "caramel" descriptors, such as maltol and diethyl malonate, putatively, whereas Ruby Port wines' aroma is more impacted by fruity aromas, e.g., "apple", "citric" and "pineapple", associated with the presence of ethyl butanoate, linalool and ethyl hexanoate, respectively, as well as herbaceous aromas such as anise, tea and mint, associated with the presence of α -terpineol and others. Lastly, White Port wines presented high notes of floral aromas, such as "citric floral" and "roses", associated with the presence of linalool and benzyl alcohol, respectively, and fruity, such as "mango" and "passion fruit", associated with 4-mercapto-4-methylpentan-2-one, putatively. These findings help fill a gap in literature regarding Port wines, since there are limited studies carried out on Port wine's aroma.

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PURE PORT, AN INNOVATIVE AROMA EXPERIENCE

Isabel Furtado^{1,*}, Ricardo Silva¹, Sónia Ribeiro², Alisa Rudnitskaya³, Sílvia M. Rocha², Ilda Caldeira⁴, Frank S. S. Rogerson¹, Fernando Alves¹

¹ Symington Family Estates, Vinhos S.A. Travessa Barão de Forrester, 86, 4400-034 Vila Nova de Gaia, Portugal

² Department of Chemistry & LAQV-REQUIMTE, University of Aveiro, Campus Universitário Santiago, 3810-193 Aveiro, Portugal

³ Department of Chemistry & CESAM, University of Aveiro, Campus Universitário Santiago, 3810-193 Aveiro, Portugal

⁴ Instituto Nacional de Investigação Agrária e Veterinária, Polo de Dois Portos, Quinta de Almoinha, 2565-191 Dois Portos, Portugal;

isabel.furtado@symington.com

Port wine, a fortified wine produced in the Douro Demarcated Region under peculiar conditions, is characterized by its attributes. Its unique flavour and aroma are the result of the combination of several distinct aspects, namely the terroir, climate conditions, grape varieties, and winemaking process. During this process, the fermentation is interrupted by the addition of grape spirit (ca. 77% v/v ethanol). Grape spirits undergo sensorial and physicochemical analysis to ensure that they possess the quality necessary to be added to Port wines. These grape spirits may contain other components that are not monitored, i.e., volatile organic compounds, whose impact on Port wine aroma has not been fully assessed. Furthermore, as consumers' habits of consumption shift over the years, there's a growing need to improve the knowledge regarding Port wine and adapt the product to the consumers' lifestyles. This is especially important considering younger costumers, who search continuously for alternative and innovative drinks. Thus, it is important to search for new strategies to demystify the traditional way of Port wine consumption. Hence, this work aims to study the volatile profile of Port wine and grape spirits, in order to select adequate grape spirits, absent of defects specific for each Port wine category, resulting in the production of a new line of Port wines, denominated as "Pure Port". These wines are intended to be incorporated in cocktails, with well-studied and selected ingredients. Firstly, the volatile profile of White, Ruby and Tawny Port wines was assessed through Gas Chromatography-Olfactometry (GC-O) and Gas Chromatography coupled with Mass Spectrometry (GC-MS), as well as the volatile composition of several grape spirits through GC-O, GC-MS and Two-Dimensional Comprehensive Gas Chromatography with Time-of-Flight Mass Spectrometry (GC×GC-ToFMS). Thereafter, it was possible to predict which grape spirits were better suited for Pure Port wines' fortification. Lastly, the cocktails' formulation is being developed by studying the best ingredient combinations for each Port wine category.

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