



CENTRAL WASHINGTON UNIVERSITY

WORLD WINE PROGRAM

Wine Quality Initiative

Assuring Quality in the Burgeoning U.S. Wine Industry

*The wine industry in the United States is expanding rapidly, with wine sales more than doubling from \$10.9 billion in 1991 to \$23.2 billion in 2004. The total economic impact of the industry is estimated at over \$50 billion annually. Washington State is the second largest wine-producing state in the United States, with an annual economic impact in excess of \$3 billion. Even so, the U.S. wine industry should not rest on this record of impressive growth. In the face of stiff international competition, U.S. wine producers must take steps to ensure quality in every bottle. The problem is that many wine producers don't have the laboratory facilities or other expertise required to ensure consistent quality in their product. Central Washington University has established the **Wine Quality Initiative** to address this important need and to ensure continued growth.*

Wine Faults Hurt Business and the Economy

In 2004, a large wine producer recalled over 1.2 million bottles of flawed wine due to re-fermentation in the bottle and the possibility that the bottles could explode in their retailers' stores. Wine quality testing and education could have prevented this problem. The financial impact? A loss of \$17 million in sales, plus the costs associated with the product recall and immeasurable damage to the brand's reputation.

Preventing Wine Faults is the Key to Quality



The rapid growth of the wine industry in Washington State and in the nation is the result of many new startup wineries and vineyards. Over 90 percent of these wineries are small, producing fewer than 5,000 cases of wine per year. These smaller operations do not have the laboratory facilities or testing expertise to ensure consistent quality. Chemical and biological "wine faults," are a major challenge in winemaking. They cause damage to the product, make it difficult to conform to quality control and quality assurance standards, reduce the ability of wineries to meet the standards of written contracts with buyers, and result in costly recalls. In

addition, wineries wishing to export their products must meet strict requirements that include wine fault testing.

CWU's World Wine Program

The CWU World Wine Program (WWP) is unique in the U.S. because it focuses on the business and marketing aspects of the wine trade and provides professional wine evaluation aimed at assessing and improving wine quality. Whereas other university programs focus on viticulture (grape growing) and enology (wine making), CWU offers distinctly different and complementary educational programs:

- Academic Programs:
- Wine Trade Professional Certificate
- Wine Trade and Tourism Minor
- Global Wine Studies Degree
- Trade Training for the Wine Industry
- Consumer Courses



Currently, CWU offers awareness training about the critical importance of wine faults and their effect on the entire industry. This training has been offered to sold-out audiences in Washington State and at numerous national wine industry conferences. This demand attests to the growing need in this critical area.

The Wine Quality Initiative

Central Washington University's World Wine Program intends to develop a wine quality testing and education program that will help Washington winemakers and serve as a model that can be replicated throughout the nation. The Wine Quality Initiative will consist of two phases to begin in the summer of 2008. During Phase I, research will be conducted to determine the most common wine quality problems in selected Washington State Cabernet Sauvignons. During Phase II, curriculum to educate winemakers will be developed based on the findings of the research.

Project Design and Management Plan

Background

Chemical and biological wine faults are a major challenge in winemaking. Wine faults damage the product, make it difficult to conform to quality control and quality assurance standards, reduce the ability of wineries to meet the standards of written contracts with buyers, and result in costly recalls. In addition, wineries wishing to export their products must meet strict requirements that include wine fault testing. Wine faults manifest themselves in the wine three ways: visually they impact color and depth, they create foul odors, and they alter taste and mouthfeel.

The problem is that most wine producers don't have the awareness, knowledge, laboratory facilities or expertise required to detect and correct faults to ensure consistent quality in their product. Central Washington University's Wine Quality Initiative will begin to address this important need by developing curriculum to train winemakers, helping them understand the problems and provide strategies for correcting and/or eliminating them.

Stated goals and objectives

Project Goal: Develop a model curriculum based on wine faults research that will help winemakers understand the nature of wine faults, their sources and causes, detection protocols and appropriate actions to correct and prevent them.

Objective 1: To conduct laboratory testing and analysis on one varietal from Washington State to determine the most common faults (undesirable levels of chemical and biological components) present.

Objective 2: To develop an educational program designed to raise awareness among industry members of the most common wine faults present in this region and the corrective actions for prevention.

Anticipated outcomes

Outcome 1: A list of the most common faults.

Outcome 2: A report that describes the methods and findings of the study.

Outcome 3: A *Wine Faults* curriculum for Washington State based on the results of the research.

Actions/activities needed to meet objectives

The initiative will consist of two phases:

Phase I - Research to determine the most common wine quality problems in selected Washington State Cabernet Sauvignons.

Phase II - Curriculum development based on the findings of the research.

Phase I

CWU scientists will develop testing methodologies and conduct research to determine the most common wine faults suspected among the predominant varietal in Washington – Cabernet Sauvignon. At nearly 6,000 acres,

Cabernet Sauvignon is the most planted varietal and produced by the majority of wineries. Analysis of the data will establish the particular winemaking factors responsible for the most common wine faults.

Seven specific chemical and biological tests will be performed:

- Chemical tests of (1) Volatile Acidity and (2) Sulfates.

Volatile Acidity adds complexity to wines, but in excess it causes ethyl acetate (nail varnish) smell and a vinegar taste. Sulfates in a reductive environment can cause Hydrogen Sulfide which, at excessive levels, manifests as a rotten egg or dirty drain smell.

- Biological tests of (3) *Brettanomyces*, (4) *Peddiococcus* and (5) *Lactobacillus*.

Excessive *Brettanomyces* can cloud wines and alter its taste and smell. Large quantities of *Peddiococcus* can cause acetate, carbon dioxide, off flavors and aromas. *Lactobacillus* can cause acetic acid or bitter flavors.

- Chemical tests of (6) Pyrazines and (7) Mercaptans - Thiol Groups.

Pyrazines in excess can cause unpleasant odors and flavors of green pepper. Many thiols are colorless liquids having an odor resembling that of garlic. ETS Laboratories, an independent wine laboratory, will be contracted to conduct the Thiol Groups tests.

Thirty wines (90 total samples) that are suspected to have chemical and biological components at fault levels will be tested along with 30 wines (90 total samples) that are believed to be fault-free.

Phase II

CWU scientists and wine experts will develop an educational program designed to raise awareness among industry members of the most common wine faults present in this region and corrective actions for prevention. Given that over 90 percent of Washington wineries are small, producing fewer than 5,000 cases of wine per year, and do not have the laboratory facilities or expertise to ensure consistent quality, such a curriculum is important to the success of the industry.



The curriculum will incorporate the following:

- Findings from Phase I research will be incorporated into the curriculum: Individual and/or aggregate values for each of the seven chemical and biological tests conducted on the wine will be presented.
- Methods for wine faults detection: Information about testing for biological and chemical faults will be presented, including types of tests and laboratory contacts.
- The impact of faults on taste, mouthfeel, smell and/or appearance of wine.
- Methods for corrective measures and/or prevention of wine faults.

Timeline

The research phase will be conducted through the first three quarters of the one-year performance period with results incorporated into the training curriculum as they become available. Curriculum development will take place during the last two quarters of the project.

Project	Year 1			
	Q1	Q2	Q3	Q4
Research phase: Wine testing (Methodology development, testing, analysis of data, compilation of results by wine)				
Curriculum development				

Methods used to ascertain results

Chemistry

Volatile acidity in wines will be tested with a DIONEX Ion Chromatograph (IC) with standard methods of elution and conductivity detection. The chromatographic resolution of these analyses will provide quantitative information of a series of organic acids that range from high to low degrees of volatility. Amongst the more volatile acids are: acetic (the most abundant volatile acid), formic, propionic and butyric acids. Other less volatile species that also play a role in the fermentation process for which concentration can be determined are malonic, malic, citric, and tartaric acids. Levels of acetic acid can be used to infer levels of ethyl acetate, as the latter is a product of esterification of ethanol and acetic acid.



Microbiology

The three groups of organisms of most interest in wine faults, *Brettanomyces* species, *Lactobacillus* species, and *Pediococcus* species, will be tested with two complementary approaches: (i) the culturing approach, and (ii) the culture-independent, polymerase chain reaction (PCR), approach. Culturing will reveal population sizes of these organisms, thus providing a degree of contamination, which can also be used for correlation with chemical faults. The common limitation with this procedure is that some microbes may take too long to grow, or have been damaged during wine processing to an extent that they are “viable, but nonculturable.” To circumvent this lack in detection, genes specific to these organisms can be detected via PCR by extraction directly from the wine samples, and although this is not a quantitative technique, it provides quick proof of the presence of as few as 3 organisms in 100 mL of wine.

Project Team

Ms. Amy Mumma, MBA, Wine, Bordeaux Business School, Bordeaux, France, 2008. Diploma of Sensory Analysis and Wine Studies, University of Dijon, France. B.A., French and International Affairs, University of Puget Sound, Tacoma, Wash. Coordinator of the CWU World Wine Program and 2005 International Wine Woman of the Year, Amy serves as the principal program curriculum developer. Amy is also a member of the organoleptic team that analyzes each wine to determine faults by appearance, aroma, and taste.

Dr. Anne Johansen, PhD, Environmental Science Engineering, California Institute of Technology, Pasadena, 1999. M.S., Materials Science and Engineering, Oregon Graduate Institute, Beaverton, Oregon, 1993. M.S., Inorganic Chemistry, University of Oslo, Oslo, Norway, 1991. B.S., Chemistry, University of Oslo, Oslo, Norway, 1989. Dr. Johansen directs the EPA accredited CWU Analytical Chemistry Laboratory and coordinates the chemical analysis of the wine samples.

Dr. Holly Pickart, PhD, Microbiology, University of Tennessee, 1996. B.S., California State University, Long Beach (Microbiology major, Chemistry minor), 1990. Dr. Pickart, CWU department of Biological Sciences, coordinates the microbiology laboratory testing of the wine samples.

Dr. John E. Hudelson, PhD, Cultural Anthropology, Columbia University. B.A., Social Anthropology, Columbia University. Dr. Hudelson, a CWU Global Wine Studies faculty member with expertise in viticultural research, enology, and wine chemistry, supports the laboratory research and curriculum development efforts. John is also a member of the organoleptic team that analyzes each wine to determine faults by appearance, aroma, and taste.

Sara Rybka is a senior Chemistry Major at Central Washington University and has worked in the CWU Chemistry lab as an analytical chemist for one year on several federally funded projects, including research on precipitation and lake water chemistry, and urban air pollution chemistry and toxic effects. Sara is also responsible for analysis and reporting of proficiency tests to keep the EPA laboratory accreditation current. Sara conducts chemical laboratory analysis on the wine samples.

Celia Braun Faiola is a senior at Central Washington University with a double major in Chemistry with a biochemistry specialty and Biology with science education focus. She has been involved in a number of externally funded projects both in the Geology and Chemistry departments, including research on the chemical composition of urban aerosols in the context of toxicity. She is also responsible for trace metal analysis of groundwaters in Washington State. Celia conducts chemical laboratory analysis on the wine samples.

Brad Snaza is a senior double major in Global Wine Studies and Tourism Management at Central Washington University. Brad is a graduate of the CWU Wine Trade Professional Certificate, March of 2008. Brad is a member of the organoleptic team that analyzes each wine to determine faults by appearance, aroma, and taste.

ETS Laboratories will be contracted to perform testing for Thiol Groups. ETS was established in 1978 to provide the rapidly expanding California Wine Industry with technical assistance and laboratory support. ETS is accredited by A2LA to ISO/IEC 17025:2005 standards—the nation's first independent wine laboratory so designated.