Complexing Factors in Sparkling Wine, with Particular Reference to New Zealand

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A brief history of bottle fermented sparkling wine in New Zealand
The first experimental work on bottle fermentation was done as late as the 1950s by the late Mate Selak from Selak’s Wines in Auckland. This was followed by the first small volume of wine produced by Brother John at the Mission Vineyard, Hawkes Bay in the 1960s. These wines from the Mission Vineyard were based on Pinot Gris and Pinot Meunier. On the retirement of Brother John in the mid 1970s sparkling wine production at the Mission ceased.

Selak’s ‘Champelle’, the first commercially available fermented sparkling wine made by a New Zealand company, was released in the mid 1970s. The New Zealand Wine Guide, published in 1976, described the wine as being Made from the Golden Chasselas grapes. A straw coloured, medium dry and very pleasant sparkling wine with the slightly earthy taste of all the great Champagnes.

With the first substantial quantities of methode champenoise produced by Montana in 1981 and Penfolds (NZ) in 1983 came the use of the classical Champagne varieties, Pinot Noir and Chardonnay. Continuous improvements by Selak’s and new production by Le Brun, Vidal and Morton Estate saw a dramatic increase in the quality of premium quality New Zealand sparkling wine.

The second half of the 1980s and the early 1990s led to recognition of the potential by overseas producers, resulting in the direct or indirect involvement of four Champagne houses and a substantial number of Australian producers.

Material for base wine is sourced mainly from Hawkes Bay, Marlborough and Gisborne, but with such a wide range of cool grapegrowing areas scattered throughout both Islands, the options are very broad. Chardonnay and Pinot Noir are normally used, but Pinot Meunier is becoming more common.

A recent article by Tom Stevenson published in the UK magazine stated that he felt that the best sparkling wine producer in the Southern Hemisphere was Cellier Le Brun from Marlborough. This recognition, coupled with the rapid improvement in New Zealand’s overall sparkling wine quality and Montana’s substantial export success, makes the future look promising.

Note from Table 1 that Chardonnay is now the largest area planted of all varieties.

Complexing factors in sparkling wine
Sparkling wine is very much a man-made wine, with the scope for winemaker influence very broad. The greater the potential for interference by the winegrower, the greater the potential for complexity and individual styles. Possibly the only wine offering the same palette of colours to work with is Champagne. To the winegrower, bottle fermented sparkling wine offers the same opportunity to stamp his or her style on the end result. Because of these possibilities, wines of great complexity can result.

Complexity is the effect on a wine of many different factors, each adding its own piece to the puzzle. None should dominate and the aim should be for balance. If the winegrower’s aim is to produce a simple, one-dimensional wine, then bottle fermentation should not be used since the very nature of the process results in a myriad of aromas and flavours.

The major factors giving rise to complexity in sparkling wine include:
1. Viticultural considerations
2. Base wine production - winemaking aspects

Table 1. New Zealand production figures*

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total table wine</td>
<td>48 million litres</td>
</tr>
<tr>
<td>including - total sparkling</td>
<td>5.7 million litres</td>
</tr>
<tr>
<td>- total red</td>
<td>4.3 million litres</td>
</tr>
<tr>
<td>- total white</td>
<td>38 million litres</td>
</tr>
</tbody>
</table>

Of total sparkling, methode champenoise accounted for: (4.2% total table wine)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total vineyard area planted</td>
<td>6,000 ha</td>
</tr>
<tr>
<td>Chardonnay</td>
<td>1,230 ha</td>
</tr>
<tr>
<td>Pinot Noir</td>
<td>384 ha</td>
</tr>
<tr>
<td>Pinot Meunier</td>
<td>10 ha</td>
</tr>
</tbody>
</table>

3. Tirage decisions
4. Disgorging decisions
5. Post disgorging ageing.

Viticultural considerations
Bearing in mind that sparkling wine is about finesse, which factors are going to have the major influence in producing a base wine with a wide range of primary aromas and flavours, yet still allow the appropriate balance and texture to be achieved? Ideally ripe fruit flavours are required at approximately 10-11% (v/v) alcohol.

Vineyard site selection
Macro-, meso- and microclimates will play the largest role in flavours and analytical considerations. Soil type, and in particular physical aspects, will greatly effect wine vigour.

Variety selection
To produce a complete and complex wine, the combination of inputs of each variety’s characteristics is required. The following outlines the contribution of Chardonnay, Pinot Noir and Pinot Meunier to wine structure.

Chardonnay – finesse, ageing potential, intensity of aroma, acidity, lightness, freshness and elegance. It contributes largely to the nose of the wine.

Pinot Noir – vinosity, body, strength, richness, depth and aromatic primary fruit characters. It provides the backbone of the blend and its fruity characters are enhanced by yeast autolysis.

Pinot Meunier – in suitable (cool) vineyard sites, adds immediate fruity-flowery aromas and flavours, strength and shows less finesse, making the wines more accessible when young since it ages more rapidly. Barrel fermentation rapidly gives characters we normally associate with autolysis, in particular delicate ‘mushroomy’ aromas.

Other varieties such as Pinot Gris and Pinot Blanc may also be considered for sparkling wine as their characteristics are quite distinct and complementary. Pinot Gris in particular shows potential in New Zealand conditions.

Cultural Practices
Cultural practices of relevance include:
- planting distances and row orientation
- trellising, training and pruning

These affect fruit flavours and acid balance by controlling vigour and fruit exposure.

- crop level: affects vigour and fruit flavour intensity
- irrigation: affects vigour
- leaf removal: influences exposure and affects acid balance and flavour
- pest and disease control: e.g. occurrence of botrytis certainly adds to complexity, but it is not exactly desirable.

Winemaking aspects
Whilst the viticultural aspects provide the canvas on which to work, winemaking provides the points with which to colour the picture.

Harvest date can be timed to meet specific criteria to produce base wines which in turn will contribute the required complexity following the blending process.

The data shown in Table 2 indicates that different areas, and vineyards within those areas, obviously ripen at widely varying times. For the same analytical criteria, flavours, colours and resulting textures will be very different, adding to the complexity of the final blend.

Table 2. New Zealand grape maturity data for Chardonnay and Pinot Noir at harvest time.

<table>
<thead>
<tr>
<th>Harvest date</th>
<th>°Brix</th>
<th>TA (g/L)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marlborough</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993 Pinot Noir</td>
<td>30/3</td>
<td>19.4</td>
<td>9.4</td>
</tr>
<tr>
<td>1993 Chardonnay</td>
<td>2/4</td>
<td>20.6</td>
<td>10.9</td>
</tr>
<tr>
<td>1992 Pinot Noir</td>
<td>9/4</td>
<td>20.5</td>
<td>14.1</td>
</tr>
<tr>
<td>1992 Chardonnay</td>
<td>24/3</td>
<td>20.5</td>
<td>12.2</td>
</tr>
<tr>
<td>1991 Pinot Noir</td>
<td>24/3</td>
<td>19.6</td>
<td>13.2</td>
</tr>
<tr>
<td>1991 Chardonnay</td>
<td>24/3</td>
<td>19.6</td>
<td>13.2</td>
</tr>
<tr>
<td>Hawkes Bay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993 Pinot Noir (from 2 vineyards)</td>
<td>26/3</td>
<td>21.1</td>
<td>15.8</td>
</tr>
<tr>
<td>1993 Chardonnay</td>
<td>29/3</td>
<td>18.4</td>
<td>13.4</td>
</tr>
<tr>
<td>1992 Pinot Noir</td>
<td>1/4</td>
<td>19.7</td>
<td>13.8</td>
</tr>
<tr>
<td>1992 Chardonnay</td>
<td>12/3</td>
<td>17.3</td>
<td>13.4</td>
</tr>
<tr>
<td>1991 Pinot Noir (from 2 vineyards)</td>
<td>20/3</td>
<td>20.2</td>
<td>13.1</td>
</tr>
<tr>
<td>1991 Chardonnay</td>
<td>23/3</td>
<td>18.6</td>
<td>13.7</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993 Pinot Noir</td>
<td>24/3</td>
<td>17.1</td>
<td>10.3</td>
</tr>
<tr>
<td>1992 Pinot Noir</td>
<td>29/3</td>
<td>17.1</td>
<td>12.0</td>
</tr>
<tr>
<td>1991 Pinot Noir</td>
<td>19/3</td>
<td>19.6</td>
<td>8.9</td>
</tr>
</tbody>
</table>

Figure 2. Flavour profiles of young cuvées
Source: Adapted from the article ‘Methode Champenoise and High Technology’ by W. Randall, presented at the Viewcon Conference (1989).
Generally the criteria would be to have mature fruit flavours, not over-ripe, at Brix levels sufficient to give 10–11% (v/v) alcohol and a balanced acid and low pH. Base wines should be clean, delicate and not too varietal, showing body and texture. Unripe grapes are unlikely to produce these results, hence the importance of cool growing areas. Ideally, the acid should not have to be adjusted.

Timing of the harvest in cool, damp conditions may also be critical for freedom from disease, particularly botrytis.

Sugar concentration, total acidity and pH are the principal criteria used, but flavour, colour (especially in the red varieties) and cleanliness are very important considerations.

**Fruit handling and processing considerations**

The following factors will influence the levels of primary fruit characters and phenols in the juice, and hence the texture of the wine:
- hand harvesting vs machine
- size of picking containers
- skin contact from harvest processing for machine harvested fruit
- use of sulfur dioxide, ascorbic acid vs oxidative handling
- whole bunch pressing vs crushing/dejuicing
- the type of press and cycles used
- use of enzymes
- cut-off points for juice fractions
- fining of the juice (PVPP, gelatine, carbon, bentonite)
- temperature of fruit
- juice clarification: cold settling, centrifugation, filtration

The aim is to produce a wine of finesse, balance and complexity of flavours and aromas, so those techniques which reduce phenolics and retain the desired fruit should be favoured. Oxidative juice handling can add to the complexity, reduce phenolics and aid the MLF (if considered desirable).

**Apects of primary fermentation**

Factors to consider at the primary fermentation stage which can influence complexity include:
- type of yeast strain, including wild yeast can dramatically alter the aroma and flavour characteristics of the resulting wines, giving many options for complexity
- temperature of fermentation: increase, decrease fruit aroma
- chaptalization and acid adjustment: change mouth feel
- choice of fermentation vessel: the inertness and ease of temperature control of stainless steel vs the complexity options of old or new oak barrels or large oak fermentation tanks
- use of oak chips to add a different dimension
- the potential to use malolactic fermentation during the primary ferment obviates the need for warming product later; MLF normally proceeds more rapidly and with less off odours or stuck ferments.
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- use of enzymes
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**Post primary fermentation factors**

Base wine blending can be preceded by various steps to enhance complexity including those identified in the following points:
- time on yeast lees after fermentation and stirring of lees over the period to give some autolysis character prior to tirage. Consider the implications of oxygen scavenging and colour and protein fining capability of spent yeast cells on freshness, colour and bubble retention in the potential base wine.
- further barrel ageing following barrel (or tank) fermentation with regard to oak flavours and barrel fermentation characters, such as meaty and biscuity aromas and flavours
- post fermentation clarification and fining using finings such as isinglass and casein to modify mouth feel (texture) of the base wines vs centrifugation or filtration
- stabilising considerations: use of bentonite and acid/pH adjustment to give balance
- temperature of storage of base wine prior to tirage.

**Blending considerations**

The complexity of the base wine is probably the single most important factor influencing complexity of the finished sparkling wine. Having produced a range of base wines from differing areas and varieties, all with their own distinct characteristics, the blender must then take the individual pieces of the puzzle and build the whole picture, taking into consideration the style he is trying to reproduce. It is necessary to consider:
- vintage or non-vintage; with non-vintage, variety of style is an important consideration. Whilst maintaining a house style with vintage wines, vintage variations are an obvious influence on the end result.
- the use of reserve wines adds another dimension to the blend and is especially useful for maintaining house styles
- storage of reserve wines: whether glass, stainless steel or oak, will influence the balance of complexity added to the blend.
- perceived age of reserve wines will also greatly influence complexity: storage conditions, especially temperature will have a great effect on the quality of the reserve wines.
- fining of the blend with casein, gelatine, carbon, etc. will influence its ageing potential, colour and texture.

**Tiraging, secondary fermentation and ageing**

Yeast strains vary considerably in the type of flavours they produce during the secondary fermentation and the subsequent autolysis characters they contribute to the final wine. Further considerations at this stage of the production process include:
- source of sugars for tirage: e.g. use of cane sugar, liquid cane sugar, honey or raw sugars for the secondary fermentation can add vastly different flavours if used in appropriate amounts
- fermentation temperatures are quite critical and should be from 12–15°C for the most consistent and best results. Higher temperatures can give rise to excess off odour products and low temperatures may result in very sluggish fermentations with off odours or stuck fermentations.
- mixing of yeast during storage following secondary fermentation allows for greater control with yeast cells, possible giving greater autolysis character
- length of time on yeast prior to disgorging has a large influence on the level of autolysis, hence complexity, texture and general flavour as the yeast cells excrete amino acids
- autolysis is dependent upon pH, ethanol concentration and storage temperature
- ultra violet light can produce mercaptan and butyric acid which certainly increases complexity, but very undesirably; hence the use of dark storage areas or suitable glass colours.

**Disgorging**

In comparing the transfer process to that of methode champeroise, product consistency and the ability to blend at disgorgement are key considerations. The expedition liqueur can have great complexity value. Relevant characteristics of the expedition liqueur include:
- reserve wine used — bottle, barrel or tank-aged
- type of spirit — brandy or neutral
- origin of sweetener/sugar
- amount used
- SO₂/ascorbic as anti-oxidants.

**Post disgorging**

The length of time 'on cork' affects autolysis and bottle age, adding a toasty element. The temperature of storage of finished wine will also affect final complexity.

To sum up, the following are the factors I consider to be most influential in producing complexity in sparkling wines.

- Vineyard selection
- Variety selection
- Trellising and training
- Vintage variations
- Harvest criteria and timing
- Fruit handling
- Pressing considerations
- Type of yeast for primary fermentation
- Fermentation vessel type and temperature
- Malolactic fermentation
- Yeast lees handling
- Blending and use of reserve wines
- Type of yeast for secondary fermentation
- Temperature of secondary fermentation
- Length of time on yeast lees
- Expedition liqueur
- Length of time 'on cork'

**Final comments**

Bear in mind the situations when sparkling wine is consumed. It is made mainly as a drink of celebration, and balance and texture are most important.

Despite what producers might say to the contrary, we are indeed seeking to emulate the style and complexity of Champagne by the use of traditional Champagne grape varieties and production techniques, albeit modified to take advantage of our own strengths.