Building the Iowa Wine Culture Through Improved Quality

Funded by the Leopold Center for Sustainable Agriculture

IOWA STATE UNIVERSITY
University Extension
Value Added Agriculture Program

LEOPOLD CENTER

State of the Viticulture Industry

A joint project between Midwest Wine and Grape Industry Institute and Iowa State University Extension-Value Added Agriculture Program

Executive Summary

ISU Extension Value Added Agriculture Program (VAAP) and the Midwest Grape and Wine Institute (MGWII) cooperatively created the first-ever "State of the Viticulture Industry" quality report for Iowa. This report is intended to identify benchmarks of quality to help determine where the industry needs to allocate additional resources and provide technical assistance in order to collectively raise the quality of wine grown and processed throughout the state.

The study has also attempted to identify preliminary data to support varietal differences and characteristics across various soil profiles. The collection of this data will lay the groundwork for thorough assessments of the entire process from vineyard production practices through the bottling of the finished product. Data from this report and future studies will be critical in building and maintaining the reputation of Iowa's American Viticulture Area (AVA) designations as sustainable "quality" wine-producing regions.

Methodology

To accomplish this task, the ISU Extension VAAP and the MGWII staff surveyed wineries and collected and analyzed wines from across the state to determine the current norms for which future comparisons will be made. The MGWII, under the supervision of Dr. Murli Dharmadhikari, conducted a regimen of standardized lab tests to develop a composite profile of the current quality of wine in Iowa. The MGWII evaluated the wines based on their standard Vintners Quality Alliance (VQA) protocol available through their wine quality lab services. This project targeted wineries that are not currently using, or familiar with, the benefits of using the lab services. In addition to the actual wine sample, basic production and processing data was collected to help identify consistencies and variability in quality assessments.

For this study, 55 wine samples from 20 wineries were submitted from wineries that traditionally have not participated in the MGWII – VQA program. This data was combined with data from VQA participating members to provide a comprehensive profile of the baseline quality parameters of the Iowa wine industry. The combined dataset represents a total of 163 samples from 47 wineries; representing 49 percent of the 95 total licensed wineries in Iowa at the time of the report. All participating wineries received a copy of their individual lab results and a comprehensive report for comparison. Individual results were kept confidential.

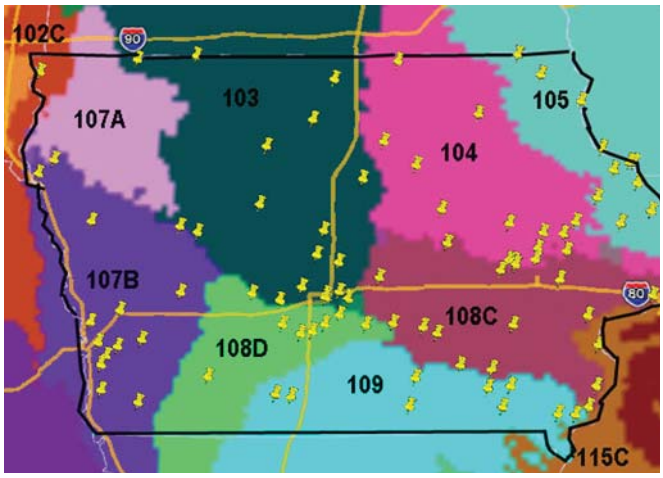
Because the grape composition is influenced by both the terroir and the genetic makeup or varietal characteristics, each winery was asked to submit samples of cold climate varietal wines made predominantly from Iowa grown grapes. Production and processing data collected from these varietal wines provides initial insight about sustainable production issues related to climate, soil types, production methodology and other standard operating procedures impacting the

industry's sustainability. In some cases the terroir has a dominant impact on fruit composition and in others, the genetic makeup plays a greater role. Major Land Resource Areas (MLRA) as defined by the USDA were used to isolate these soil-based terriors. Additionally, climate data was collected from these regions to correlate the impact of rainfall and Growing Degree Units (GDU) on quality attributes.

Datasets are initially separated into reds, whites and roses. Each of these set are further subdivided into dry and off-dry end products and also categorized into Major Land Resource Areas (MRLA).

Wineries were asked to submit samples of cold climate varietal wines made from Iowa grown grapes. Varietal wines that had 5 or more submission are also compared in the data sets. Production and processing data collected from these varietal wines will provide valuable baseline data about sustainable production issues related to soil types, varietal selections, production methodology and other standard operating procedures that affect quality.

The following map illustrates the distribution of all Iowa wineries across the Major Land Resource Areas (MLRA) used to segregate the data for this project. Soil quality data is expected to influence the wine produced from grapes grown in each MLRA.

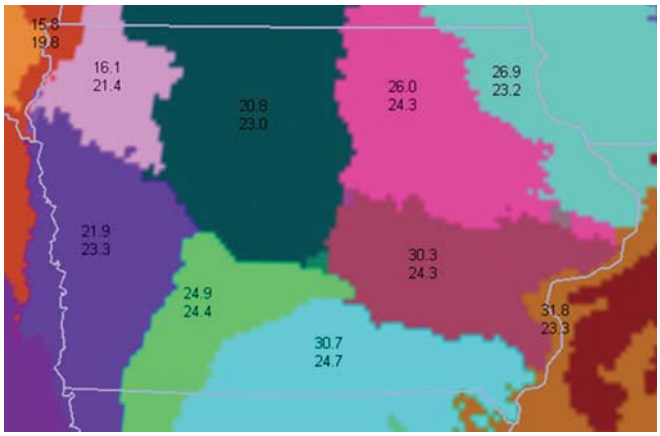


MLRA #	MLRA Name	Total Samples	Red	White	Rose
102	Loess Uplands and Till Prairie	0	0	0	0
103	Central Iowa Till Prairie	19	13	6	0
104	Eastern Iowa Till Prairie	13	8	3	2
105	Northern Mississippi Valley Loess Hills	34	14	15	5
107A	Iowa Loess Hills	0	0	0	0
107B	Iowa Deep Loess Hills	28	13	12	3
108C	Iowa Deep Loess and Drift, West Central	33	12	18	3
108D	Iowa Deep Loess and Drift, Western	34	13	18	3
109	Iowa Heavy Till Plain	4	1	2	1
115C	Central Mississippi Valley Wooded Slopes, Northern	3	1	1	1
	TOTAL	168	75	75	18

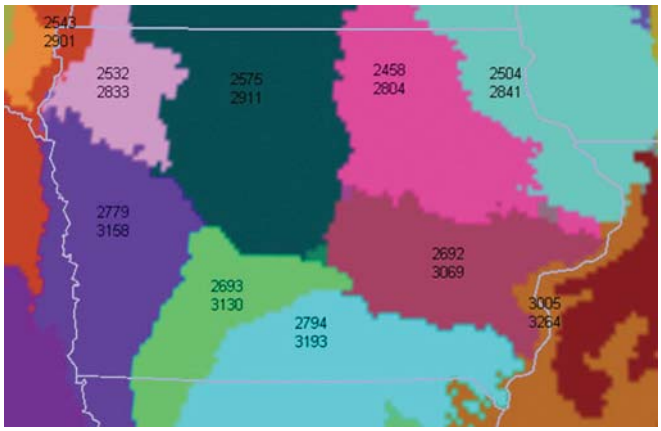
Weather 2009

Growing conditions provide an additional variable to product quality – tracking trends across the MLRA regions will be critical in creating baseline data for terrior characteristics. Although no conclusive impacts about weather can be drawn from a single year's data; it serves as a reference point for future comparisons. General observations for the 2009 weather trends indicate that the northwest part of the state was drier and cooler than normal while the east and southeast regions were wetter and cooler than normal – providing more ideal growing conditions during this season.
In the maps below, the top number illustrates 2009 average rainfall or GDU and the bottom number is the historical average.

MLRA Average Rainfall 2009



MLRA Average Growing Degree Days Units



Production 2009

Unfortunately data collected for the single 2009 season provides no conclusive evidence or correlations; however, this data will be critical in determining the baseline for future evaluations. Using the production, weather and processing data in conjunction with the cumulative quality analysis, stakeholders can begin to make science-based production and processing decisions that minimize risk and maximize profit potential. This data can clarify where technical assistance and future research can help producers and processors address critical issues that impact quality.

Analysis Procedure

The following instruments and methods were used in obtaining results. All tests were performed in duplicate and presented as an average across participants.

TA - Titratable acidity was determined by titration with Phenophthalein and a pH meter. A calibrated Orion 3-Star pH meter was used as a secondary pH measurement.

VA - Volatile acidity was determined via distillation of volatile acids using a cash-still.

OH - Alcohol content was determined by ebulliometry.

FSO_2/TSO_2 - Both free and total sulfur dioxide content was determined the aeration-oxidation setup to isolate the sulfur dioxide with subsequent titration.

RS - Residual Sugar content was determined by using the 2-drop Clinitest method. Wines with a residual sugar amount of 1 percent or less were categorized as dry. Wines with residual sugar of 2 percent and above were categorized as off-dry.

FZ - Cold stability was evaluated using the freeze test method. Results were provided to participants for their use but were not used as criteria for acceptability.

HT - Heat stability was evaluated by heating a sample to 65^{o}C for 6 hours, followed by cooling. Results were provided to participants for their use but were not used as criteria for acceptability.

SEN - Sensory analysis was performed by a sensory panel using the 20-point Davis method as a guide. All samples were presented blindly to the panel. Panel members included individuals with enology, chemistry, hospitality, and wine retail backgrounds. A score out of a maximum 20 was assigned to each wine and then majority determined the label given as commercially acceptable or needs improvement. Comments were also made by the panel.

Parameter	Hydrogen Ion Concentration	Titratable Acidity	Volatile Acidity	Alcohol	Free Sulfur Dioxide	Total Sulfur Dioxide
Acronym	pH	TA	VA	OH	FSO_2	TSO_2
Unit		g/L tartaric acid	g/L acetic acid	%	ppm (mg/L)	ppm (mg/L)
Recommended Range	3.2 - 3.4 Whites 3.4 - 3.6 Reds	7 - 9 Whites 6 - 8 Reds	< 0.7	11 - 14	pH dependent	< 100

Summation of Red Wine Analysis

A total of 72 red wines were analyzed and charted for pH, TA, VA, OH percentage, FSO_2, TSO_2 and RS percentage. For comparison the group was then sub-divided into dry and off-dry wines with greater than 1 percent residual sugar. Additionally, for comparative purposes, the three most common varietal wines were analyzed using the same analysis criteria.

The dry and off-dry comparisons incorporate the MLRA soil data subsets for the purpose of identifying geographic terroir tendencies and strengths or constraints for particular styles of wine produced in these areas.

Category	pH	TA (g/L)	VA (g/L)	OH%	FSO_2	TSO_2	RS%
All Reds Average	3.61	8.50	0.81	11.54	27.82	101.16	1.80
Maximum	4.19	16.77	2.90	18.30	123.84	396.80	5.00
Minimum	2.98	5.10	0.27	8.00	0.00	1.76	0.00
Standard Deviation	0.24	2.04	0.41	1.59	25.98	76.40	1.83
Recommended Range	3.4 - 3.6	6 - 8	<0.7	11 - 14	pH dependent	<100	

Comments on Red Wine Data

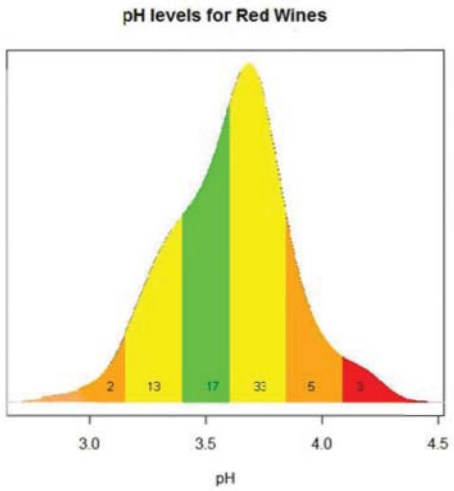
Each of the categories exhibit great variability and although the average across all 72 samples was close to the acceptable range for each criterion, none of the averages actually fell within industry recommended parameters with the exception of OH percent. However, considering the standard deviation within each category with careful evaluation and comparison by the individual vintners and targeted technical assistance provided by Midwest Grape and Wine Industry Institute, the comprehensive findings can be refined.

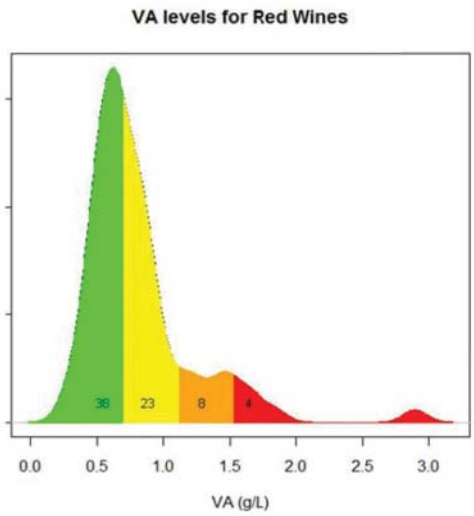
Average pH is acceptable, however TA really needs to be in the range of 6-7 g/L. Many of the reds produced tend to have high acidity due to the high malic acid content of the grapes which contributes to imbalance between acids and tannins in the wines. To obtain balance, the issue of fruit containing high pH and high TA must be addressed.

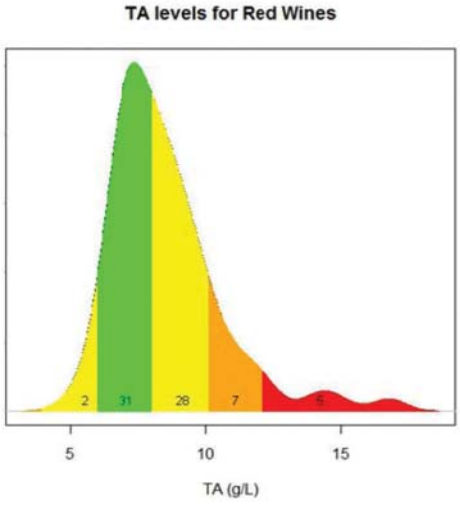
The average SO_2 values show that SO_2 additions are insufficient. Using the average pH of 3.61 an appropriate level of FSO_2 would be 50 ppm as opposed to the ~27.8 ppm average found in analysis. High VA can be attributed to high pH which leads to spoilage problems, especially when SO_2 is insufficient

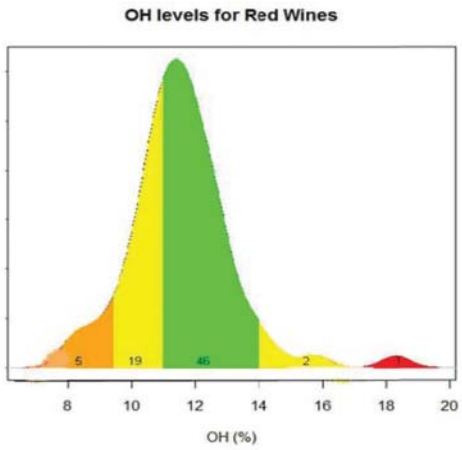
Priority consideration needs to be given to address samples with results far exceeding their respective minimum and maximum recorded analysis.

The charts on the following page illustrate the distribution of the 72 red wine samples for pH, TA, VA and OH. The green bar represents the recommended range. Samples in yellow are one standard deviation off the recommended range, orange is two and red is three or more standard deviations from the norm.


pH levels for Red Wines
2
13
17
33
5
3.0
3.5
4.0
4.5
pH


VA levels for Red Wines
38
23
8
0.0
0.5
1.0
1.5
2.0
2.5
3.0
VA (g/L)


TA levels for Red Wines
2
31
28
7
5
5
10
15
TA (g/L)


OH levels for Red Wines
5
19
46
2
8
10
12
14
16
18
20
OH (%)

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
All Dry Reds	42	3.68	8.29	0.82	27.48	99.53	11.64	0.42
Recommended Range		3.4 - 3.6	6 - 8	<0.7	pH dependent	<100	11 - 14	
Zone								
102	0							
103	8	3.76	8.18		25.03	85.40	12.38	0.44
104	5	3.70	8.14	0.56	13.22	36.24	10.14	0.44
105	4	3.53	8.62	0.97	28.32	117.77	11.30	0.43
107A	0							
107B	8	3.66	8.92	0.79	33.31	173.83	10.98	0.36
108C	7	3.67	7.35	0.67	31.58	103.47	12.07	0.43
108D	8	3.65	8.63	1.07	22.67	58.37	12.50	0.46
109	1	4.09	8.26	0.60	92.88	231.84	10.20	0.60
115C	1	3.62	7.42	0.55	12.80	31.20	11.30	0.20
Total	42							
Average		3.68	8.29	0.82	27.48	99.53	11.64	0.42
Maximum		4.19	16.77	2.90	92.88	396.80	14.60	1.00
Minimum		3.19	5.93	0.34	1.80	2.16	8.50	0.00
Standard Deviation		0.24	1.93	0.47	23.03	85.85	1.31	0.25

Dry Red Comments

Dataset was segregated to include only red wines with 1 percent residual sugar or less. The set was further divided into the MLRA in which the winery is located. Samples were requested from product made from grapes grown in their region.

Results of the 42 dry red samples reveal a consistent challenge of balancing pH, TA and VA. MLRA 105 located in far NE Iowa was the only region with multiple samples maintaining an average pH between 3.4 and 3.6 but subsequently had the some of the highest TA and VA averages. Extreme variability in FSO_2 and TSO_2 totals indicate production inconsistencies that can be addressed through technical assistance and production management changes.

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
All Off-dry Reds	30	3.50	8.83	0.81	25.10	99.79	11.46	3.77
Recommended Range		3.4 - 3.6	6 - 8	<0.7	pH dependent	<100	11 - 14	
Zone								
102	0							
103	2	3.67	8.67	1.59	13.95	168.11	11.10	4.00
104	3	3.52	9.03	0.92	24.80	111.09	11.07	3.00
105	10	3.47	8.53	0.75	17.25	88.50	12.05	4.10
107A	0							
107B	5	3.43	9.31	0.53	46.51	109.15	10.98	3.80
108C	5	3.52	8.12	0.87	24.56	94.10	11.84	3.20
108D	5	3.52	9.56	0.75	24.59	84.48	10.79	4.00
109	0							
115C	0							
Total	30							
Average		3.50	8.83	0.81	25.10	99.79	11.46	3.77
Maximum		3.82	14.78	1.66	118.88	262.40	18.30	5.00
Minimum		2.98	5.10	0.27	0.00	1.76	8.00	2.00
Standard Deviation		0.21	2.24	0.33	24.99	62.13	1.97	1.22

Off-dry Red Comments

Data set was segregated to include only red wines with greater than 1 percent residual sugar. The set was further divided into the MLRA in which the winery is located. Samples were requested from product made from grapes grown in their region. Unlike the dry red wines the comprehensive results for this set showed acceptable averages for pH. However TA and VA remained slightly above the industry recommended standards. Variability within acids and sulfur dioxides was still high, but considerably less than variability in their dry-red counterparts. Although TA is higher than recommended, the maintenance/addition of residual sugar can enhance acceptability.

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
Varietal Reds								
Frontenac	12	3.49	9.21	0.65	23.91	94.58	11.17	1.37
Marechal Foch	12	3.69	8.15	0.93	27.40	97.47	11.12	1.21
St. Croix	5	3.87	6.86	0.76	28.95	101.59	11.26	0.40
Total	29							
Recommended Range		3.4 - 3.6	6 - 8	<0.7	pH dependent	<100	11 - 14	
Average		3.64	8.36	0.78	26.22	96.99	11.17	1.13
Maximum		4.09	11.48	1.84	92.88	396.80	13.90	5.00
Minimum		3.30	6.15	0.37	0.00	1.76	8.30	0.00
Standard Deviation		0.21	2.24	0.33	24.99	62.13	1.97	1.22

Varietal Red Comments

This dataset was segregated to include only commonly submitted red varietal wines with no consideration given to residual sugar content. Varieties were only considered if five or more samples were submitted for analysis. Three varieties met this requirement: Frontenac, Marechal Foch and St Croix. Due to the limited number of samples, they were not sub-divided into MRLA.

Of the samples submitted, Frontenac consistently produced a product with acceptable pH and VA scores but exceeded the industry recommendation for TA. Marechal Foch averages were only slightly high pH, TA and VA results. Though fewer samples of St. Croix were submitted, results showed more manageable TA and VA levels, which could be a strength of this variety. Frontenac fruit tends to have higher TA values at harvest than Marechal Foch and St. Croix. Research is needed to address the issue of high malic acid and high pH in Frontenac to improve dry wines of this varietal.

Summation of White Wine Analysis

A total of 44 white wines were analyzed and charted for pH, TA, VA, OH%, FSO_2, TSO_2 and RS%. For comparison the group was then sub-divided into dry and off-dry wines with greater than 1 percent residual sugar. Additionally, for comparison the three most common varietal wines were analyzed using the same criteria.

The dry and off-dry comparisons incorporate the MLRA soil data to identify geographic tendencies, strengths or constraints for particular styles of wine produced in these areas.

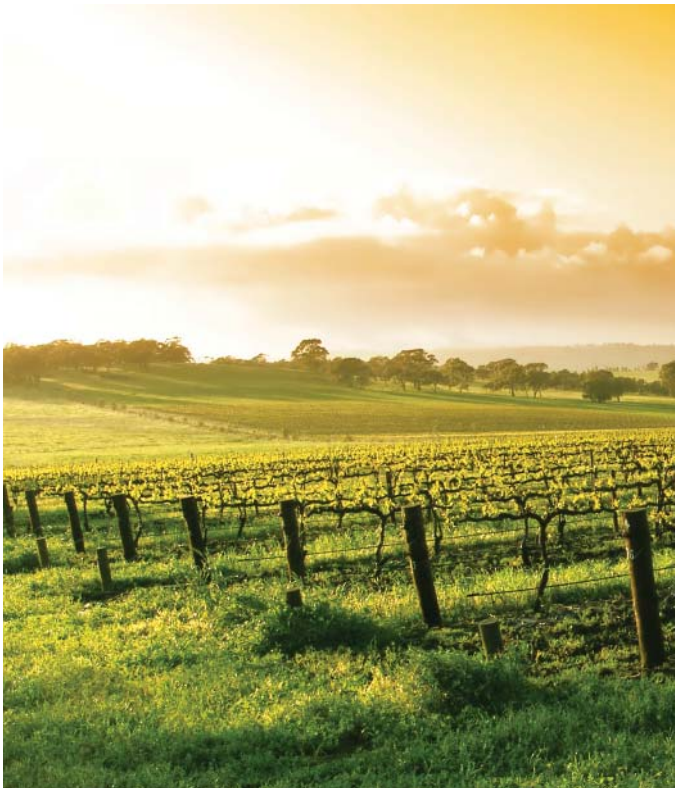
Category	pH	TA (g/L)	VA (g/L)	OH%	FSO_2	TSO_2	RS%
All Whites Average	3.36	8.73	0.68	11.50	31.94	131.94	1.80
Maximum	3.91	14.74	2.06	14.20	188.18	188.18	5.00
Minimum	2.89	5.33	0.37	8.10	0.00	0.00	0.00
Standard Deviation	0.20	1.81	0.31	1.24	33.63	33.63	1.83
Recommended Range	3.2 - 3.4	7 - 9	<0.7	11 - 14	pH dependent	<100	

Comments on White Wine Data

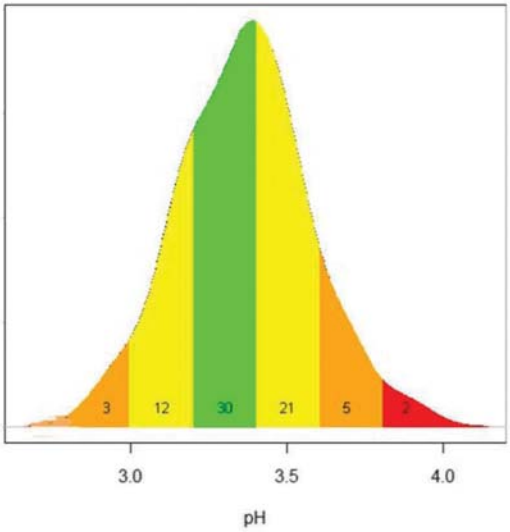
Each of the white wine categories exhibited some variability, yet the average scores across all 73 samples were in the acceptable range for each category tested.

Special consideration needs to be given to address samples with levels at or near the minimum and maximum limits. The chart below illustrates that the majority of the samples lie within or very near the recommended parameters, with only a limited number of outlier samples.

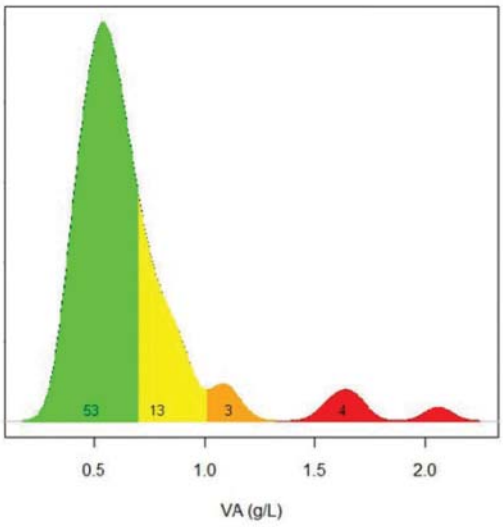
The charts on the following page illustrate the distribution of the 73 white wine samples tested for pH, TA, VA and OH. The green bar represents the recommended range. Samples in yellow are one standard deviation off the recommended range, orange is two and red is three or more standard deviations from the norm.



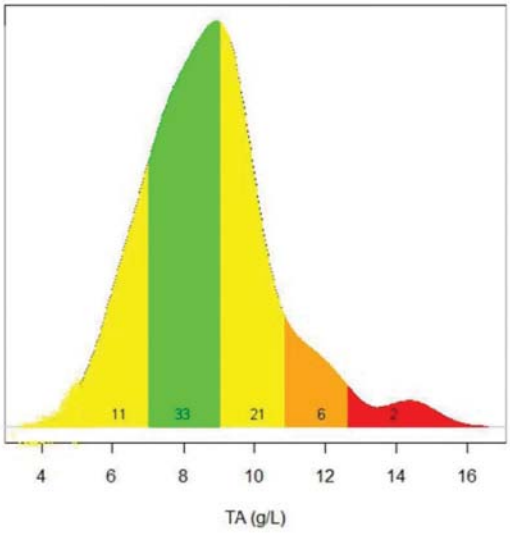
pH levels for White Wines



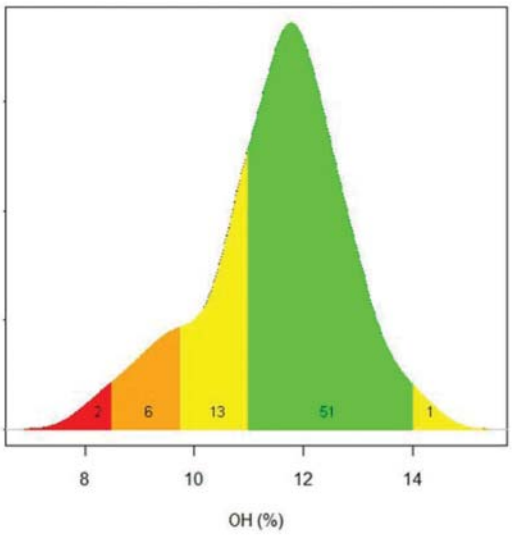
VA levels for White Wines



TA levels for White Wines



OH levels for White Wines



Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
All Dry Whites	15	3.35	8.20	0.66	30.46	159.87	11.92	0.54
Recommended Range		3.2 - 3.4	7 - 9	<0.7	pH dependent	<100	11 - 14	<1
Zone								
102	0							
103	2	3.30	9.66	1.05	5.82	150.04	11.35	1.00
104	1	3.69	8.61	0.55	59.20	189.60	10.90	0.60
105	1	3.20	9.75	0.93	32.80	221.60	11.60	1.00
107A	0							
107B	1	3.38	8.33	0.42	10.56	65.04	12.30	1.00
108C	4	3.26	6.93	0.55	22.22	103.98	11.80	0.23
108D	4	3.29	7.85	0.68	18.72	154.21	12.68	0.58
109	2	3.56	8.97	0.49	89.46	294.48	11.70	0.13
115C	0							
Total	15							
Average		3.35	8.20	0.66	30.46	159.87	11.92	0.54
Maximum		3.69	11.32	1.69	115.20	344.52	13.90	1.00
Minimum		3.13	5.33	0.38	0.16	60.96	10.90	0.00
Standard Deviation		0.17	1.57	0.35	31.02	85.10	0.73	0.39

Dry White Comments

Dry white wine samples were segregated to include only white wines with 1 percent residual sugar or less. The set was further divided into the MLRA in which the winery is located. Samples were requested from product made from grapes grown in their region.

Results of the 15 dry white samples reveal consistency in meeting the recommended ranges in all categories except TSO_2. Given the limited number of samples from each MRLA, no conclusion can be drawn between the regions and the terroir impact on the final product.

Off-Dry White

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
All Off-dry Whites	58	3.37	8.86	0.68	32.33	139.67	11.39	4.14
Recommended Range		3.2 - 3.4	7 - 9	<0.7	pH dependent	<100	11 - 14	
Zone								
102	0							
103	2	3.36	7.91	1.00	6.34	121.85	10.55	3.50
104	2	3.65	7.35	1.08	74.44	276.48	10.35	3.50
105	14	3.27	9.50	0.62	19.39	127.91	11.82	4.43
107A	0							
107B	11	3.39	8.24	0.75	21.43	102.77	11.62	4.64
108C	14	3.38	8.71	0.66	53.12	182.47	11.59	3.86
108D	14	3.40	9.20	0.62	32.58	126.18	10.96	3.86
109	0							
115C	1	3.29	8.93	0.37	6.40	61.60	9.60	5.00
Total	58							
Average		3.37	8.86	0.68	32.33	139.67	11.39	4.14
Maximum		3.91	14.74	2.06	188.18	439.13	14.20	5.00
Minimum		2.89	5.46	0.37	0.00	1.60	8.10	2.00
Standard Deviation		0.21	1.87	0.30	34.80	87.57	1.34	1.19

Off-dry White Comments

These samples were segregated to include only white wines with greater than 1 percent residual sugar. The set was further divided into the MLRA where the winery is located. Samples were requested from product made from grapes grown in their region.

Similar to the dry white wines the comprehensive results for this set showed acceptable averages for pH, TA and VA. However TSO2 was consistently above industry recommended standards. Proper storage and handling of wines will minimize oxidation, thus lowering TSO2 levels to acceptable limits.

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
Varietal Whites								
Edelweiss	12	3.36	8.04	0.68	19.23	110.98	11.40	4.47
St. Pepin	6	3.57	7.93	0.69	26.48	128.46	10.42	3.52
LaCrosse	11	3.43	8.67	0.64	48.33	160.85	11.45	2.30
Total	29							
Recommended Range		3.2 - 3.4	7 - 9	<0.7	pH dependent	<100	11 - 14	
Average		3.43	8.26	0.66	31.77	133.51	11.21	3.45
Maximum		3.91	11.03	2.06	188.18	439.13	14.20	5.00
Minimum		3.00	5.46	0.37	0.16	2.08	8.50	0.05
Standard Deviation		0.21	1.25	0.37	39.99	101.32	1.51	1.84

Varietal White Comments

These samples were segregated to include only commonly submitted white varietal wines with no consideration given to residual sugar content. Varieties were only considered if five or more samples were submitted for analysis. Three varieties met this criteria Edelweiss, St. Pepin, and LaCrosse. Due to the limited number of samples, they were not sub-divided into MRLA.

Of the samples submitted, Edelweiss consistently produced a product with acceptable pH while all three varietals yielded acceptable TA and VA scores. SO_2 content was highly variable.

Summation of Rose Wine Analysis

A total of 18 rose wines were analyzed and charted for pH, TA, VA, OH%, FSO_2, TSO_2 and RS%. For comparison, the group was then sub-divided into dry and off-dry wines with greater than 1 percent residual sugar. The dry and off-dry comparisons incorporated the MLRA soil data sub-sets for the purpose of identifying geographic tendencies, strengths or constraints for particular styles of wine produced in these areas.

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
Dry Rose Wines	3	3.51	8.89	0.44	39.65	99.57	11.07	0.13
Recommended Range		3.2 - 3.4	7 - 9	<0.7	pH dependent	<100	11 - 14	
Zone								
102	0							
103	0							
104	1	3.44	7.70	0.48	2.16	23.76	8.60	0.10
105	0							
107A	0							
107B	1	3.28	11.84	0.36	8.80	35.20	12.00	0.20
108C	0							
108D	0							
109	1	3.80	7.39	0.47	108.00	239.76	12.60	0.10
115C	0							
Total	3							
Average		3.51	8.89	0.44	39.65	99.57	11.07	0.13
Maximum		3.80	11.84	0.48	108.00	239.76	12.60	0.20
Minimum		3.28	7.39	0.36	2.16	23.76	8.60	0.10
Standard Deviation		0.27	2.78	0.07	59.28	121.54	2.16	0.06

Dry Rose Summary

Due to the limited number of samples, no conclusions can be drawn regarding regional trends or tendencies.

Category	# Samples	pH	TA (g/L)	VA (g/L)	FSO_2	TSO_2	OH%	RS%
Off-dry Rose Wines	15	3.19	9.56	0.59	26.29	122.63	10.54	4.20
Recommended Range		3.2 - 3.4	7 - 9	<0.7	pH dependent	<100	11 - 14	
Zone								
102	0							
103	0							
104	1	2.84	13.97	0.43	4.08	83.28	10.90	2.00
105	5	3.18	8.74	0.64	15.79	108.10	10.96	4.60
107A	0							
107B	2	3.27	9.44	0.47	24.72	163.80	8.95	3.50
108C	3	3.18	10.86	0.66	21.18	106.41	11.07	4.33
108D	3	3.25	8.35	0.67	62.24	176.37	10.50	4.33
109	0							
115C	1	3.30	9.19	0.26	11.66	39.75	9.80	5.00
Total	15							
Average		3.19	9.56	0.59	26.29	122.63	10.54	4.20
Maximum		3.51	14.49	0.91	100.40	272.80	12.60	5.00
Minimum		2.84	6.68	0.26	1.44	39.75	7.90	2.00
Standard Deviation		0.22	2.28	0.17	26.17	62.64	1.38	1.21

Off-dry Rose Summary

Due to the limited number of samples, no conclusions can be drawn regarding regional trends or tendencies.

However, it is noteworthy that with a few exceptions, the off-dry rose category had a high number of samples in the recommended pH and VA ranges when compared to all other samples.

Sensory Summary

Sensory analysis was conducted on the 55 wines surveyed for this study. The sensory panel used the 20-point Davis method as a guide. All samples were presented blindly to the panel. Panel members included individuals with enology, chemistry, hospitality, and wine retail backgrounds. A score out of a maximum 20 was assigned to each wine by each panelist. Comments were made by consensus among panelists, such as "commercially acceptable" or "needs improvement" and each winery received their sensory scores and comments. The table below displays results of acceptability overall and in each category; red, white, and rose. Percentages and average sensory scores are also given.

Category	Total Samples	Commercially Acceptable	%	Needs Improvement	%	Average Sensory Score
All Wines	55	33	60	22	40	10.2
Red Wines	29	15	52	14	48	10.3
White Wines	18	14	78	4	22	10.9
Rose Wines	8	4	50	4	50	8.8

Comments on Sensory Data

Iowa's grape and wine industry is young and expanding at a rapid pace. Iowa's climate is cold and the growing season is short with rain episodes throughout the growing season. This kind of climate is not suited to growing vinifera, and many of the American and French hybrid grapes.

Introduction of Vitis riparia-based cultivars has made it possible to grow grapes and make wine in Iowa, where it was not feasible before. In spite of being a young industry with limited experience in grape and wine production, the overall quality of Iowa wine is good. This is evident from the results of this survey where 60 percent of the samples were found to be commercially acceptable by an expert sensory panel.

Moving forward, as growers and winemakers become more knowledgeable and skilled in their craft, we are confident that the quality of wine will be substantially improved. We also believe that repeating the survey at a future date will be helpful in measuring the progress of Iowa's grape and wine industry.

Comparing red and white wine categories, it appears that wineries are making better whites, with 78 percent of white wines submitted deemed acceptable, while only 52 percent of reds gained the same recognition. Recurring comments made by panel members for wines needing improvement centered on oxidation, the effects of which are seen visually in the color or by aroma/flavor changes associated with spoilage. Red winemaking is more challenging because of the high acid and high pH conditions. As these issues are minimized through experience and further research, production techniques will allow for more balanced and approachable reds. Only a small number of rose wines were submitted, with half gaining acceptable titles and the other half needing improvement.

Survey

Production data wfor this survey was solicited from participants to provide additional cross referencing for variability that can be tracked to the terroir, production methods and or varietal genetic composition. Below is the data that was requested.

Winery
Winery Address
Participant
Phone
E-mail
Wine sample name/varietal

Question 1. Please provide information regarding the site on the following criteria:

a. Address of the primary vineyard location, elevation and direction of slope. Include County and Section number and/or a FSA aerial photo if available.

b. Information on soil: predominant soil type, color, depth, presence of bed rock, texture, structure, pH, organic matter content drain tiles installation before planting, and soil mineral composition.

Question 2. Please provide information on micro climatic conditions specific to the site:

a. Growing season temperature (degree days), days with temperature over 86^0F, sunshine hours

b. Rain fall distribution, humidity and wind

Question 3. Please provide following information about viticulture practices.

a. Year of planting
b. Variety
c. Vine spacing
d. Canopy management practices followed
e. Nutrient application
f. Irrigation and the frequency
g. Phenology dates: bud break, flowering, fruit set veraison and harvest
h. Harvest parameters used, Brix, pH, TA, presence of materials other than grape (MOG) and % rot

Question 4. Winemaking. Please provide the answers to following:

a. Yeast strain used
b. Fermentation temperature
c. Must treatment(SO_2, enzyme, etc)
d. Must adjustment, sugar and acid
e. Clarification and stabilization
f. Sterile filtration
g. Bottling