



**OXYGEN MANAGEMENT RESEARCH RESULTS
MARCH 2014**

Nomacorc's research consortium has undergone several significant changes over the past two years. New partnerships have been forged with the aim of introducing additional capabilities, allowing exploration of new aspects of wine chemistry. Other partnerships and projects that have been running for several years have also come to completion; however, Nomacorc still works collaboratively with these partners to summarize project outcomes, in a continuing effort to rapidly share key findings from its research on wine and oxygen with the industry. These insights have also been leveraged into Nomacorc's own business and product development initiatives. At present, one major focus lies in the development of analytical capabilities to predict how wine will interact with oxygen. Nomacorc believes that research in this field will provide winemakers with novel and revolutionary decision-making tools.

Programs with Individual Research Institutes

Institut Français du Vin (IFV) (France)

- Grape variety and winemaking strategies are two major elements of the diversity existing among wines from different regions, both chemically and sensorially. As such, they also influence the way different wines interact with oxygen. IFV has long experience of supporting the French wine industry in the development and optimization of winemaking protocols aimed at addressing the specific needs of individual grape varieties or winemaking region. This program is providing novel insights into how winemakers should adjust their oxygen management strategies depending on grape variety and winemaking procedures. Among varieties tested, the program includes Grenache, Syrah, Mourvedre, Cinsault, Cabernet Sauvignon, Gamay, Chardonnay, Sauvignon Blanc, and Riesling. Depending on the grape and the region, different winemaking practices are evaluated, including thermovinification, inerted pressing, and lees aging. Special focus is given to the production of no-SO₂ wines. The data obtained allowed to redefine oxygen recommended levels for this category of wines.

[View presentation from Philippe Cottereau here:](https://www.youtube.com/watch?v=LhegZPBg5SI)
<https://www.youtube.com/watch?v=LhegZPBg5SI>

DLR Neustadt (Germany)

- This study is exploring the complex relationship between must preparation techniques (e.g. thermovinification), controlled oxygen exposure (e.g. micro-oxygenation) and use of closures with different oxygen permeability. Pinot Noir has been chosen for the study, representing an example of wines where combining oxygen and must preparation strategies can help obtain more intense and stable color. Micro-oxygenation showed great potential to improve wine color, although accumulation of acetaldehyde needs to be carefully monitored to avoid excessive oxygen exposure. Increased post-bottling oxygen, as obtained by means of closures with higher oxygen permeability, allowed dissipating reductive aromas from fermentation. By combining advanced analytical techniques and sensory analysis,

this study is contributing to identify key chemical markers for wine sensitivity to oxygen.

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View presentation from Dr. Dominik Durner here:

<https://www.youtube.com/watch?v=F1bt8A2EskY>

Geisenheim Institute (Germany)

- The relationship between grape variety, winemaking procedures and oxygen management strategies has been explored in a study involving Riesling and Pinot Gris. From the same lot of grapes, typical light-style wines have been made as well as more complex, full-bodied wines aged in contact with yeast lees. These two styles of wines were then exposed to different levels of oxygen during cellar handling (simulating typical cellar situations), and then bottled with three different types of closures (therefore creating six different wines). Oxygen exposure during cellar handling had a major impact on wine sensory evolution post-bottling, reinforcing the importance of measuring and controlling oxygen the winery. Lees aging appeared to increase wine resistance to oxidation during post-bottling storage.

View presentation from Prof. Rainer Jung here:

<http://www.youtube.com/watch?v=zH9BFIBaF14>

Fondazione Edmund Mach-Centro Ricerca e Innovazione (Italy)

- “Conventional” analytical approaches used in wine science are typically focused on the analysis of selected compounds thought to play an important role in a given process. However, this type of approach is limiting when compared to the complex array of chemical reactions taking place during wine bottle maturation. This project takes advantage of the most advanced platforms for non-targeted metabolomic analysis to study wine response to oxygen. The study will be carried out on a range of Italian white wines of different varieties and regions. The development of such a dataset is expected to generate significant advances in understanding how specific wine compositional profiles respond to oxygen management strategies.

View presentation from Dr. Fulvio Mattivi here:

<https://www.youtube.com/watch?v=Sg2-MrpxRzE>

University of Naples, Department of Food Science (Italy)

- A joint research program was launched in 2013 by University of Naples – Dept. of Food Science and Nomacorc. The project aims at studying the evolution of Campania red and white wines during bottle aging under different oxygen supply, to identify their optimal “oxygen demand.” The range of grape varieties studies, including whites Falanghina, Greco, Fiano, Pallagrello bianco, and reds Aglianico, Primitivo, Casavecchia and Pallagrello nero, is expected to provide a comprehensive overview of the many different wine styles existing in the region. Thanks to the dedicated analytical capabilities at Dept. of Food Science, the study is expected to shed some

light on oxygen modulation of wine astringency, in addition to investigating aroma, phenolic and sensory composition of the different wines.

View presentation from Angelita Gambuti here:

<http://www.youtube.com/watch?v=phuAd2EIWQM>

Universidad de Zaragoza-Laboratorio de Análisis de Aroma y Enología (Spain)

- Wine aroma deterioration due to oxidation is still a problem for the wine industry. Aldehydes are known to play a major role in the occurrence of oxidative aroma defects. However, in the complex environment of wine, the factors leading to aldehydes formation are not completely understood. Sulfur dioxide effectively binds to aldehydes reducing their sensory impact. However, growing consensus around reducing the use of sulfur dioxide in winemaking reinforces the need to better understand mechanisms of aldehydes formation, especially in the context of “natural” wines. In particular, to date it is not possible to determine the likelihood that a wine could develop potentially harmful levels of aldehydes. The data generated in this project indicates that, in addition to sulfur dioxide equilibria, other factors play a role in determining the risk of aldehydes formation, including wine amino acid composition, presence of certain metals, and wine phenolic profile. Further developments in this study are expected to provide decision-making tools to assist winemakers in tailoring closure selection to the oxygen needs of wines.

View presentation from Prof. Vicente Ferreira and Monica Bueno here:

<https://www.youtube.com/watch?v=AOgp8u5LtLU>

Ecole de Changins (Switzerland)

- Control of grape must oxidation is one key aspect in the management of white wine aroma expression, color stability and shelf-life. On one hand, controlled must oxidation can allow removing highly reactive phenolic compounds that can later contribute to premature oxidation. On the other hand, in certain cases of extreme protection of the must from oxygen (e.g. pressing under inert atmosphere) can help preserve varietal aromas and must natural antioxidants. Although must handling is way upstream in the winemaking process, the outcomes of oxygen exposure at this stage are deeply connected with different steps intervening at a much later stage of winemaking, in particular with post-bottling oxygen exposure and therefore closure selection. To address these issues, Nomacorc has launched a research program in collaboration with the Ecole de Changins, the most highly recognized wine science institution in Switzerland. Chasselas grapes will be treated with different levels of oxygen protection, and the resulting wines will then be bottled with closures allowing different degrees of oxygen exposure. The results are expected to shed light on the optimal balance of pre-fermentative/post-bottling oxygen exposure for Chasselas wines.

Pontificia Universidad Católica del Chile (Chile)

- The potential of rapid analytical methods to predict wine oxidability, including FT-IR, antioxidant capacity assays, and electrochemical profiling has been investigated using a range of Chilean red wines. The different analytical techniques allowed fingerprinting wine oxidation to different extents, and “oxidation spectra” of different wines could be developed. This spectral database will then be used to assess wine aroma oxidability.

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List of recent publications

1. Ugliano, M, Dieval, J-B, Vidal, S. Passion fruit with a hint of mineral, some smokiness but kind of stinky: many faces of volatile thiols in wine. *Practical Winery Vineyard*. Jan 2014, 4-8, 2014.
2. Dieval, J-B, Ugliano, M, Sciacchitano, J, Vidal, S. L'ossigeno, parametro chiave per la conservazione dei vini biologici. *L'Enologo*, 1-2, 89-93, 2014.
3. Rodriguez-Mendez, M.-L., C. Apetrei, M. Gay, C. Medina-Plaza, J.A. de Saja, S. Vidal, O. Aagaard, M. Ugliano, J. Wirth, V. Cheynier Evaluation of oxygen exposure levels and polyphenolic content of red wines using an electronic panel formed by an electronic nose and an electronic tongue. *Food Chem.*, 155, 91-97, 2014.
4. Ugliano, M. Oxygen contribution to wine aroma evolution during bottle aging. A review. *J. Agric. Food Chem.*, 61, 6125-6136, 2013.
5. Dimkou, E., Ugliano, M., Dieval, J-B., Vidal, S., Jung, R. Impact of dissolved oxygen at bottling on sulfur dioxide and sensory properties of a Riesling wine. *Am. J. Enol. Vitic.* 4, 325-332, 2013
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10. Gambuti A, Rinaldi A, Ugliano M, Moio L. Evolution of phenolic compounds and astringency during aging of red wine: effect of oxygen exposure before and after bottling. *J. Agric. Food Chem.*, 60, 2012
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13. Laurie, F., Zúñiga, M.C., Carrasco-Sánchez, V., Santos, L.; Cañete, A., Olea-Azar, C. Ugliano, M., Agosin. E. Reactivity of 3-sulfanyl-1-hexanol and catechol-containing phenolics in vitro. *Food Chem.* 131, 1510-1516, 2012
14. Ugliano, M., Dieval, J.B., Vidal, S. Gestion del oxygen durante la crianza del vino mediante la seleccion del tapon. *Tendencia actuales y perpsectivas. Enologos*, 20-30, 2012
15. Ugliano, M., Dieval, J.B., Vidal, S. Composti volatili solforati in vini Sauvignon blanc. Effetto del glutatione e del tenore di esposizione all'ossigeno durante la conservazione in bottiglia. *L'Enologo*, 87-91. 2012
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