# ELABORATION OF TECHNOLOGY FOR PRODUCING WHITE WINES WITH LOW ALCOHOL DEGREE BY COMBINED FERMENTATION

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**Abstract:** It's often stated that there is a need for more innovation in the wine category, but actually realizing this can be problematic in an area of the drinks industry where tradition is so important, and so many rules surround its production. Now, however, technology and consumer demand have come together to create the potential for an entirely new category of wine: reduced alcohol table wines that should taste every bit as good as their full-strength peers.

The use of immobilized yeast technology and its advantages in sparkling wine production was chosen for reduced alcohol wines production by using immobilized active dry yeasts sterile and sterile air dosage 6 mg $O_2$/L must into sacks made from permeable membranes with diameter of pore 0,60 μm.

**Keywords:** reduced alcohol wines, immobilized yeast, combined fermentation.

## Introduction

Production techniques for manufacturing low or reduced alcoholic strength beverages have been developed over the last 15 to 20 y in order to satisfy a consumer demand for healthier alcoholic products. Decreasing alcohol consumption is a worldwide trend and lower alcohol consumption rates are associated with certain positive health benefits [2]. Beverages with reduced ethanol concentrations are also more favorably excised in most countries thereby producing some competitive advantages for wine sales compared to full alcoholic strength wines. Producers may also wish to marginally reduce alcohol concentrations in full-strength wines to correct balance and maintain consistency of style between vintages or blends. It has also been reported that alcohol reduction can lead to an alcohol "sweet spot". These sweet spots have been described when the alcohol level in a given wine is varied by as little as ±0.1%. Significant differences in flavor intensities and balances are purportedly present in the favored sweet spot alcohol levels [1]. This anecdotal evidence should be considered in light of recent investigations that demonstrate ethanol difference thresholds are approximately 1.0% v/v [4]. The production methods that are of most relevance to the wine industry, while not exhaustive, are summarized in Table 1 and generally form the basis of discussion in this article. Technologies have been classified according to the stage of wine production they are typically used; that is, pre, concurrent, or postalcoholic fermentation.

However, some well-established "post fermentation" techniques, such as low-temperature distillation, have been applied during alcoholic fermentation for the removal of approximately 2% v/v of ethanol without significantly changing the concentration of other wine constituents [1]. This information will allow winemakers to assess the relative technical merits of each of the technologies described and make decisions regarding implementation of novel winemaking techniques for reducing ethanol concentration in wine.

***Table 1.*** Technologies for reducing ethanol concentration in wine and fermented beverages [1]

| Stage of wine production | Principle | Technology |
|---|---|---|
| Prefermentation | Reduced fermentable sugars | Early fruit harvest<br>Juice dilution<br>Glucose oxidase enzyme |
| Concurrent with fermentation | Reduced alcohol production | Modified yeast strains<br>Arrested fermentation |
| Postfermentation | Membrane separation | Reverse osmosis<br>Pervaporation<br>Osmotic distillation |
| | Nonmembrane extraction | Solvent extraction<br>Ion exchange<br>Spinning cone column |

Limiting alcohol production during fermentation by lowering the concentration of fermentable sugars in juice through early grape harvest, juice dilution, or arresting fermentation, while significant levels of unfermented sugars remain in the wine are some of the options that enable wines with reduced alcohol levels to be produced. Early grape harvest may result in wines that are organoleptically undeveloped due to reduced flavor precursor development in the grapes prior to harvest, high acidity levels, and lack of yeast-contributed flavor compounds. Comparatively, arrested fermentation leaving high residual sugar levels in wines may dictate that the finished product will require pasteurization for microbial stabilization, thereby leading to potential loss or alteration of volatile flavor and aroma compounds. Adjusting vine leaf area to crop ratio is an interesting viticultural intervention for moderating the concentration of fermentable carbohydrates in harvested wine grapes [3]. This promising and emerging approach to managing grape sugar concentrations attempts to address the imbalance between carbohydrate accumulation and the development of sensorially important grape constituents. However, significant research is still required to determine the optimum leaf to crop ratios, timing, and location of leaf removal from the vines relative to fruit location and the long-term impact upon vine physiology. Juice dilution can only be performed using a low Brix grape adulterate, as addition of water is not a permitted process for wine production. Low Brix grape juice, a by-product of grape juice concentrate, is more commonly used to maintain wine concentration during reverse osmosis or thermal distillation techniques for alcohol removal. Recent methods that target prefermentation production strategies for reducing alcohol in wines have, therefore, focused upon technologies that minimize loss or alteration of desirable organoleptic qualities and off-flavor development. The use of enzyme technology for lowering the concentration of fermentable sugars in grape juice there by limiting alcohol production prior to fermentation is one such methods and will form the basis of discussion for prefermentation production options in this article.

The other technique currently used to reduce alcohol is reverse *osmosis,* which is a type of filtration system. It’s complex to explain in brief, but it works in a similar way to the body’s kidney: while conventional filtration systems have their flow blocked by the filtration membrane, which becomes clogged, here the flow is tangential to the membrane, which helps prevent the pores becoming blocked, although it requires a much larger membrane surface. It's also known as „cross-flow" filtration The consequence of this is that you need lots of very long filtration tubes all bundled together for reverse osmosis, making the system expensive compared with standard filtration systems, although it is still portable and very much cheaper than the spinning cone column.

Exporting an alcohol-reduced wine from a country where this is legal to the European Union can be problematic. In the UK the regulations are overseen by the Wine Standards Branch of the Food Standards Agency, which is staffed largely by ex-policemen, who enforce the rules rigidly and who don't necessary have expert technical wine knowledge. The legal definition of wine is that it has to have 9% alcohol.

How does the process work? You might have a Chardonnay at 14% alcohol. You take 10 000 litres, which you put through the spinning cone, taking off first the volatile fraction ('essence') and then the alcohol, leaving you with 8250 litres of Chardonnay at 4% alcohol. You then add the aromatic 'essence' back in, which in some cases may enhance the wine because you are adding the volatile fraction from the original wine back to a smaller volume. The resulting 4% wine can be used as a blending component to add to untreated wine, to result in a final wine at a lower alcohol level.

How do the wines taste? The Californian Chardonnay at 14.3% alcohol. It had a sweet, ripe, slightly buttery nose, leading to a rich buttery palate that was quite broad. I then tasted the same wine after it had been through the spinning cone column, at 4% alcohol. This was more minerally with tangerine notes and some spicy richness. The palate was lemony and tart with hollow fruit and an enhanced sensation of acidity. Alcohol is a masking agent, so taking it away reveals what's there. It also adds sweetness to the palate.' It's this sweetness that is missing in the 4% sample, and which exaggerates the acidity.

The next wine was a blend of 10% of the 4% sample with the remainder of the original wine, resulting in a Chardonnay at 13.2%. This was fresher than the original with more acidity apparent. The fruit showed through more. There's a quite a difference, and the 13.2% wine was much nicer than the 14.3% original.

Then it tried the alcohol fraction that comes off the machine. This had a big whiff of sulphur dioxide, which comes off with the alcohol, and tasted quite sweet with a nice richness to it. The next sample was the essence fraction: the aromatic component that's the first to come off the column. This had amazing aromatics when it was cut with water: really citrussy, fruity and estery.

Selection of specific yeast strains and their use as starter cultures for the consistent manufacture of a wine style is a common winemaking practice. The use of specific yeast strains for wine production also ensures improved fermentation reliability and predictability than reliance upon natural fermentation [1]. A difficulty faced by some winemakers and viticulturists is the production of wine grapes that have a balance between flavor components and accumulated sugar. The requirement for some producers to harvest grapes at high levels of fermentable sugar to achieve typical varietal characters produces wines with excessive alcohol concentrations and undesirable palate hotness [2].

One strategy to overcome the excessive production of alcohol in these wines is the selection of yeast strains with lowered ethanol production during fermentation. Some variability in ethanol production by different commercially available wine starter cultures of *Saccharomyces cerevisiae* has been described; however, the difference in final ethanol concentrations determined in one controlled experiment was less than 1% v/v [1]. The selection of yeasts other than S. cerevisiae with lower ethanol production rates for grape juice fermentation is possible. Low alcohol wines produced by the fermentation of oxidized grape juice using strains of *Pichia* and *Williopsis* were demonstrated to have an acceptable, albeit different palate structure and organoleptic qualities, than wines produced with *S. cerevisiae* [3]. A problem of fermentation using novel or wild yeast species is potential off-flavor development and undesirable organoleptic characters [4], hence the development of genetically modified *Saccharomyces strains* for wine production.

Although the future for such wine products remains unclear, the reduction of ethanol concentration in wines to acceptable levels to maintain style consistency between vintages is, however, likely to remain an important wine production process for many manufacturers.

## Materials and methods

As research's objects were accepted Sauvignon and Aligote grapes, immobilized of EZ FORM 44 - active dry yeast.

Alcoholic fermentation went with oxygen dosage. Dosed oxygen, which had a positive influence on biomass accumulation, and transforming sugars into dioxide of carbon and water. Fermentation was monitored daily, as determined by refract meter thus УРЛ-1 sugars remaining in the environment that were to be converted into alcohol. After, completion of alcoholic fermentation with yeast immobilized tubes were then dried and subjected to dialysis prompting and measuring, it was determinate exact formed pure yeast biomass.

For determination of physical and chemical indexes of obtained wine were used analytical methods appropriate standard and recommended by the OIV.

## Results and Discussion

The technology for producing wines with high alcohol reduced by alcoholic fermentation combined is based on making the alcoholic fermentation of a party must use strains of selected yeasts of the species Saccharomyces cerevisae at the optimal conditions for producing quality white wines and the aerobic in the bioreactor to another parties must, and after the first part is assembled with the second part.

To get better results on the quality of the product obtained is optimal that: the first must be obtained from aromatic varieties Sauvignon, Chardonnay, etc., and the second of predominantly non-aromatic varieties Aligote.

Elaborated scheme was carried out in production at the winery "JavgurVin" JVC. Aromatic grapes variety Sauvignon had mass concentration of sugars 198 g/L and titratable acidity 7.8 g /L.. Neutral grapes variety Aligote had mass concentration of sugars 182 g/L and titratable acidity 7.9 g /L. They were processed according to the scheme into Figure 1.

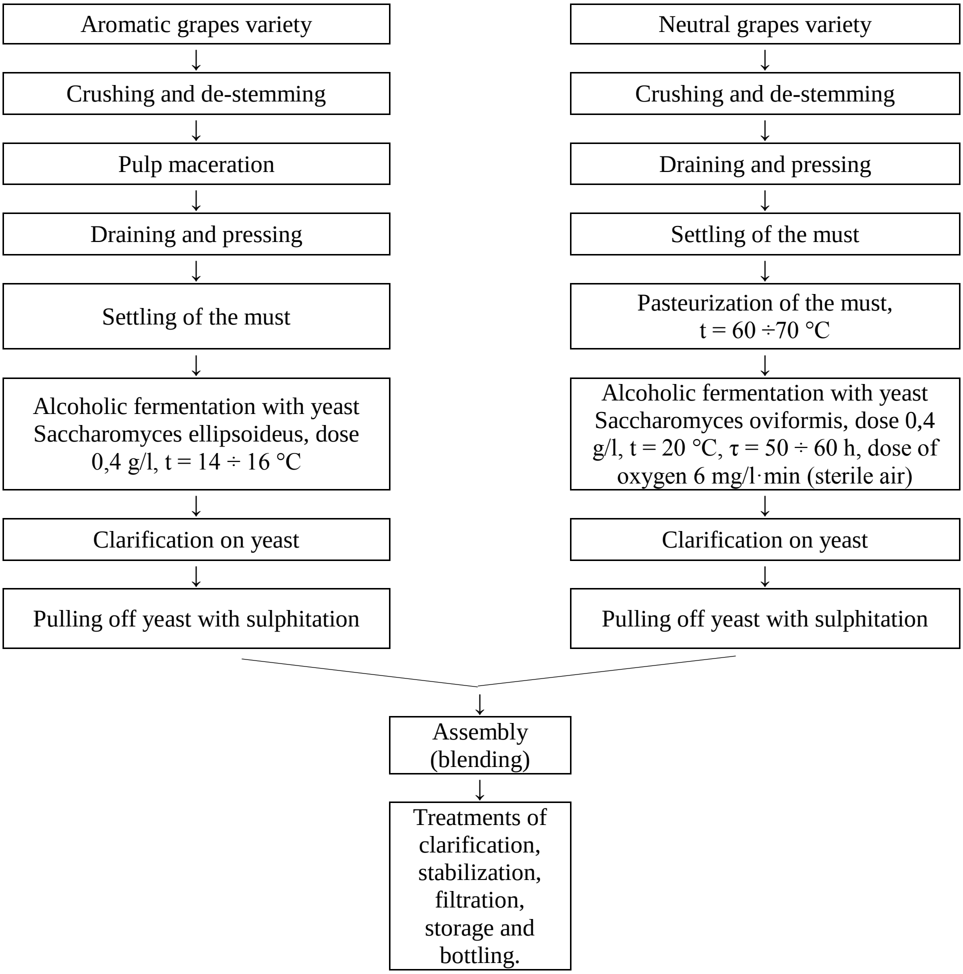


***Fig. 1.*** Technological scheme of producing low alcohol grade wines by combined fermentation

Theoretical calculations have shown practically confirmed that in order to obtain a 2% vol low alcohol wine is necessary to carry out the following calculations in Table 2.

***Table 2.*** Physico-chemical indices of wines with low alcohol grade

| **Mass concentration of initially sugars in grape must, g/L** | **Volume, dal** | | **Alcoholic strength of the final product,% vol.** |
|---|---|---|---|
| | **Party I** | **Party II** | |
| 200 | 800 | 200 | 10,8 |
| | 700 | 300 | 10,2 |

After removal of the yeast, the obtained products were blended in a ratio of 8: 2 to 7: 3. Physical and chemical indices of obtained wines are presented in Table 3.

***Table 3.*** Physico-chemical indices of wines with low alcohol grade

| Samples | Physico-chemical indices | | | | | | |
|---|---|---|---|---|---|---|---|
| | The alcoholic strength, % vol. | Mass concentration of: | | | | | pH |
| | | invert sugar, g/L | titratable acids, g/L | volatile acids, g/L | total sulfur dioxide, mg/L | nonreducing dry extract, g/L | |
| Sauvignon | 11,6±0,1 | 3,0 ± 0,5 | 6,7 ± 0,13 | 0,6 ± 0,003 | 113 ± 10 | 18,7 ± 0,1 | 3,2±0,1 |
| Aligote | 5,9±0,1 | 2,6 ± 0,5 | 7,3 ± 0,13 | 0,7 ± 0,003 | 120 ± 10 | 18,1 ± 0,1 | 3,1±0,1 |
| Sample 1 (8:2) | 10,3±0,1 | 2,9 ± 0,5 | 7,1 ± 0,10 | 0,65±0,003 | 115 ± 10 | 18,6 ± 0,1 | 3,1±0,1 |
| Sample 2 (7:3) | 9,6±0,1 | 2,8 ± 0,5 | 7,2 ± 0,10 | 0,67±0,003 | 116 ± 10 | 18,5 ± 0,1 | 3,1±0,1 |

Organoleptic analysis showed the difference between wine from variety Sauvignon which it has a superior flavor than sample 1 and sample 2. Also it was found that experimental samples satisfy the requirements for dry white wines.

## Conclusion

It was experimentally confirmed the possibility of obtaining low alcoholic wine by using combined fermentation with aerobic fermentation.

We have confirmed that the quality product can be obtained by blending wine obtained by alcoholic fermentation and product obtained through aerobic fermentation.

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