

## A Comparison of Table and "Late Harvest" Style Cayuga White Wines Made With Amelioration, Freeze and Evapor® Concentrated Juices

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**Abstract** Many Eastern grapes are naturally low in sugar. The sugar content of the juice is often increased by amelioration with sugar. This results in wines with reduced body and sensory characteristics compared to wines made from grapes with higher sugar levels. Concentration of the juice should increase varietal character and subsequently increase wine quality. Cayuga wines were made by ameliorating from 17.2 to 20.5°B with cane sugar and by concentrating the juice from 17.2 to 20.5°B using either freeze concentration or an Evapor® thin-film centrifugal evaporator. A "late harvest" style wine was also produced by concentrating juice from 17.2 to 30.5° Brix using each concentration method. The wines made from concentrated juice had the most intense yellow-green color. A sensory panel could not tell the difference between table wines made by concentrating juice or by adding cane sugar. Wines made by concentrating juice with the Evapor® unit were slightly more brown than the wines made from freeze concentrated juice. This was most evident in the "late harvest" style. The "late harvest" style wine made with Evapor® concentrated juice was also more yellow in color than the wine made with freeze concentrated juice. Late harvest style wines, made using freeze concentrated juice, rated slightly higher in sensory tests than wines made with the Evapor® concentrated juice.

**Introduction** Many grapes grown in cool climates do not develop adequate sugar levels and are ameliorated with sugar for wine production. Wines produced using cane sugar generally have reduced body and sensory characteristics as compared to grapes produced from the same variety that develop higher sugar content. If low sugar juices were concentrated without the loss of flavor and aroma compounds, they might produce wines with improved sensory characteristics.

Two concentration methods are available that do not cause significant loss of flavor or aroma components. These methods are thin-film evaporation and freeze concentration.

Evapor® is a thin-film evaporator incorporating several unique features important to the wine industry. This device passes a thin layer of juice (0.1 mm) under vacuum across a rotating heat transfer surface. The temperature of the heat control surface can be regulated from 50 to 100°C. On average, 10 to 30% of the volume of the juice is removed in a single pass. A paring tube is used to remove the concentrated liquid. The design of this unit minimizes entrainment of air in the juice. The 200g force (adjustable) imparted by the rotating heat transfer surface minimizes foaming and maximizes heat transfer. On the steam side, the rotation maintains a dry heat transfer surface so steam is always in dropwise condensation.

The rotating heat transfer surface moves juice quickly. In general, the time on the heat transfer surface is less than 0.5 seconds. The heat transfer surface has extremely high heat transfer coefficients in a range of 4,000 to 8,000 kcal/ml/°C/h. This makes juice concentration to 68°Brix or higher possible.

Freeze concentration is based on the physical phenomenon of freezing point depression. Water freezes separate from the dry solid. The greater the dissolved solids content of the juice, the lower the freezing temperature required. Freeze concentration avoids most of the difficulties associated with evaporation methods that depend upon heat. It is capable of concentrating most fruit juices to 50°Brix without appreciable loss of taste, aroma, color or nutritive value.

**Figure 1. Juice preparation prior to fermentation.**

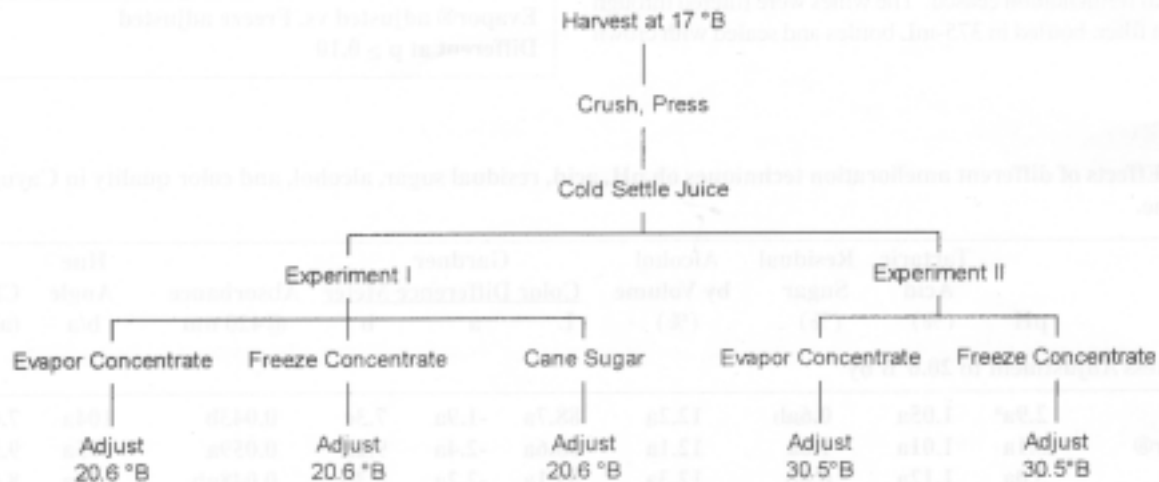


Table 1. °Brix for Cayuga White juice prior to fermentation.

Original Juice °Brix	17.2°B
Table Wine Style Adjusted to 20.6 °B	
Juice 'Brix adjusted with cane sugar	20.6°B
Juice 'Brix adjusted by Evapor®	20.7°B
Juice 'Brix adjusted by Freezing	20.6°B
Late Harvest Wine Style Adjusted to 30.5 °B	
Juice 'Brix adjusted by Evapor®	30.5°B
Juice 'Brix adjusted by Freezing	30.5°B

**Materials and methods** Cayuga White grapes were harvested at the University of Arkansas Vineyards in Fayetteville at 17°Brix. The fruit was crushed and destemmed. The must was pressed in an idopress with the resultant juice cold settled overnight. The solids were racked from the juice. The clear juice was thoroughly mixed and divided into two lots (Experiment I and Experiment 11) (Figure 1).

In Experiment 1, 3 treatments were applied: (1) adjust soluble solids to 20.6°B with cane sugar; (2) adjust soluble solids to 20.6°B with the Evapor®; (3) adjust soluble solids to 20.6°B by freeze concentration. In Experiment II, juice was concentrated to 30.5°Brix using both the Evapor® and freeze concentration.

Freeze concentration was accomplished by freezing juice in a large plastic container to -10°C. The container was removed from the freezer, inverted over a strainer and allowed to thaw. Juice concentrate was collected until the soluble solids level of the melting ice was less than 1°B. This process was repeated several times to achieve 30°Brix.

The juices were inoculated with 0.26 g/L of the yeast *Prise de Mousse* and nutrient *Fermaid K* (Lallemand Inc., Montreal Canada). The wines were racked as necessary and cold stabilized when fermentation ceased. The wines were filtered through a 0.45-µm filter, bottled in 375-mL bottles and sealed with crown caps.

Standard juice and wine analysis techniques were used to determine pH, titratable acidity and absorbance at 420 nm. HPLC techniques were used to determine residual sugars and alcohol. A transmission accessory with a 20 mm-cup was attached to a Gardner Colorgard System 2000 to determine L, a, b values. The module was standardized using the values of L=94.12, a=-0.97 and b=-0.40. Hue angle is defined as the angle whose tangent is b/a.

Triangle tests were used to determine if differences existed between treatments. Samples were tasted under lighting conditions that masked their color. The residual sugar and acidity levels were adjusted on samples so that sugar:acid balance would not be a determining factor.

**Results and discussion** Sugar concentrations were raised from the original 17.2°B to 20.6°B or 30.5°B for the table and late harvest style wines respectively (Table 1).

Experiment I. The table wines produced from these juices were very similar in terms of pH, acidity and alcohol levels (Table 2). There were small differences in color especially for the Gardner colorimeter "b" value. A higher "b" value indicates a more yellow color. Wines made from both the Evapor® and freeze concentrated juices were more yellow in color than the wine made from sugar adjusted juice. The Evapor® treatment had the most yellow color. The chroma value indicates the depth of the color. Wines from the Evapor® and freeze concentrated juices would appear more gold than the wines made from sugar adjusted juice. Wines made from Evapor® treated juices were also more brown in color as indicated by the absorbance at 420nm.

A sensory panel could not detect a difference between the table wine samples in a triangle test (Table 3).

Table 3. Sensory panel results for Cayuga White wines.

Triangle Test	
<u>Wines made from juice adjusted to 20.6°B</u>	
Sugar adjusted vs. Evapor® adjusted	No Difference
Sugar adjusted vs. Freeze adjusted	No Difference
<u>Evapor® adjusted vs. Freeze adjusted</u>	<u>No Difference</u>
<u>Wines made from juice adjusted to 30.5°B</u>	
Evapor® adjusted vs. Freeze adjusted	
<u>Different at p &gt; 0.10</u>	

**Table 2. Effects of different amelioration techniques on pH, acid, residual sugar, alcohol, and color quality in Cayuga White table wine.**

	pH	Tartaric Acid (%)	Residual Sugar (%)	Alcohol by Volume (%)	Gardner Color Difference Meter			Absorbance @420 nm	Hue Angle b/a	Chroma (a <sup>2</sup> + b <sup>2</sup> )
					L	a	b			
Sweetness Adjustment to 20.6°B by										
Sugar	2.9a <sup>a</sup>	1.05a	0.6ab	12.2a	88.7a	-1.9a	7.3c	0.043b	104a	7.6c
Evapor®	3.1a	1.01a	1.0a	12.1a	88.6a	-2.4a	9.2a	0.059a	105a	9.5a
Freeze	3.0a	1.12a	0.4b	12.3a	89.1a	-2.2a	8.3b	0.048ab	105a	8.6b

<sup>a</sup> Means within columns and main effects having the same letter are not significantly different from one another at alpha ≥ 0.05.

**Table 4. Effects of concentration method on pH, acid, residual sugar, alcohol and color quality in Cayuga White "late harvest" style wine.**

	pH	Tartaric Acid (%)	Residual Sugar (%)	Alcohol by Volume (%)	Gardner Color Difference Meter			Absorbance @420 nm	Hue Angle b/a	Chroma (a <sup>2</sup> + b <sup>2</sup> )
					L	a	b			
Concentrated to 30.5°B by										
Evapor®	3.08a <sup>a</sup>	1.32a	9.1b	14.3a	87.1a	-3.1a	14.4a	0.108a	102a	14.7a
Freeze	3.07a	1.36a	10.3a	12.8a	88.6a	-3.7a	12.1b	0.074b	107a	12.7b

<sup>a</sup> Means within columns having the same letter are not significantly different from one another at alpha ( 0.05.

Experiment H. In this experiment "late harvest" style wines were produced by concentrating the juice to 30.5°B using either the Evapor® or by freeze concentration. The freeze concentrated juice fermented more slowly and more residual sugar was left at the end of fermentation (Table 4). The color of the Evapor® treatment was more yellow (higher "b" value), more brown (higher absorbance at 420 nm) and had more depth to the color (chroma). Overall, wine made from Evapor® concentrated juice was more yellow-gold than wine made from freeze concentrated juice.

The sensory panel could distinguish a difference between Evapor® and freeze concentrated treatments in a triangle test. Subsequent sensory tests were conducted to see if one wine had a fruitier aroma than the other and to see if there was a preference. The panelist could not consistently determine that one wine had a fruitier aroma than the other. Over 50% of the sensory panelists preferred the freeze concentrated treatment over the Evapor® treatment.

**Conclusions** Increasing the sugar levels of juice by 3% using either the Evapor® system or by freeze concentration did not improve the quality of Cayuga White wine as compared to cane sugar addition. Both concentration methods increased the yellow color of the wines. The "late harvest" style wines produced by the concentration methods were very similar to the freeze concentration method, slightly preferred.