NOLO wine — laying the groundwork for big steps forward

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NOLO (no and low alcohol) beverages are a growing category with enormous potential worldwide; however, NOLO wines have not been taken up by consumers as quickly as NOLO beer and spirits. There is a perception in the market that NOLO wines lack some key sensory attributes compared to traditional wines. AWRI researchers investigated the sensory and chemical properties of existing products, as well as a range of production techniques and ingredients. By building our industry's knowledge base, this work will support the development of Australian NOLO wines that satisfy consumer demands for more wine-like products.

INTRODUCTION

The category of no- and low-alcohol (NOLO) beverages has shown enormous growth globally in recent years. Modern consumers are chasing products that contain all the aroma, flavour and texture of traditionally produced alcoholic beverages but with little or no alcohol. The NOLO wine category, however, is seen as lagging behind both NOLO beer and spirits. In September 2022, the AWRI completed a two-year project funded by Wine Australia to understand the desirable sensory attributes of existing NOLO beverages and evaluate NOLO production practices, technologies and ingredients required to give NOLO wines palate attributes similar to full-alcohol dry wines. Overall, the goal of this work was to understand the current NOLO landscape and support development of wine-like NOLO beverages that will satisfy consumer demands, boosting the success of this category for Australian producers.

A key element of this project was the formation and involvement of an industry reference group in co-designing the areas of focus for the project. This group involved industry members from various stops along the supply chain, ensuring a varied and comprehensive overview of industry wants and needs for NOLO wines. Regular interaction with this group helped inform the direction of the project and ensure project deliverables and future projects address the needs of the sector.

SENSORY EVALUATION OF EXISTING NOLO PRODUCTS

The project began by evaluating existing NOLO products from the Australian marketplace. One hundred and twenty NOLO products, including wine, wine-like products, grape-based products, cider, beer and spirits,
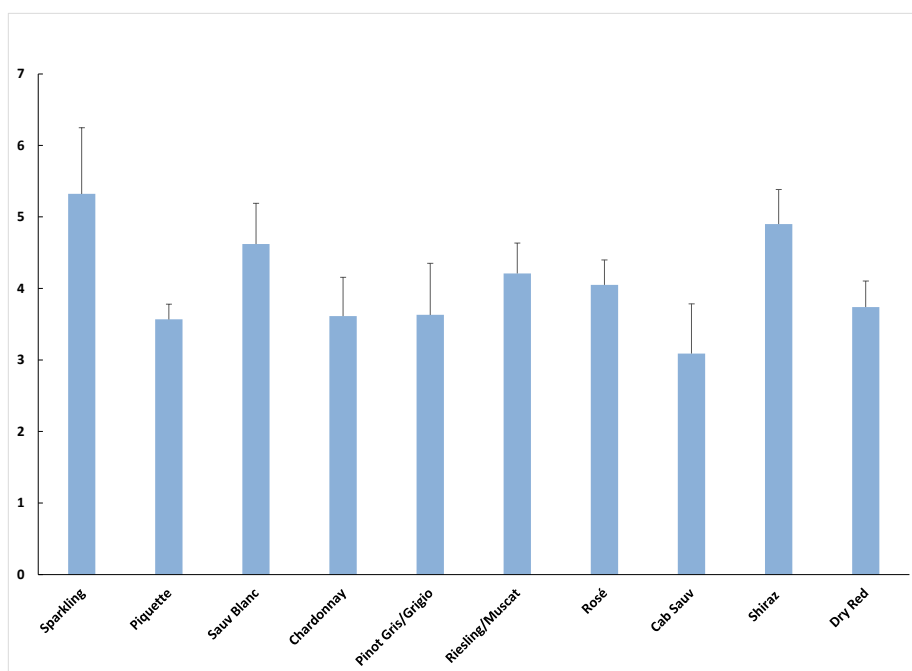

Figure 1. Mean vinosity scores by wine style or grape variety, including standard deviations.

were evaluated. Wines were selected based on availability, with every product available in the marketplace purchased for initial screening. Sparkling, white, rosé and red NOLO wines, NOLO wine- and grape-based products, NOLO ciders and beer, and NOLO spirits were all obtained for initial assessment.

Initially, the wine and wine-like products were evaluated using a comparison scale, where the taster assessed the likeness to their concept of what wine should smell and taste like — dubbed the 'vinosity scale'. This preliminary assessment was used to screen potential products for inclusion in a more rigorous study involving descriptive sensory analysis. Initial sensory evaluations highlighted the lack of wine-likeness in most products, with the sparkling and white NOLO categories having higher mean vinosity scores than the red NOLO category (Figure 1).

From this group of NOLO products, 10 sparkling, 16 white and rosé, and eight red wines were selected for sensory descriptive analysis. The results of the detailed sensory evaluations were then paired with the vinosity scores from the initial product assessments to highlight the sensory attributes most associated with the vinosity of the NOLO wines (see Figures 2 to 4).

Sparkling NOLO wines

For the sparkling wines (Figure 2), vinosity was associated with the sensory attributes 'astringency' and 'banana confection', but more importantly it was negatively associated with the attribute 'sweet', with most of the products being too sweet for the panellists to call wine-like. Another interesting result was that viscosity had neither a positive nor negative association with vinosity, which was
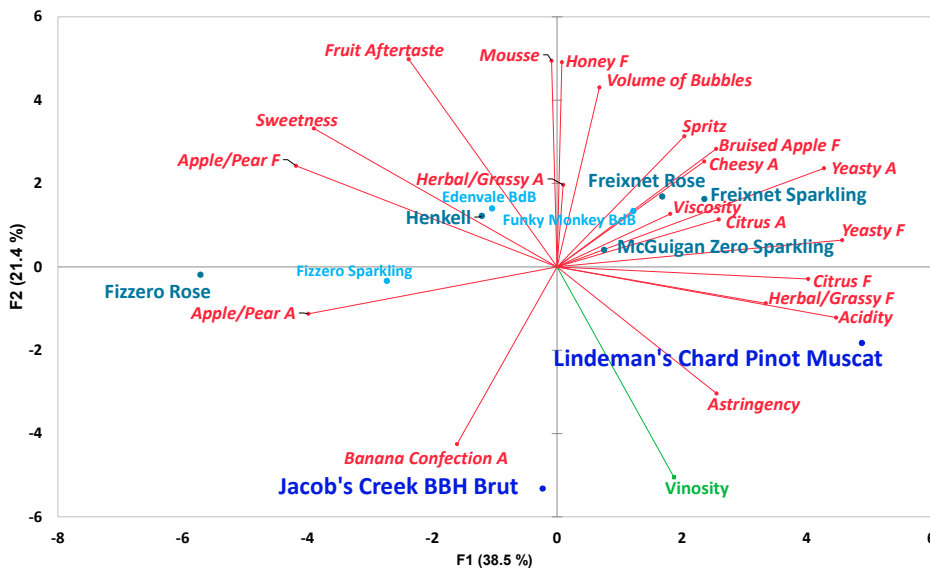
Figure 2. Principal component analysis biplot of factors 1 & 2 of sparkling NOLO wines, with attributes in red, samples in blue, and vinosity in green. A larger font for a sample denotes a higher vinosity score.
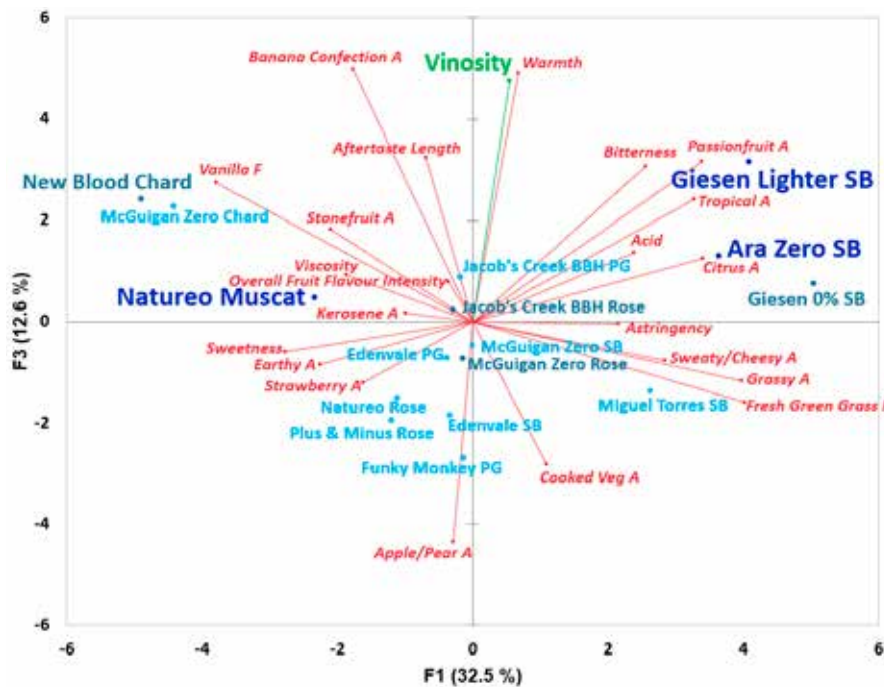

Figure 3. Principal component analysis biplot of factors 1 & 3 of white and rosé NOLO wines, with attributes in red, samples in blue, and vinosity in green. A larger font for a sample denotes a higher vinosity score.

surprising as it was thought that the viscosity of a product would be correlated with its alcohol content and, therefore, would affect vinosity ratings.

White NOLO wines

Similarly for the white and rosé NOLO products (Figure 3), viscosity was neither positive nor negatively associated with vinosity. However, the attribute 'warmth on the palate' was strongly associated with vinosity. The two most wine-like products (highest vinosity scores) were found in this category and both were Sauvignon Blanc-based products,

suggesting this variety has good potential for NOLO products.

Red NOLO wines

Red NOLO products (Figure 4, see page 28) were less uniform in their sensory assessments with regard to vinosity, with three Shiraz and one Cabernet Sauvignon having the highest vinosity scores; however, with scores lower than the white examples. Sensory attributes related to lower quality or faulty wines ('cheesy', 'barnyard', 'cooked veg', 'bitter') were negatively associated with vinosity in this segment.

IN BRIEF

■ A two-year project investigated the desirable sensory attributes of existing NOLO beverages and evaluated NOLO production practices, technologies and ingredients required to produce wines with similar attributes to full-alcohol dry wines.

■ Tasters assessed wine and wine-like products based on their concept of what wine should smell and taste like; initial sensory evaluations highlighted a lack of wine-likeness in most products.

■ 10 sparkling, 16 white and rosé, and eight red wines were selected for sensory descriptive analysis.

■ These wines were also subjected to detailed chemical analysis to understand the compounds that contribute favourable sensory attributes to NOLO wines so they can be optimised in the vineyard and winery.

■ The analysis highlighted how the removal of alcohol from wines also removes most of the aroma and flavour components and that the method of alcohol removal used affected the compositional make-up.

■ A range of flavour and textural additives were evaluated for their effectiveness at recreating the sensory effects of ethanol in NOLO wines.

UNDERSTANDING KEY COMPOSITIONAL ATTRIBUTES

It will be important for producers to understand the chemical compounds that contribute favourable sensory attributes to NOLO wines so they can optimise these in both the vineyard and winery. The wines selected for the sensory descriptive analysis were, therefore, also subjected to detailed chemical analysis so that these compositional factors could be explored. Concentrations of monoterpenes, low molecular weight sulfur compounds, norisoprenoids, oak volatiles, fermentation products, organic acids, glycerol, tannin and colour were all analysed.

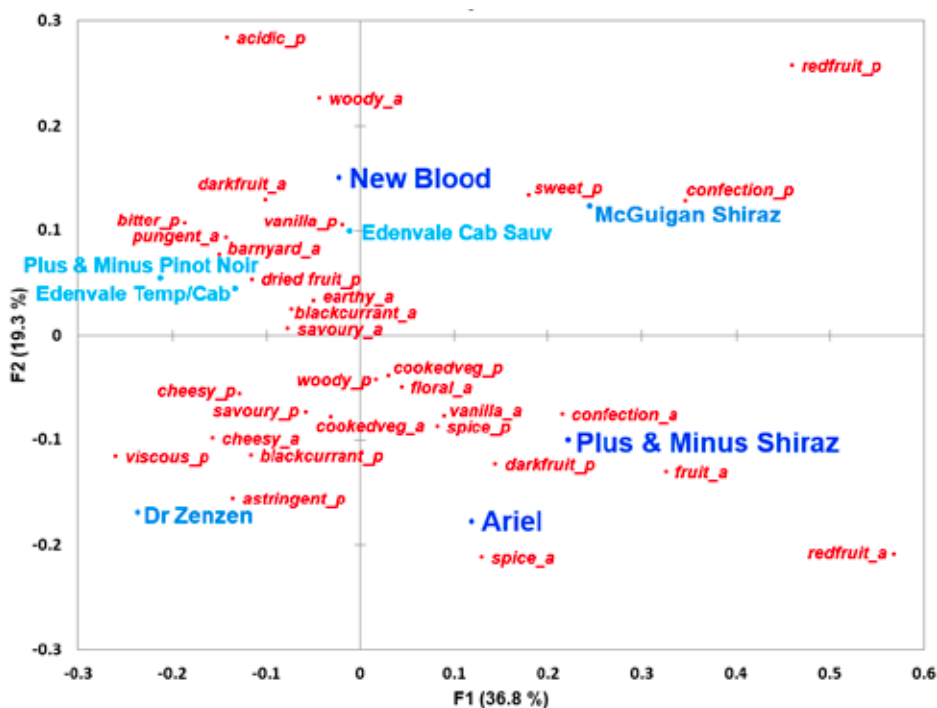Across the whole set of samples, the compositional analysis highlighted one of the

Figure 4. Principal component analysis biplot of factors 1 & 2 of red NOLO wines, with attributes in red, samples in blue. A larger font for a sample denotes a higher vinosity score, and samples with similar vinosity scores are shown in similar colours.

big issues in the dealcoholisation process, which is that the removal of alcohol from the product also removes most of the aroma/flavour component. Analysis of 66 different compounds showed that most were removed to concentrations well below their aroma thresholds. Some notable exceptions to this finding were 2-phenylethanol (responsible for 'floral' aromas) and ethyl butanoate ('fruity' or 'pineapple' aromas), and the 'tropical' thiol compounds 3SH, 3-SHA and 4-MMP. This, again, highlighted the suitability of Sauvignon Blanc for NOLO products as these thiols are key contributors to Sauvignon Blanc flavour and aroma. It also appeared that the method of alcohol removal affected the compositional make-up, with the wines produced using different methods exhibiting slightly different chemical fingerprints.

CAN ADDITIVES HELP RECREATE WINE-LIKE FLAVOURS?

A range of flavour and textural additives were evaluated for their effectiveness at recreating the sensory effects of ethanol in NOLO wines. Two sensory evaluations were undertaken. The first tasting involved products donated from major flavour and fragrance company Firmenich, tasted in a 0.05% alc (v/v) Sauvignon Blanc. These products are currently part of the company's offering to the brewing industry for NOLO beer products.

The general comments from the sensory panel regarding these additives were that they were not particularly wine-like, and on their own did little to replicate the sensory effect of ethanol in wine. However, there may be value in blending these products together to better optimise their wine-like characters.

The second tasting involved adding the amino acid L-proline to dealcoholised wine to evaluate its potential for use as a flavour enhancer in NOLO products. Proline has been shown to enhance taste, mouthfeel and flavour in wine (Espinase Nandorfy *et al.* 2022). Proline was added to dealcoholised Sauvignon Blanc at 2g/L and 4g/L, and also to samples of dealcoholised Sauvignon Blanc containing 400mg/L of glycosides extracted from Muscat Gordo Blanco marc at the same concentration. Samples were assessed along with a control sample in an informal sensory session at the AWRI with members of the technical quality panel.

Tasters found the addition of L-proline did not enhance the sweetness of samples where only proline had been added; however, the samples were thought to be less acidic than the control. The samples where both proline and glycosides had been added were perceived as higher in flavour as well as lower in acid than the control and proline-only samples, with the 4g/L addition of proline plus glycosides showing the highest flavour concentration. The use of proline as a flavour enhancer does show some potential, with concentrations able to be boosted both using

an additive and through viticultural practices. More work is needed to explore how proline and glycosides might best be used to improve flavour in NOLO products. As proline is produced by grapes but not consumed by yeast during fermentation, grape varieties that produce higher concentrations of proline could potentially be selected for use in NOLO products, or viticulture techniques that aid in the grapevine's production of proline could be specifically adopted for grapes grown for NOLO products. There is also potential to explore the impact of other amino acids on the sensory characteristics of NOLO products.

SUMMARY OF PROJECT OUTCOMES

This project was successful in setting the scene for research into the many facets of NOLO wine production. The goals for this study were to better understand the products available in the market and their sensory deficiencies, to explore the technical processes that are available for removing alcohol from wine, and to understand the pain points and priorities for industry with regard to these products. Prior to this study, no work appears to have been published on the technical know-how in NOLO wine production and sensory evaluation. This project has provided valuable information on the challenges being faced in this product category, and with continued industry engagement further research can potentially solve the many issues that surround these products.

Overall, from this work it was clear that there was a lack of well made, wine-like products in the NOLO wine category. Examples with higher vinosity scores were seen in every style (sparkling, white, rosé and red) but they appeared to be outnumbered by the less wine-like products in the category at the time this work was undertaken. Many of the wines potentially suffered from poor starting materials and obvious wine faults that would be difficult to overcome even if they were at full alcohol. Market factors such as consumers not being willing to pay a premium for NOLO wines, and the fact that the production of NOLO wines is costlier than traditional wines, likely explain the choice of low-cost inputs. However, examples that have been made with sound winemaking practice, judicious use of technology, optimal choice of grape variety and wine style, and higher quality starting materials highlighted the possibilities and opportunities in this market segment.

WHAT'S NEXT FOR NOLO WINES?

According to the IWSR, the NOLO category surpassed $11b in market value in 2022, and 7% growth by volume is predicted by 2026.

Further investigations are needed to help the Australian wine sector develop NOLO products that meet consumer requirements if they wish to capitalise on this projected growth. Some of the opportunities for research and development include:

- improving understanding of consumer requirements for NOLO wines
- optimising the dealcoholisation process to maximise flavour
- developing products and techniques to improve mouthfeel of NOLO wines
- exploring options for ensuring the microbial and flavour stability of NOLO wines
- identifying viticulture and winemaking practices that can improve NOLO wines.

Preliminary studies into the sensory effect of proline in NOLO wines is one example of where further research could be targeted. The regulatory framework surrounding these products is also unclear and confusing and this is a further area that needs consideration, along with new product development and consumer research. Some of these areas are being tackled through an Australian Government-funded CRC-P project involving a consortium of producers and suppliers, led by Australian Vintage Ltd.

In addition, the South Australian Government, through PIRSA, in 2023 launched a NOLO trial-scale research facility at the Waite Campus in Adelaide. This facility allows research and new product development trials on volumes as low as 150 litres of wine, providing opportunities for producers to develop NOLO wine products in a low-risk environment. The centrepiece of the facility is a FlavourTech spinning cone column, a form of low-temperature vacuum steam distillation used for NOLO wine production. The facility also has canning and bottling facilities that will allow successful trial products to be packaged and used for consumer, trade, market research and export samples. South Australian businesses have priority access to the facility at substantially subsidised rates, thanks to the investment from the South Australian Government. University of Adelaide and AWRI researchers will also share access to the facility, which is managed by WIC Winemaking Services, a joint venture between the University of Adelaide and the AWRI. Winemakers interested in accessing the new facility should contact John Gledhill, winemaker at WIC Winemaking Services, email: john.gledhill@awri.com.au

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