

Final Plain Language Research Summary - AgriScience Grape & Wine Cluster 2018-2023

Activity: *Improving wine quality through mixed and sequential fermentations with indigenous yeasts*

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Introduction

Winemaking is a burgeoning industry in Nova Scotia, with many new opportunities to create regionally distinctive products. While commercial yeasts are usually added to grape juice to induce wine fermentation, many native yeasts reside naturally on grape skins and can noticeably influence wine flavour (the “microbial terroir”). There is therefore recent interest in natural, or spontaneous, fermentations that forgo the addition of commercial yeast and rely on native yeasts to produce wines that are more representative of the local region. Although a lack of control over the end product makes natural fermentations somewhat risky, this can be reduced by using both indigenous (native) and commercial yeasts simultaneously (mixed fermentation), or by allowing the native yeasts to ferment initially, followed by commercial yeast to ensure completion of the fermentation process (sequential fermentation). This project aimed to 1) document and characterize the native yeasts in Nova Scotia vineyards, 2) determine their influence on wine quality, alone or in combination with commercial yeast, and 3) grow and store promising native yeast strains to produce mixed starter cultures that can provide the benefits of native yeasts without the risks of fully natural fermentations.

Methods

Grape samples were collected from eight Nova Scotia vineyards over multiple years and used for spontaneous (natural) fermentations. Yeasts were also cultured from these grapes and characterized with respect to their fermentation properties. Promising indigenous yeasts were then utilized in both mixed and sequential fermentations with a commonly used strain of commercial yeast. The flavour and aroma of the products of these fermentations were assessed by a wine tasting panel to link the quality of the final products to the occurrence of specific native yeasts. Indigenous vineyard yeast communities were also characterized by next generation DNA sequencing technology before and after spontaneous fermentation, as well as across vineyards and across sampling years, allowing for more informed selection of promising indigenous yeast strains.

Results

The isolated indigenous yeasts exhibited a wide diversity of fermentation properties (e.g., tolerance to alcohol and sulphur dioxide). Wines made with the indigenous yeast *Saccharomyces uvarum*, and wines made with non-*Saccharomyces* yeasts had alcohol and acid levels that were slightly lower, and sugar levels that were slightly higher, than wines fermented with commercial yeast. A native yeast collection and data base have been established for future research and to allow wine makers access to this resource.

Wine tasting scores (based on flavour, texture and aftertaste) for wines produced with an indigenous species of *Saccharomyces* followed by commercial wine yeast after either seven or 14 days were generally somewhat better than the score for the commercial yeast alone, although the differences were not statistically significant.

Important attributes of these wines included light flavour, sweet, crisp and apple taste. Scores for wines fermented with three non-*Saccharomyces* indigenous yeasts followed by a commercial yeast at 4 and 7 days were also higher than that score for the commercial yeast alone. Although again, the differences were not statistically significant. Important attributes included strong flavour, bitter and pungent tastes in some cases.

Scores for wines made using mixtures of indigenous *Saccharomyces* yeasts and commercial yeast at different ratios were more variable. Favorable descriptors included sweet, light flavour, pear, and citrus, although some bitter and pungent attributes noted in some treatments. Scores for the mixed fermentations were slightly higher than for the commercial yeast alone, but one of the yeast mixtures resulted in wines with an average score that was significantly higher than that of the commercial yeast alone.

The next generation DNA sequencing of vineyard yeasts showed strong shifts from non-fermentative yeasts in the pre-fermentation musts to dominance by either *Saccharomyces cerevisiae* (the same species as used commercially) or its native relative, *Saccharomyces uvarum*. The DNA data also shows that although yeast communities within a vineyard differed from year to year, this was not as great as the variation among different vineyards. Although we had expected that yeast communities in vineyards with organic management would be more diverse than in conventional vineyards, this difference was not statistically significant. However, there were large differences in the groups of yeasts inhabiting organic and conventional vineyards, mainly related to the types of non-fermentative yeasts present.

We have characterized Nova Scotian indigenous vineyard yeasts in terms of their diversity, fermentative properties and the taste and aroma of the wines they can produce. We found that specific mixtures of indigenous and commercial yeasts can result in wines with sensory attributes superior to those made with commercial wine yeast alone. This is a promising result, which together with our other data, will allow local winemakers to begin utilizing the native yeasts found in their vineyards to create distinctive wines with qualities reflecting the Nova Scotia wine making region.