

TOASTING TECHNIQUES: Old World and New World

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World Cooperage

INTRODUCTION

In the traditional art of barrel making, each and every cooper developed their own process for toasting their barrels that, in turn, affected the flavor of oak-aged wines. Unraveling what causes those differences has been a major task, but slowly tradition is giving up its secrets. The modern day barrels will emulate those of yesteryear, but with the benefit of a clear understanding of what needs to be done so that the winemaker can imprint his or her style with confidence.

A program of wood engineering, heating technology, traditional expertise, chemistry and biology, guided by the taste buds of skilled winemakers has led to a range of barrel toasting techniques that enable the classic flavors of Bordeaux, Burgundy, and the more intense oak of the New World to be recreated at will.

Barrel Styles Examined

World Cooperage Traditional, French & American oak

World Cooperage Aroma Toast™

T.W. Boswell Legacy, American & French oak

T.W. Boswell Côte d'Or, French oak

T.W. Boswell Médoc, French oak

World Cooperage standard barrels are toasted a total of 60-65 minutes: 20 minutes over a bending fire, and 40-45 minutes over a low/medium open fire. The T.W. Boswell Legacy barrels are toasted a total of 40-45 minutes. For the first 8-10 minutes the fire is very high, then it is brought down mid-way for an additional 10-12 minutes before the barrel is bent. The fire is brought down again for another 10-15 minutes, and the final 5-10 minutes of toasting are over a smoldering fire. Variation on the T.W. Boswell toasting for the Médoc barrel is to shorten the toasting time. For the Côte d'Or, the barrel is capped to retain the smoke from the fire. The Aroma Toast® utilizes an electric heating coil to toast the barrel; there is no aroma coming directly from heat source.

THE WINE

Producer: Beaulieu Vineyard

Vintage: 1999

Varietal: Carneros Chardonnay

On 10/06/00, Carneros Chardonnay filled 28 barrels in W99 T01-WC. Lab analysis at this time:

<i>Date</i>	<i>F/TSO₂</i>	<i>pH</i>	<i>TiA</i>	<i>Brix</i>	<i>Malic</i>	<i>RS</i>	<i>Alc</i>
10/06/00	12	3.36	0.71	23.5	265		
11/27/00					62	.036	
12/05/00					37	Dry	
02/01/01	27/52	3.52	0.56		20		14.30

OAK DATA

Source: American oak, French oak

Wood Age: 24 months

Toast Level: Medium Plus

Size: 59 gallons

TRIAL EXECUTION

Sample Size: 4 barrels each variation

TRIAL

American oak

World Cooperage

T.W. Boswell

World Cooperage Aroma Toast®

French oak

World Cooperage

T.W. Boswell Legacy

T.W. Boswell Médoc

T.W. Boswell Côte d'Or

TASTING RESULTS

	<i>Winemaker</i>	<i>Other</i>	<i>Overall</i>
American oak—1st Choice			
T.W. Boswell Legacy	34%	27%	31%
World Cooperage	21%	36%	29%
World Cooperage Aroma Toast®	45%	36%	39%
American oak—2nd Choice			
T.W. Boswell Legacy	39%	33%	36%
World Cooperage	30%	31%	30%
World Cooperage Aroma Toast®	30%	35%	33%
French oak—1st Choice			
T.W. Boswell Médoc	16%	19%	17%
T.W. Boswell Legacy	36%	41%	36%
World Cooperage	30%	24%	27%
T.W. Boswell Côte d'Or	18%	17%	19%
French oak—2nd Choice			
T.W. Boswell Médoc	31%	30%	31%
T.W. Boswell Legacy	27%	24%	24%
World Cooperage	20%	24%	21%
T.W. Boswell Côte d'Or	22%	22%	23%
French and American Overall			
T.W. Boswell Legacy AO	5%	8%	6%
World Cooperage AO	4%	16%	9%
World Cooperage Aroma Toast® AO	7%	12%	9%
T.W. Boswell Médoc FO	14%	12%	13%
T.W. Boswell Legacy FO	30%	28%	27%
World Cooperage FO	27%	18%	22%
T.W. Boswell Côte d'Or FO	13%	6%	10%

THE WINE

Producer: Marchesi Antinori s.r.l.
Vintage: 2000
Varietals: Sangiovese (80%) / Cabernet Sauvignon (20%)
Vineyard: Santa Cristina (San Casciano Val di Pesa, Firenze)
Crush Dates: 25 September / 5 October
Varietal: Carneros Chardonnay

Harvest Data

Total Acidity: 6.5 g/l tartaric acid
Brix: 23
pH: 3.35
Prior to fermentation: added SO₂
Days of fermentation: 15 (Sangiovese) / 21 (Cabernet Sauvignon)
Fermented with: 522 Davis yeast
End of fermentation: added SO₂
Barrel Preparation: cold water

Wine Analysis as of January 2001

Alcohol: 13.50 % vol.
Total Acidity: 5.2 g/l (tartaric acid)
Volatile Acidity: 50 g/l (acetic acid)
Free Sulfur Dioxide: 25 mg/l
Total Sulfur Dioxide: 75 mg/l
pH: 3.62
Residual Sugar: 1.50 g/l
Additional Info: poliphe. Ind. 62; malic acid 0

OAK DATA

Size: 59 gallon

TRIAL EXECUTION

Sample Size: 3 barrels of each variable

Oak Contact Time: 4.5 months

First Fill: December 2000

Bottling Date: 5 April 2001

THE TRIAL

French oak

T.W. Boswell Côte d'Or (barrels 1, 2, 3)

T.W. Boswell Médoc (barrels 4, 5, 6)

T.W. Boswell F/O (barrels 10, 11, 12)

World Cooperage F/O (barrels 13, 14, 15)

American oak

T.W. Boswell A/O (barrels 7, 8, 9)

World Cooperage A/O (barrels 16, 17, 18)

World Cooperage A/O Aroma Toast® (barrels 19, 20, 21)

THE RESULTS

Sensory Results, Beaulieu Vineyard

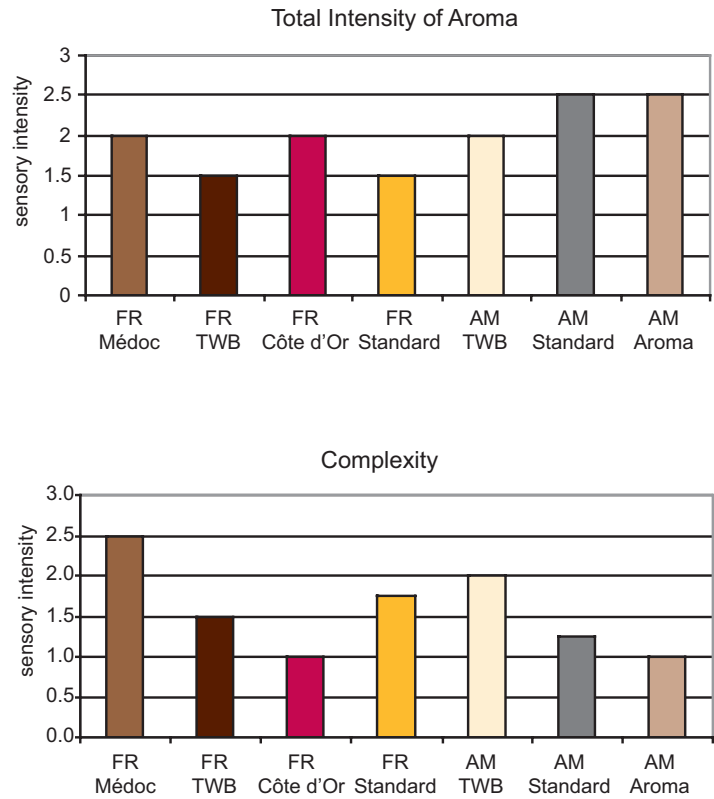
In March 2001, the wines were tasted for preference and the number of first places given by winemakers are shown in Table 1.

Comments on the T.W. Boswell included “most full bodied,” “great balance,” and “more delicate wood.” The Médoc barrel was described as “reserve quality barrel” and “great nose.” The Côte d'Or was similar to the Médoc, but with slightly more smoke character.

Table 1: Preference scores on barrel toasting

	Preferred (no. of 1st places)
American oak	
World Cooperage Standard	2
T.W. Boswell	4
World Cooperage Aroma Toast®	2
French oak	
World Cooperage Standard	0
T.W. Boswell Legacy	1
T.W. Boswell Médoc	4
T.W. Boswell Côte d'Or	3

Figures 1 and 2: Sensory scores from selected descriptors of wine from barrels of different toasting (FR = French oak, AM = American oak)



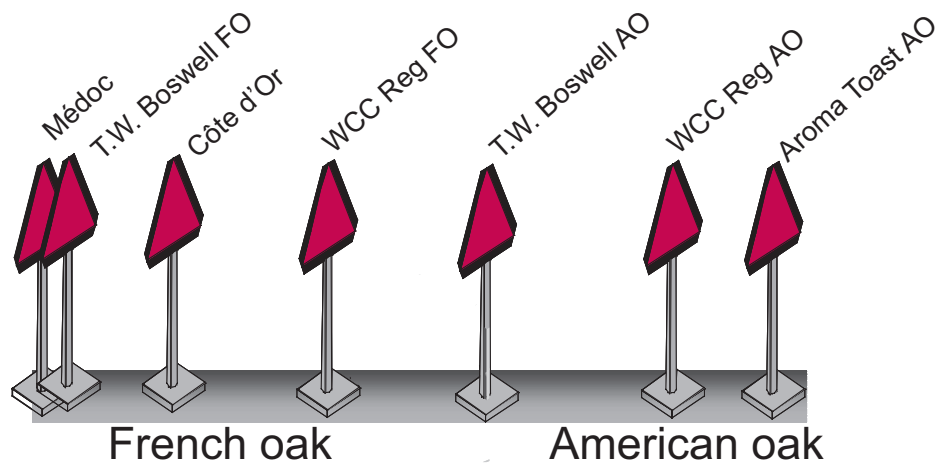
While the standard fire bent American oak and Aroma Toast® barrels gave the highest Total Intensity of Aroma, the T.W. Boswell Médoc barrel produced the most complex wine. The highest level of fruit was found in the T.W. Boswell Legacy American oak barrel. Toastiness was highest in the wine from the Côte d'Or French oak and standard fire bent American oak barrels. Only the Médoc, Côte d'Or, and standard fire bent American oak barrels had any detectable levels of smokiness.

CHEMICAL ANALYSIS

Chemical analysis of the Beaulieu Wines is given in Table 2.

Table 2: Chemical analysis of Beaulieu Vineyard's barrel toasting wines (mg/L)

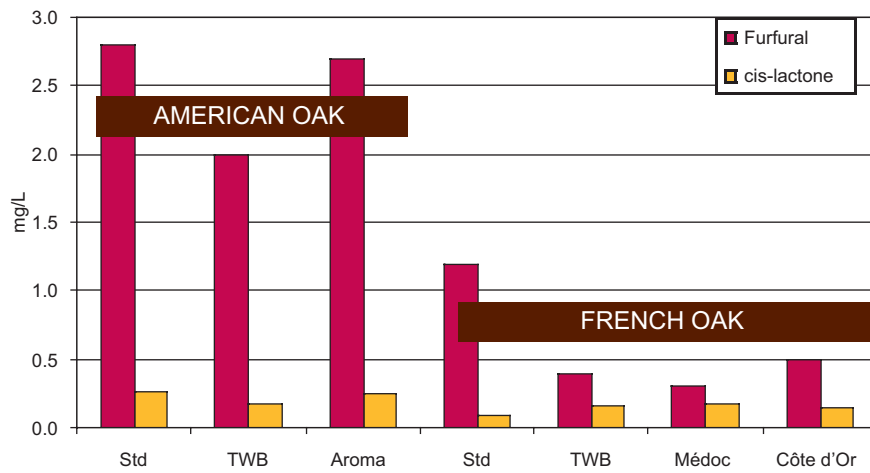
Compound	WCC AO	WCC FO	TWB AO	TWB FO	Médoc FO	C. d'Or FO	Aroma AO
Gallic acid	0.7	0.6	0.9	1.3	1.0	1.0	1.0
Ellagic acid	0.1	0.1	0.2	0.2	0.2	0.2	0.2
5-Hydroxymethyl furfural	2.3	1.6	2.0	1.2	0.9	1.2	1.9
Furfural	2.8	1.2	2.0	0.4	0.3	0.5	2.7
Protocatechuic Acid	2.2	2.1	2.1	2.2	2.2	2.1	2.4
Catechin	4.4	4.4	3.9	4.1	4.2	4.0	3.9
Epicatechin	8.8	8.8	9.1	9.5	9.9	9.1	8.0
Syringic acid	0.2	0.2	0.2	0.1	0.2	0.1	0.2
Myricetin	0.1	0.0	0.0	0.1	0.0	0.0	0.0
Quercetin	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Chlorogenic acid	0.1	0.1	0.2	0.1	0.1	0.2	0.1
Caffeic acid	2.4	3.0	2.3	3.3	2.9	2.7	2.2
Vanillin	0.2	0.2	0.2	0.1	0.3	0.2	0.2
Syringaldehyde	1.0	1.2	1.0	1.0	0.9	0.1	1.0
Phenol	0.00	0.02	0.02	0.00	0.00	0.02	0.01
Guaiacol	1.13	1.2	1.07	1.19	1.24	1.16	1.28
4-ethyl phenol	0.00	0.03	0.02	0.00	0.00	0.01	0.00
4-ethyl guaiacol	0.02	0.02	0.03	0.01	0.01	0.02	0.03
Trans-lactone	0.077	0.079	0.116	0.107	0.154	0.128	0.037
Cis-lactone	0.264	0.081	0.172	0.158	0.173	0.140	0.248

Figure 3: Trend line of different toasting techniques of barrels

The results show a clear distinction between American oak and French oak. They also show significant differences between the well-known 'standard' fire bent barrels and the newer T.W. Boswell Legacy and Appellation series. Figure 3 shows how the major differences reveal a trend from the Médoc barrel at one extreme to the Aroma Toast™ and fire bent American oak barrel at the other.

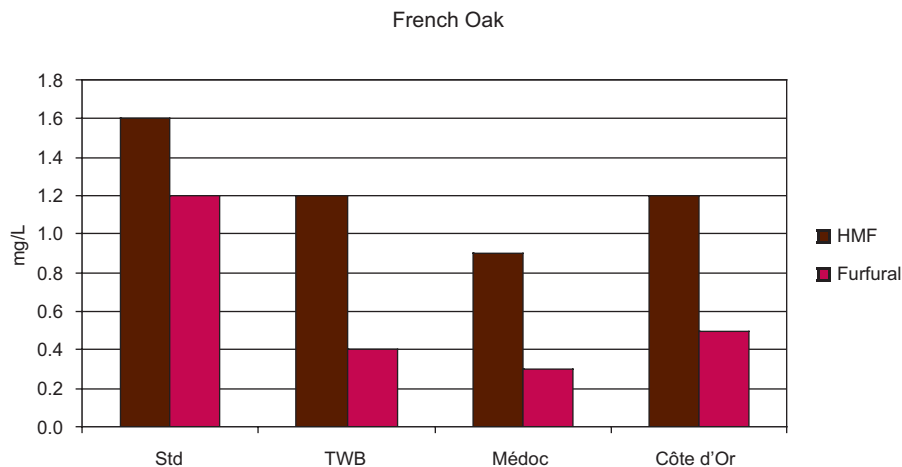
The main differences between the American oak samples and their French oak counterparts are to be found in the levels of furfural and cis oak lactone. Both occur in higher amounts in American oak. This is shown in Figure 4.

Figure 4: Furfural and cis-lactone content of different toasting techniques of barrels



American oak apart, there are substantial differences between the French oak barrels. The Médoc barrel is notable for having the highest level of vanillin (not shown here) although the T.W. Boswell Legacy is very similar to the Médoc appellation in almost every other respect. Unlike the American oak barrels, the levels of furfural are lower, with the lowest to be found in the Legacy and Appellation ranges. While furfural tends to be correlated with the less desirable aspects of toastiness, hmf (hydroxy methyl furfural) is correlated with the lighter more attractive aspects. Hmf is actually highest in the current fire bent barrel, but relative to furfural its best ratios are also in the Legacy and Appellation ranges. Figure 5 illustrates this.

Figure 5: Toasty aroma compounds in wine made in barrels of different toasting techniques



SENSORY RESULTS, ANTINORI WINERY

In March 2001, wines from Antinori winery in Italy were tasted for preference. The preference scores are given in Table 3.

Table 3: Preference scores on barrel toasting—Sangiovese (80%) / Cabernet Sauvignon (20%)

	Preferred (no. of 1st places)	Least Preferred (no. of last places)
American oak		
World Cooperage Standard	3	3
T.W. Boswell	2	3
World Cooperage Aroma Toast®	3	2
French oak		
World Cooperage Standard	2	1
T.W. Boswell Legacy	2	0
T.W. Boswell Médoc	3	3
T.W. Boswell Côte d'Or	1	4

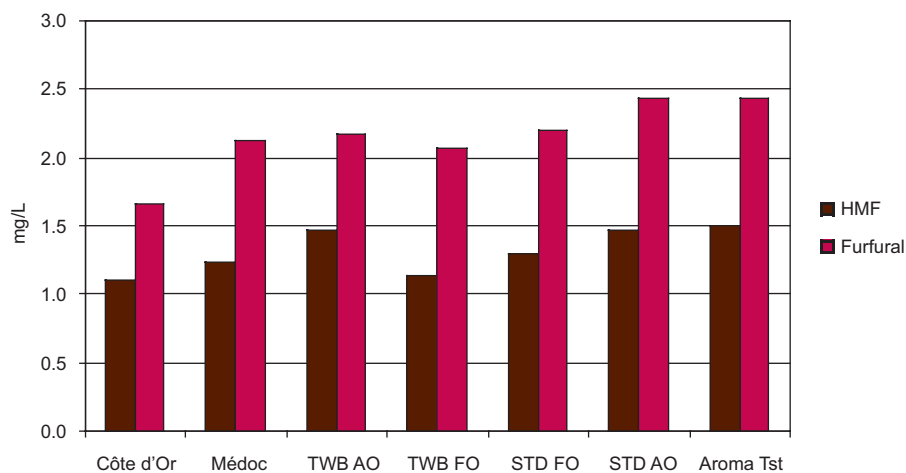
The Antinori red wines were tasted at a fairly early stage. It is expected that the barrels will show differently in a few more months of ageing. For example, the Médoc barrel was designed for reserve style Bordeaux, Cabernet Sauvignon, or Merlot, with typically 18 to 24 months ageing. Early on in the maturation it probably won't show well.

Table 4: Chemical analysis of Antinori's barrel toasting wines (mg/L)

Compound	Côte d'Or	Médoc	Legacy AO	Legacy FO	WCC FO	WCC AO	Aroma Tst
Gallic acid	37.5	38.3	38.5	37.5	38.8	36.6	36.0
Ellagic acid	1.1	1.4	2.0	2.0	1.7	1.7	1.5
Hydroxymethyl furfural	1.1	1.2	1.5	1.1	1.3	1.5	1.5
Protocatechuic Acid	6.5	8.1	8.0	8.7	7.7	7.9	7.8
Furfural	1.7	2.1	2.2	2.1	2.2	2.4	2.4
5-methyl furfural	9.9	9.7	10.0	10.4	10.4	10.3	10.1
Catechin	109.0	109.6	115.9	116.6	113.6	109.4	105.2
Epicatechin	74.8	66.1	68.0	69.2	70.5	49.4	54.0
Chlorogenic acid	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Caffeic acid	5.7	6.0	4.6	4.3	4.3	4.6	5.1
Myricetin	0.8	0.6	0.3	0.2	0.2	0.3	0.4
Quercetin	4.2	4.2	3.4	3.2	4.1	3.3	3.3
Syringic acid	10.3	9.4	9.3	10.1	10.0	10.4	10.6
Vanillin	1.0	0.9	0.8	0.7	0.9	1.1	1.1
Syringaldehyde	3.3	3.1	3.3	3.0	3.1	3.1	3.1
Trans-lactone	0.01	0.0	0.1	0.2	0.2	0.2	0.1
Cis-lactone	0.1	0.0	0.1	0.1	0.1	0.2	0.1

Taking into account that the Antinori red wine experiment is 'younger' than the Beaulieu Chardonnay experiment, some of the current findings may change a little as the wine penetrates into the barrel wood. Nevertheless, it does show the Médoc and Côte d'Or appellation barrels at one end of the flavor spectrum and the Aroma Toast® and current fire bent barrels at the other. Figure 6 below shows another common finding—the higher levels of furfural in wine from American oak barrels compared to French.

Figure 6: Furfural and HMF content of wine from different toasting techniques of barrels



CONCLUSIONS

There are significant flavor and analytical differences between the ‘standard’ fire bent World Cooperage barrels and the newer Legacy and Appellation ranges. In general, wines from the Legacy and Appellation ranges have lower levels of furfural and more attractive ‘toastiness.’ The Médoc barrel has the highest level of vanillin.

Taken as a group, the range of barrels tested offers a very wide range of flavor styles.

TASTING RESULTS

	<i>Winemaker</i>	<i>Other</i>	<i>Overall</i>
French oak—1st Choice			
T.W. Boswell Legacy	19%	25%	24%
T.W. Boswell Médoc	31%	25%	30%
T.W. Boswell Côte d’Or	31%	40%	31%
World Cooperage	19%	10%	13%
French Oak—2nd Choice			
T.W. Boswell Legacy	24%	21%	21%
T.W. Boswell Médoc	37%	23%	30%
T.W. Boswell Côte d’Or	17%	31%	28%
World Cooperage	22%	25%	20%
American Oak—1st Choice			
T.W. Boswell Legacy	30%	37%	32%
World Cooperage	27%	23%	22%
World Cooperage Aroma Toast®	43%	40%	45%
American Oak—2nd Choice			
T.W. Boswell Legacy	31%	33%	31%
World Cooperage	39%	31%	36%
World Cooperage Aroma Toast®	30%	35%	31%
French and American Oak Overall			
T.W. Boswell Legacy FO	7%	8%	9%
T.W. Boswell Médoc FO	25%	20%	24%
T.W. Boswell Côte d’Or FO	29%	22%	22%
World Cooperage FO	9%	4%	6%
T.W. Boswell Legacy AO	11%	16%	13%
World Cooperage AO	7%	4%	4%
World Cooperage Aroma Toast® AO	11%	27%	18%