RESEARCH

CUSTOM BARREL PROFILING

Beaulieu Vineyard

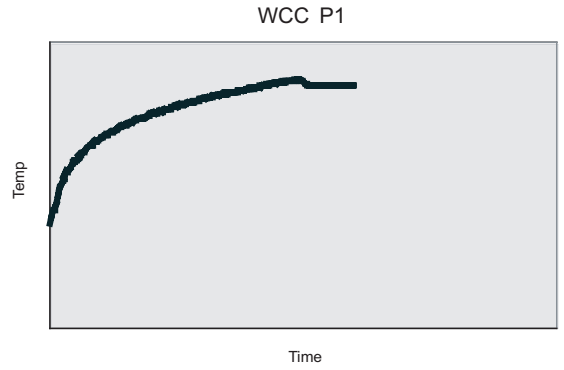
World Cooperage

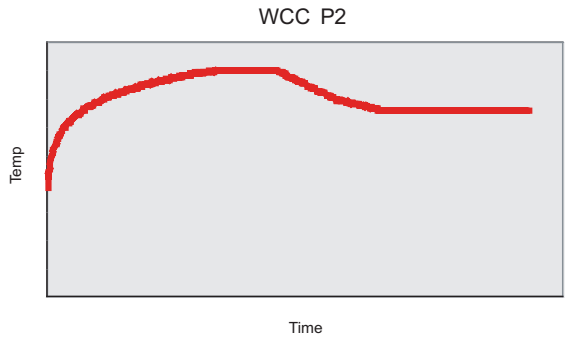
OBJECTIVE

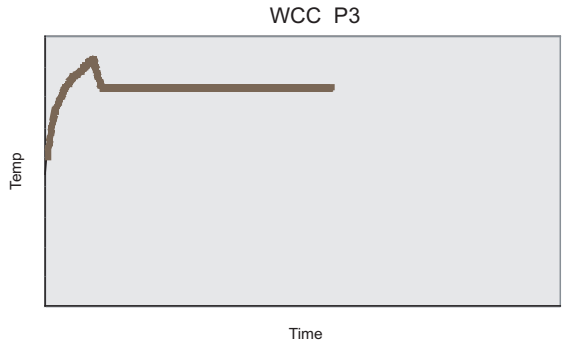
The objective is to determine if the designed, custom profiles meet expectations for Beaulieu Vineyard Chardonnay.

SYNOPSIS

Three custom, or special, profile toasting regimes were coopered and used to barrel-ferment and age Chardonnay wine (see process curves below). These were compared with three existing products: the World Cooperage Traditional, the T.W. Boswell Côte d'Or, and the T.W. Boswell Legacy. All the barrels used 24-month air-seasoned French oak.







THE WINE

Producer:	Beaulieu Vineyard
Year:	2003
Variety:	Chardonnay
Vineyard:	Carneros
Crush Date:	September 26, 2003

Harvest Data

Total Acidity:	0.72 g/100 mL tartaric acid
Brix:	24.8
pH:	3.33
Prior to fermenting added:	2#/1000 Fermaid K, 30z metabisulfite/ton
Days of fermentation:	22
Fermented with:	Ruby.ferm yeast

Wine Analysis as of May 5, 2004

Alcohol:	14.50% volume
Total Acidity:	0.44 g/100mL tartaric acid
Volatile Acidity:	0.040 g/100 mL acetic acid
Free Sulfur Dioxide:	29 mg/L SO_2
Total Sulfur Dioxide:	85 mg/L SO_2
pH:	3.64
Residual Sugar:	dry

OAK DATA

Source:	French oak
Wood Age:	24 months
Toast Level:	Medium plus
Size:	59 gallons

TRIAL EXECUTION

Sample Size:	4 of each variable
Oak Contact Time:	8 months
Bottling Date:	May 2004

THE TRIAL

WCC P1

WCC P2

WCC P3

World Cooperage Traditional

T.W. Boswell Legacy

T.W. Boswell Côte d'Or

RESULTS AND DISCUSSION

The results of the analysis of 25 extractives are shown in Table 1.

Table 1: Extractives analyzed in the Beaulieu Vineyard Chardonnay (in mgL-1, parts per million)

Compound	Traditional	Legacy	Côte d'Or	WCC P1	WCC P2	WCC P3
Tannin breakdown						
Gallic acid	3.12	2.73	3.38	3.14	2.89	2.87
Ellagic acid	5.17	4.30	7.41	4.92	4.07	5.50
Hemicellulose caramelization						
HMF	2.35	2.13	1.52	2.23	2.10	1.90
5-Methyl furfural	0.47	0.42	0.14	0.41	0.36	0.38
Furfural	7.89	5.81	2.06	5.73	4.09	5.11
Wine phenolics						
Protocatechuic acid	1.16	1.08	1.04	1.05	1.15	1.07
Epicatechin	3.42	3.26	3.39	3.37	3.54	3.52
Chlorogenic acid	0.09	0.08	0.04	0.05	0.09	0.06
Caffeic acid	2.79	2.68	2.58	2.74	2.71	2.60
Myricetin	0.02	0.02	0.02	0.02	0.01	0.02
Quercetin	0.14	0.15	0.17	0.22	0.12	0.18
Lignin degradation						
Vanillic acid	0.03	0.03	0.02	0.02	0.03	0.03
Vanillin	0.08	0.07	0.04	0.07	0.06	0.04
Syringaldehyde	0.72	0.73	0.61	0.61	0.41	0.65
Coniferaldehyde	1E-36	0.02	0.01	0.02	1E-36	0.02
Sinapaldehyde	0.05	0.08	0.08	0.11	0.06	0.14
Smoke						
Phenol	0.12	0.09	0.24	0.04	0.07	0.30
Guaiacol	0.18	0.10	0.98	0.17	1E-36	0.86
m/p-Cresol	1E-36	0.01	1E-36	1E-36	1E-36	1E-36
o-Cresol	0.01	0.02	0.21	1E-36	1E-36	0.01
4-methyl guaiacol	1E-36	0.00	0.21	0.02	0.01	0.10
4-ethyl phenol	0.09	0.11	0.54	0.00	0.10	1.20
4-ethyl guaiacol	0.03	0.02	0.20	0.03	0.16	0.68
Oak lactones						
Trans-lactone	0.065	0.086	0.108	0.122	0.09	0.03
Cis-lactone	0.094	0.17	0.203	0.137	0.101	0.101

An overview showing the similarity between the barrels is shown in Figure 1.

Figure 1. 3-D overview of the similarity between the wine samples based on principal component analysis of the chemical analysis

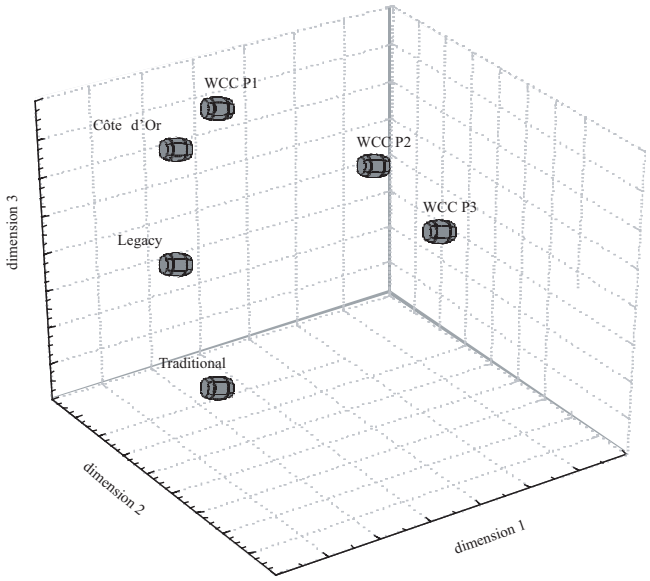
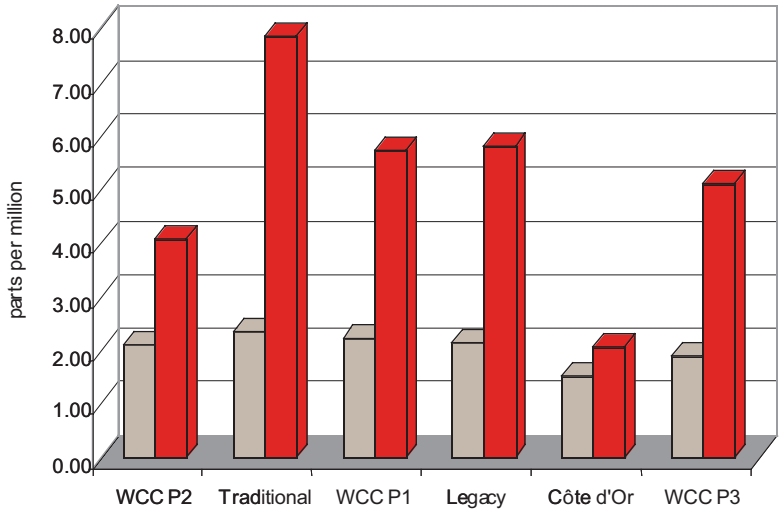


Figure 1 shows that the three new profiles are quite far removed (and therefore quite dissimilar) to the existing World Cooperage products.

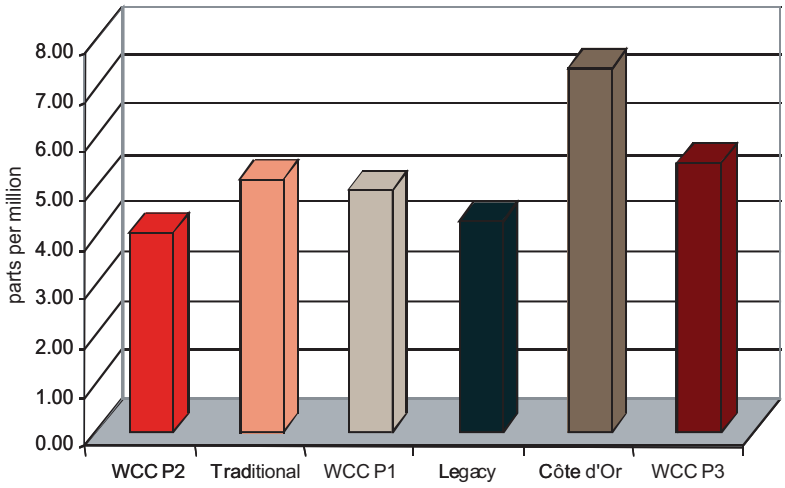
Figure 2. Hmf and furfural in the Beaulieu Chardonnay, in parts per million



Toastiness in the wines from all of the barrels, as measured by Hmf (light creamy toffee) and furfural (burnt acrid toastiness), is shown in Figure 2. The bar chart shows that the Hmf level in the samples is very similar, only the Côte d'Or being a little lower. The World Cooperage Traditional toast barrel had the highest furfural level; this is true to type. Clearly all of these barrels created generous amounts of toastiness and all of the new special profiles were like the Legacy toast, particularly in respect to the Hmf content and relative amount of light creamy toast to dark heavy toastiness.

Figure 3 shows the ellagic acid content of the barrelled wines.

Figure 3. Ellagic acid in the Beaulieu Chardonnay samples (in parts per million)



The results show that the water bent Profile WCC P1 has a little more tannin breakdown than its parent Legacy toast. However the highest level of tannin breakdown still occurs in the Côte d'Or, followed by WCC P3 which was subjected to more intense initial heating than any of the other products.

Figure 4 shows the vanillin content in the wines. Although there are trends that can be related back to the toasting process, all of the levels are very low, probably below threshold, and unlikely to influence flavor at this time. These wines were, of course, barrel fermented which does lead to assimilation of vanillin in the initial stages of barrelling.

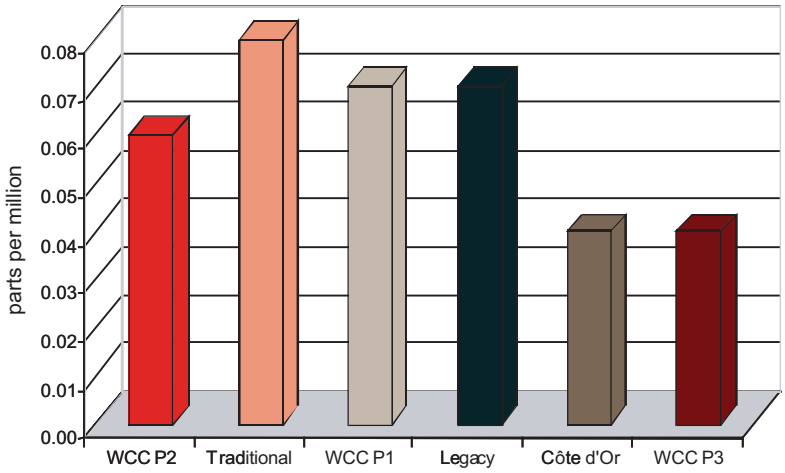
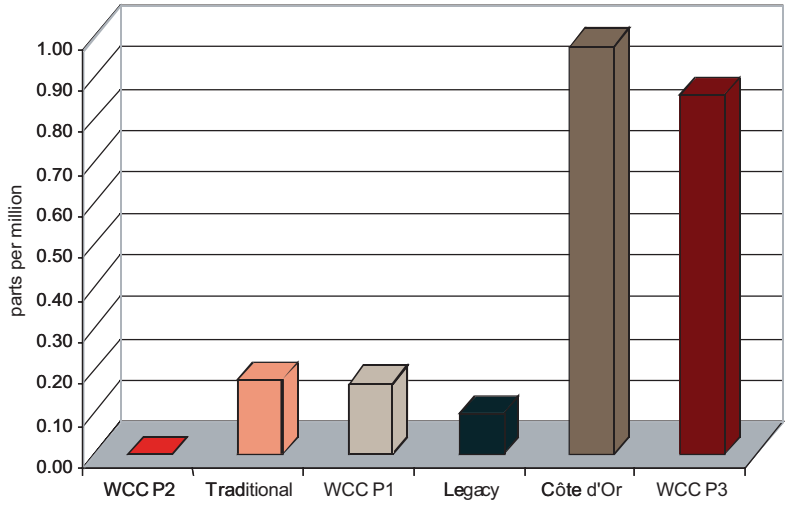


Figure 4. Vanillin in the Beaulieu Chardonnay samples (in parts per million)

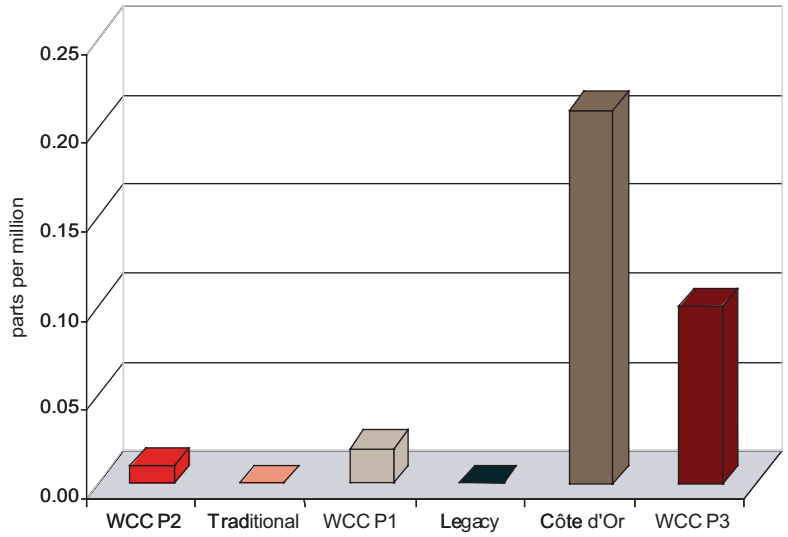
Figure 5 shows the levels of guaiacol, a sweet-smoke aromatic that is often a feature of barrel matured Chardonnays. These results show a major difference between the Côte d'Or and the other barrel samples. The Côte d'Or and special toast WCC P3 are characterized by much more intense heat application during toasting. This manifests itself here in significantly higher sweet smoke character.

Figure 5. Guaiacol in Beaulieu Chardonnay samples (in parts per million)



Spiciness as characterized by 4-methyl guaiacol is shown in Figure 6. Like the guaiacol smokiness, this compound is formed when sufficient heat is applied to break the oak lignin down beyond vanillin and related phenolic aldehydes. The effect is clearly demonstrated in Figure 6.

Figure 6. 4-methyl guaiacol (spice) in the Beaulieu barrel fermented Chardonnay samples (in parts per million)



As in the previous case, the highest levels exist in the Côte d'Or and WCC P3; however, all of the special profiles contain more spice than the other current World Cooperage products.

CONCLUSIONS

This experiment clearly demonstrates that special, tailor-made profiles can bring new features to a wine, offering a wide range of different products. In this case, they altered the flavor balance of the Beaulieu Chardonnay quite significantly.

TASTING RESULTS

	Preferences		*Total*
1st Choice	*%*	*Count*	
World Cooperage Traditional	12%	8	68
T.W. Boswell Côte d'Or	22%	15	68
T.W. Boswell Legacy	13%	9	68
World Cooperage P1	24%	16	68
World Cooperage P2	15%	10	68
World Cooperage P3	15%	10	68
2nd Choice			
World Cooperage Traditional	21%	16	76
T.W. Boswell Côte d'Or	25%	19	76
T.W. Boswell Legacy	17%	13	76
World Cooperage P1	22%	17	76
World Cooperage P2	7%	5	76
World Cooperage P3	8%	6	76
Last Choice			
World Cooperage Traditional	15%	12	81
T.W. Boswell Côte d'Or	11%	9	81
T.W. Boswell Legacy	9%	7	81
World Cooperage P1	10%	8	81
World Cooperage P2	17%	14	81
World Cooperage P3	38%	31	81