A Successful Application of Chemical Cork Screening Methods

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History of GC/MS Usage by the CQC

- Completed Primary Research at ETS in 1999
- Initiated Full-Scale Cork Screening in 2000
- Replaced Sensory Analysis as Standard Method of Screening for TCA in 2001
- Installed Similar Equipment at Primary Production Facilities 2001-2002
- Adopted Lot Acceptance Criteria in Addition to Bale Acceptance Criteria - 2005

Cork Soak Statistics – since 2000

Total Corks Soaks Performed	**95,567**
Individual Corks Soaked	**4,778,350**
Gallons of Wine Used	**114,680**
Associated Expense	**$4,705,515**

A Closer Look at Cork 6/23/06

Results ?

- Better Understanding of the Behavior of TCA, Corks and Bottled Wine
- Ability to use Group Cork Soaks to Expand Sample Sizes When Evaluating Cork Populations
- Acquired the Ability to Evaluate Cork Quality Beyond Sensory Limitations
- Established an Objective Criteria to Evaluate Cork Quality with Suppliers and Customers
- Helped Primary Manufacturers Evaluate New Production Methods
- **Cork Quality Shows Steady Improvement**

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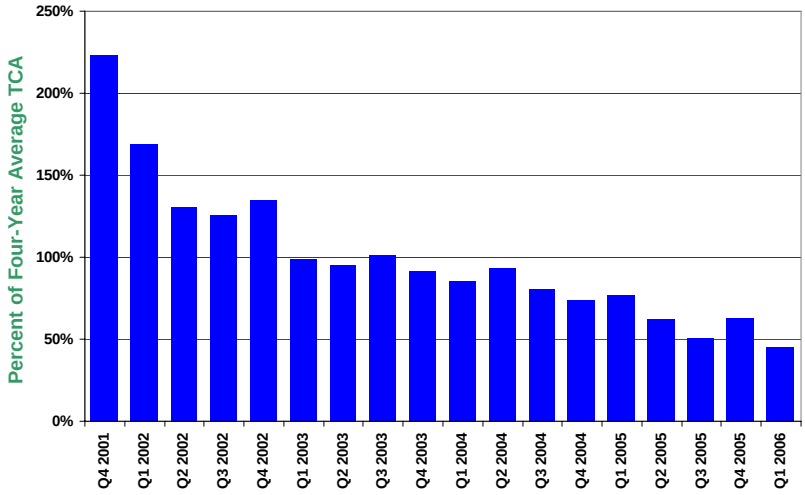
A Closer Look at Cork 6/23/06

Average TCA Scores from Incoming QA Screening Have Improved by 80% in the Past Four Years



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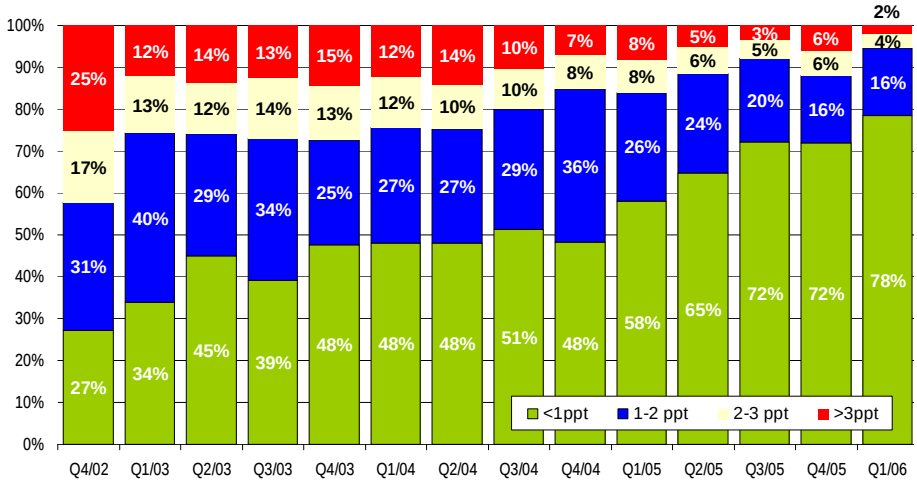
94% of TCA Scores from Incoming QA Screening Are Now Under 2ppt



Natural Corks

Reasons for Improvements

Established Objective Quality Standards

Improved Manufacturing Techniques

- **Improved Material Handling**
- **On-site Chemical Analysis**

Informed Material Sourcing

Market Forces

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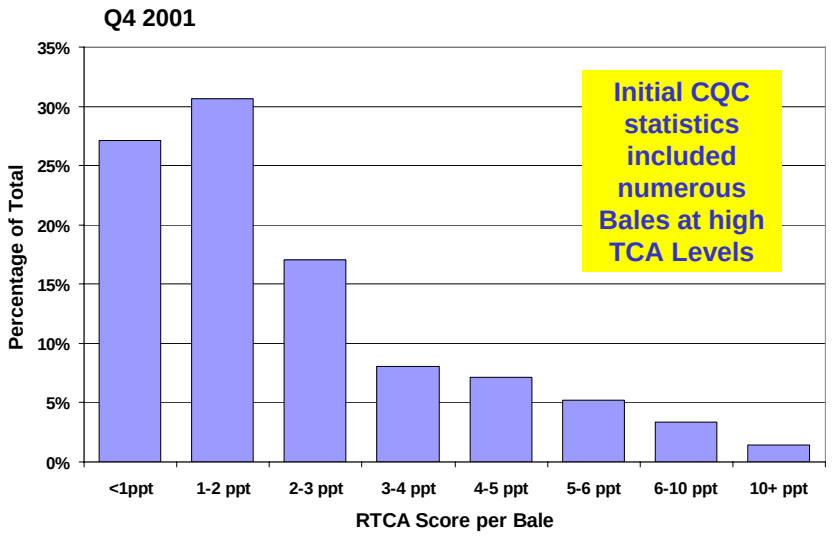
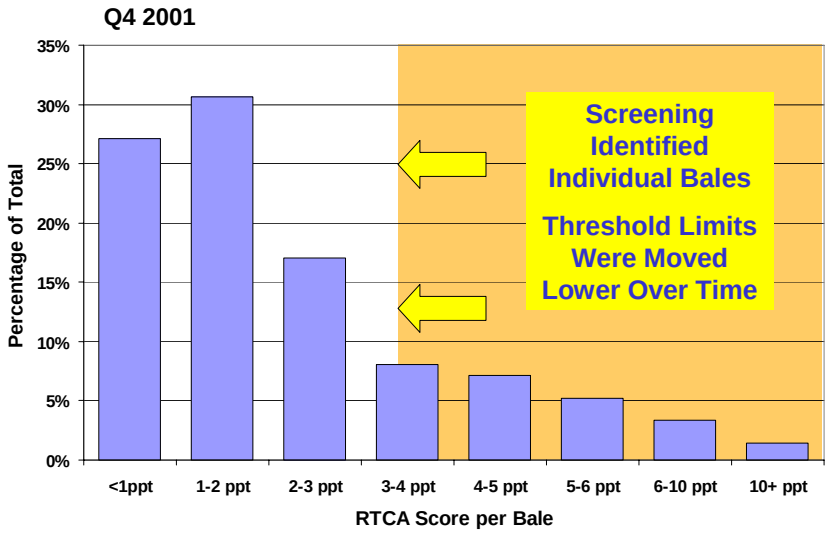
Transition in Screening Goals

Original QC Goal	Current QC Goal
Identify and Eliminate Cork **Bales** with High TCA Scores	Identify and Eliminate Cork **Lots** with High TCA Variability
Secondary Testing triggered by Lot Average	Secondary Testing triggered by Lot Variance

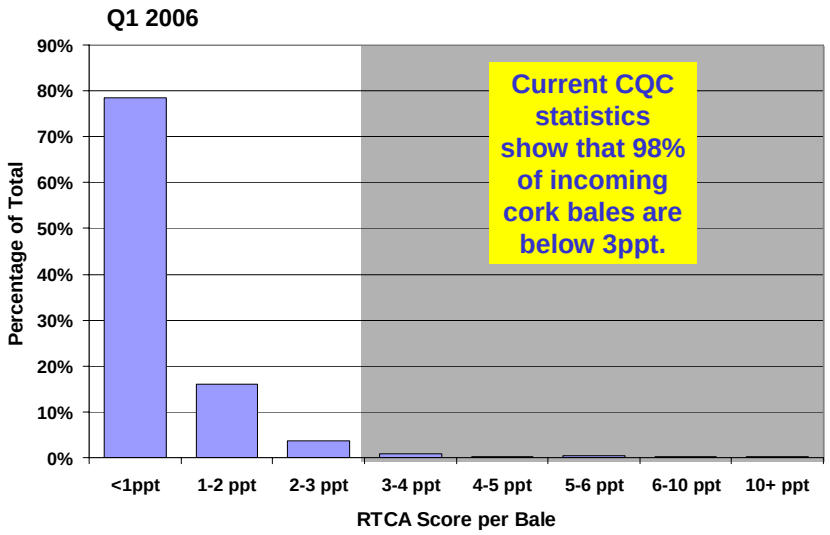
Initial Population Statistics



Initial Screening – To Remove High Scores



Current Population Statistics



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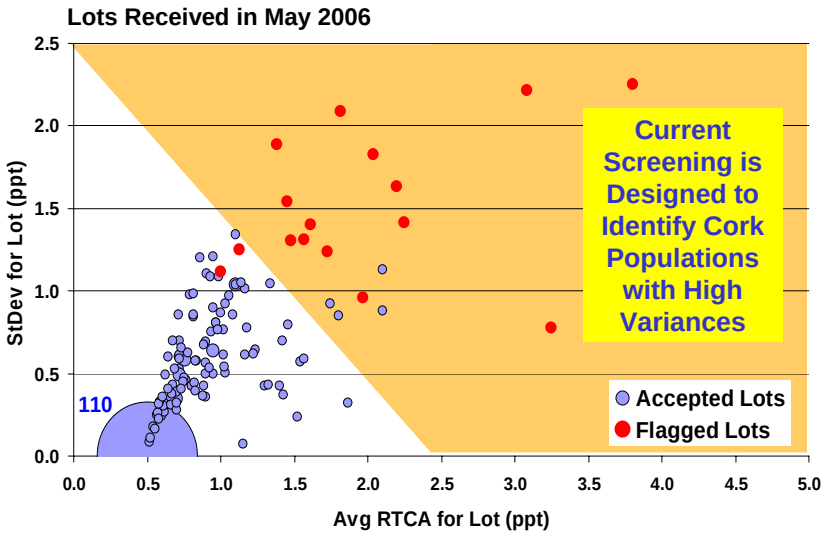
Current Screening – To Reduce Outliers



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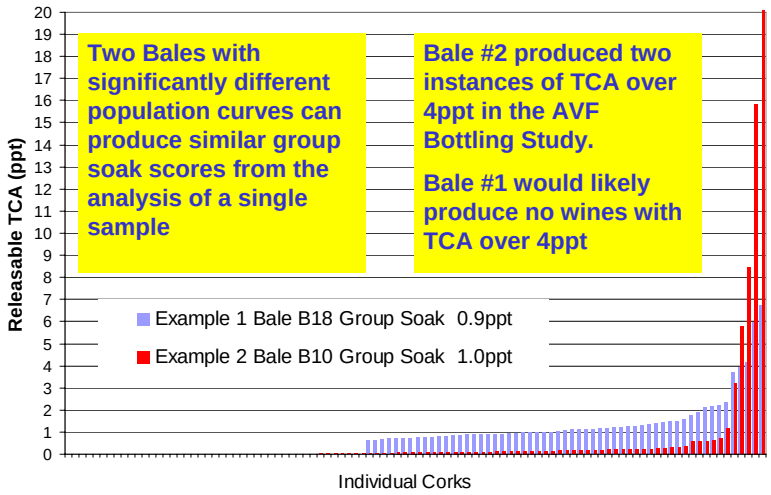
Two Population Curves Produce Different Patterns of Variance over Multiple Soaks



Two Bales with significantly different population curves can produce similar group soak scores from the analysis of a single sample

Bale #2 produced two instances of TCA over 4ppt in the AVF Bottling Study.

Bale #1 would likely produce no wines with TCA over 4ppt

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New Protocol - Lot Acceptance Standard

- **Designed to Identify Cork Lots with Low Averages but Multiple Outliers**
- **Recognizes that Individual Cork Lots have Greater Homogeneity than the General Population**
- **Uses a Secondary Sampling Step when Suspicious Bales are Encountered.**
- **An Entire Lot is Accepted or Rejected Based on the Variance Displayed – Regardless of the Number of Low Scores.**

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New CQC Minimum Sampling Standard

For all incoming natural corks.
Lots consist of same grade/treatment/supplier and shipment
Maximum Lot Size is 250,000 corks

NUMBER OF BALES		1	2–8	9–15	16–25	26–50	CRITERIA
SPME TESTING Initial Bale Samples Accept/Reject	REQUIRED *for all* *natural corks*	1 0/1	2 0/1	3 0/1	5 0/1	8 1/2	*Mil Std 105E-ISO2859-1 (L2)* *Flag @ AQL 4.0*
Additional Samples Accept/Reject	Conditional *on Initial Results*	na na	3 0/1	5 0/1	8 1/2	13 1/2	*Mil Std 105E-ISO2859-1 (L3)* *Flag @ AQL 4.0*

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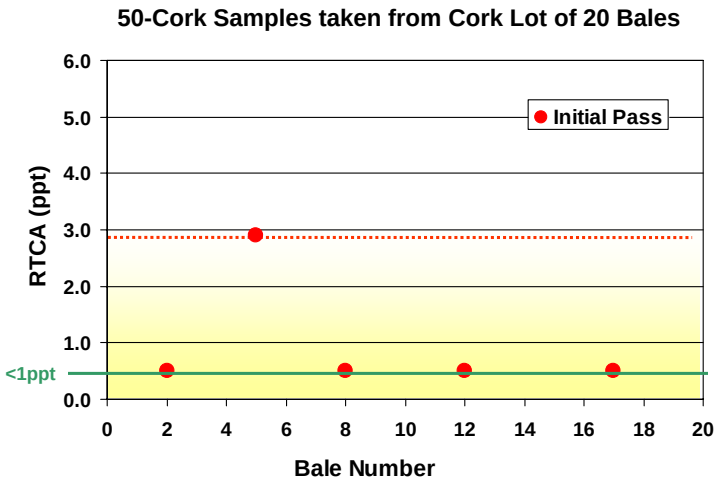
CQC Screening Protocol Example A – Initial Pass

Bale	#1
1	
2	<1
3	
4	
5	2.9
6	
7	
8	<1
9	
10	
11	
12	<1
13	
14	
15	
16	
17	<1
18	
19	
20	



Samples 5 Average Score 1.0ppt Standard Deviation 1.07

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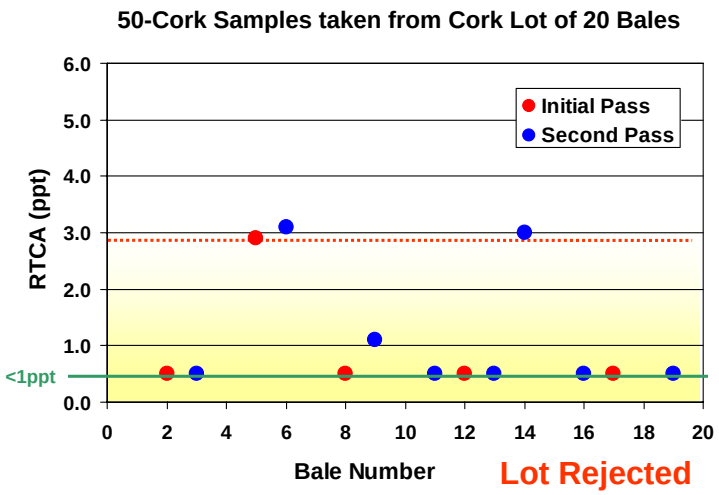
CQC Screening Protocol Example A – Second Pass

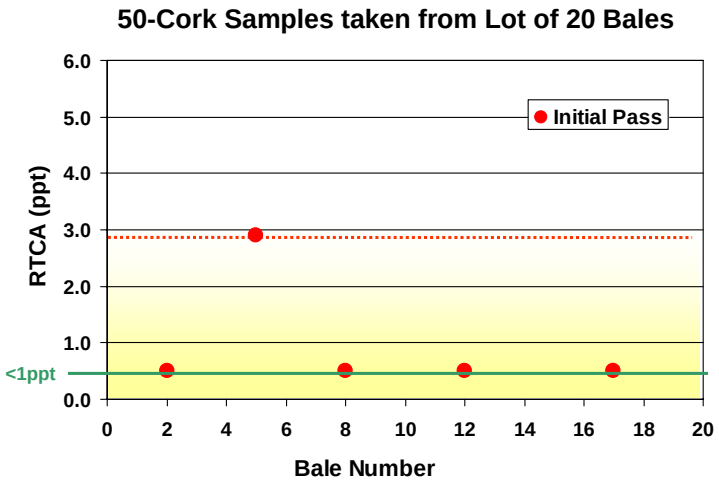
Bale	#1	#2
1		
2	<1	
3		<1
4		
5	2.9	
6		3.1
7		
8	<1	
9		1.1
10		
11		<1
12	<1	
13		<1
14		3.0
15		
16		<1
17	<1	
18		
19		<1
20		



Samples 13 Average Score 1.1ppt Standard Deviation 1.08

CQC Screening Protocol Example B – Initial Pass

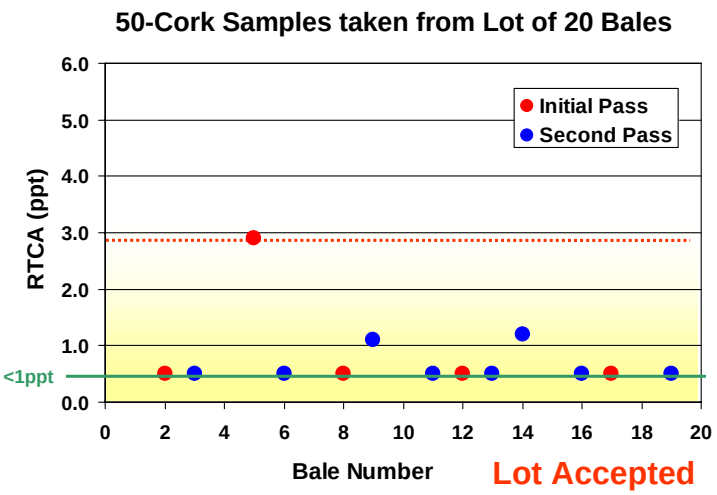
Bale	#1
1	
2	<1
3	
4	
5	2.9
6	
7	
8	<1
9	
10	
11	
12	<1
13	
14	
15	
16	
17	<1
18	
19	
20	



Samples 5 Average Score 1.0ppt Standard Deviation 1.07

CQC Screening Protocol Example B – Second Pass

Bale	#1	#2
1		
2	<1	
3		<1
4		
5	2.9	
6		<1
7		
8	<1	
9		1.1
10		
11		<1
12	<1	
13		<1
14		1.2
15		
16		<1
17	<1	
18		
19		<1
20		



Samples 13 Average Score 0.8ppt Standard Deviation 0.87

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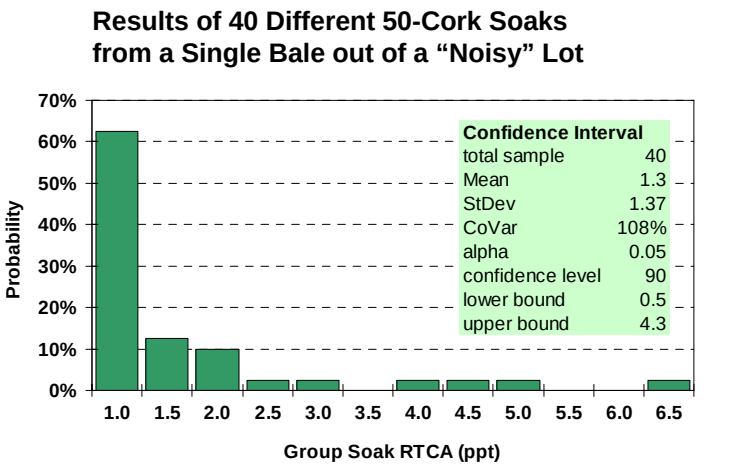
Example: High Variance Bale at 2.0ppt Lot Average

Bale	#1
1	
2	1.6
3	
4	
5	5.2
6	
7	
8	1.7
9	
10	
11	
12	<1
13	
14	
15	
16	
17	1.2
18	
19	
20	



Original Sample of 5 Bales

Samples 5 Average Score 2.0ppt Standard Deviation 1.83

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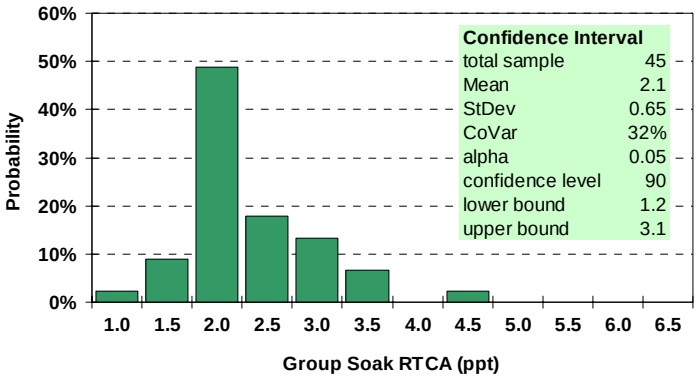
Example: Low Variance Bale at 1.9ppt Lot Average

Bale	#1
1	
2	1.8
3	
4	
5	2.4
6	
7	
8	1.6
9	
10	
11	
12	2.1
13	
14	
15	
16	
17	1.7
18	
19	
20	

Results of 45 Different 50-Cork Soaks from a Single Bale out of a "Steady" Lot



Original Sample of 5 Bales

Samples 5 Average Score 1.9ppt Standard Deviation .33

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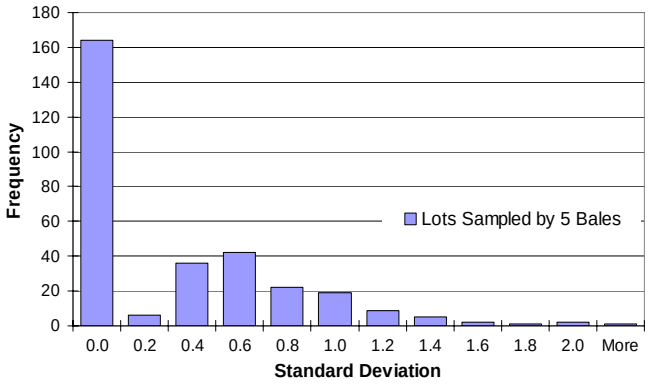
What is the Average Variance within a Lot?

In a review of 309 lots tested this year with exactly 5 samples per lot -

- 164 (53%) had a no variance – as all scores were less than 1ppt
- The remaining lots averaged an approximate 0.5ppt standard deviation

Range of Standard Deviations Found by Selected Lots (2006)



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Interpreting SPME Data at the Winery

The analysis is designed screening tool – not as a definitive statistical summary

- **Do not rely on a single TCA score.**
- **Ask your cork supplier for TCA information from the entire lot.**
- **Beware of patterns showing multiple instances of variance greater than 1ppt**
- **An isolated high score may foretell a highly variable lot – but it is often a true outlier that cannot be replicated**