
A century of wine and grape research

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The culture of grapes and the making and aging of wine are often incorrectly visualized as ancient practices that have not changed and cannot change much. True, grapes have “always” been grown and converted to fermented fluid, and certain practices are fundamental to keeping it wine and not vinegar. Grape growing and winemaking were two of the more technologically advanced processes from ancient times to the dawn of the Scientific Revolution by the mid-1800s. Nevertheless, within the past century every operation in winemaking or viticulture has become either highly modified or at least much better understood and managed. Many new steps or whole techniques leading to new types of wine have been introduced. New varieties of grapes have been developed and vineyard management made much more rational and efficient.

The University of California has had a considerable role in these developments: organizing and interpreting the related body of knowledge, teaching budding enologists and viticulturists to work both as winegrowers and as scientists, conducting research, maintaining contact with developments in other parts of the world, transferring knowledge between the public and the University (in both directions) through extension. The University, of course, never has operated in a vacuum. In viticulture and enology especially, the scale of operations necessary to experiment on some problems can place the University by itself at a disadvantage. Fortunately, the growers and winemakers of California have been forward-looking, quality conscious, and relatively free of historical prejudices. Cooperation of the University with the growers and rapid acceptance of new ideas into commercial practice have helped the public at large by raising the quality, lowering the cost, widening the choice, and standardizing the types of wines. The growing appreciation of wine by the American public and their willingness to pay extra for especially pleasing wines has also helped keep wine producers alert to new developments.

The University's roles have shifted considerably in emphasis at various times in response to the general situation. The early period up to about 1915 was characterized by boom-bust economic cycles, apprentice-trained growers and winemakers, the elementary stage of science, inadequate distribution and appreciation of good wine, growing prejudices against alcoholic beverages, and an American consumer population of diverse backgrounds and attitudes toward wine. George Husmann wrote in *Grape Culture and Wine-Making in California*, published in 1888: “We have thousands, perhaps the large majority of our wine growers, . . . who are comparatively poor men, many of whom have to plant their vineyards, nay, even clear the land for them with their own hands, make their first wine in a wooden shanty with a rough lever press, and work their way up by slow degrees to that competence which they hope to gain by the sweat of their brow . . . many bring but a scanty knowledge to their task.”

In those times one role of the University was dissemination of rudimentary understanding of grapes and wine. Another, however, was as a center of research and calm consideration of the longer term view. Almost every research project or publication was breaking new ground in those formative years, and teaching in

enology within the University included two units of lectures and four units of laboratory work as early as 1887.

With the restrictions caused by World War I and first the anticipation then the actuality of legal Prohibition, the University's role with respect to wine production and aging rapidly changed from active teaching and research to retrenchment and re-direction. Although home winemaking boomed during this period, most of the University effort in the 1918-1933 era was in research on grape juice, jellies, jams, industrial alcohol, and products other than alcoholic beverages. In fact, diversion of enology studies, which had been unusual in agricultural education in that they focused on the *processed* product, gave rise to the Fruit Products Division and later the Food Technology Department (now Food Science and Technology) of the University. The University of California was one of the early leaders in food science and has maintained a strong program with a great deal of cross-fertilization with enology. Viticulture teaching and research continued during Prohibition and grape production for home winemaking actually increased. Raisin and table grape work continued.

After Prohibition was repealed, the University resumed teaching and research directly related to wine. It was necessary to train a whole new generation of winemakers and to help solve problems as the nearly dead wine industry was brought suddenly back to life and the grape industry underwent drastic changes. During Prohibition there were perhaps a dozen active wineries in California making sacramental and medicinal wines; by 1934 the *California Wine Review* listed 433 California wineries, several of which had multiple premises. Much wine was of marginal quality because of poor processing practices and inadequate aging. Less desirable grape varieties and a high proportion of distilling wines were other factors suppressing average wine quality. Consumer appreciation of wines and demand did not develop as expected. Soon overproduction was again a problem, and many wineries were bankrupted or consolidated.

World War II relieved the surplus of brandy and dessert wines, but the wine industry stagnated during the emergency allocation of men and materials. After the war the University was again required to supply trained viticulturists and enologists and to research problems for revitalization of the industry. Finally, in perhaps the last 20 years, the wine and grape industries have survived the formative and reformatory periods with, now, well-educated enologists and viticulturists generally in charge (many graduated from the University of California). A more stable and knowledgeable clientele exists (some also educated about wine by the University). The industry has just undergone rapid growth and has advanced considerably in the science of winemaking. The grape acreage has shifted somewhat from table fruit, although they and raisins remain very important to California and the rest of the United States.

Wine production has shifted from about 80 percent dessert and appetizer wines and 20 percent table and sparkling wines to almost exactly the reverse proportion. This shift has stemmed in part from interest in and education about wines of lower alcohol content and their use with food. It also results from improvements in process-

ing and storage technology. Additional production and consumption of table wines have been superimposed on only a modest decrease in the total gallonage of dessert and appetizer-type wines (although per capita consumption of the latter has decreased considerably).

Advances with impact on winemaking, stabilization, and aging have been in many cases the result of original research done within this University. The University's work frequently has been instrumental in the application of a concept to California wines, usually with improvements, even if it originated elsewhere. Members of the University faculty and staff have helped to seek out such new ideas around the world and adapted them to American conditions. This research and its application to commercial winemaking have helped to develop respect for California wines all over the world.

From 1923 through the end of 1977, the Department of Viticulture and Enology at Davis published some 1,573 titles. It is estimated that the papers on grapes and wine published from other departments of the University (such as Food Science and Technology, Plant Pathology, Entomology) would double this total.



A thousand students each year enroll in "V & E 3," the introduction to wine and grape culture at U. C., Davis. About 125 will go on to become professional viticulturists or winemakers.

Among the 1,573 papers at least 10 percent are highly technical or scientific and are related to post-fermentation wine processing, stabilization, or aging. A greater number relate to viticulture and to fermentation. It has been conservatively estimated that, without the University's input, grape and wine production would have lagged about 10 percent. Currently this would be at least an extra \$80 million per year and represents a large return on the investment in University research by the people of California, not even considering the trained people produced.

Following are a few examples of the University's contribution to the processing and aging of wine. University faculty and students have performed many experiments on heat treatment regimes, development of experimental and commercial prototypes of special equipment, and optimizing conditions for different wine types. One objective has been adaptation of winemaking to continuous operation, and another has been keeping the pomace itself out of the winery. Browning of white wine is prevented if oxygen or air is completely excluded, but the more contact between pomace and wine, the greater the wine's capacity to brown if exposed to air. Red wines normally have maximum color when

separated from the grape pomace at an intermediate stage of fermentation, much sooner than formerly practiced. Wines separated from the grape skins and seeds earlier were found to be lighter, less coarse, generally earlier maturing, and pleasing but less costly. Partly from University research and partly from improvements by the industry, better methods of excluding air and keeping the wines bright and fresh through bottling to the consumer have been developed.

Clarification and stabilization of wines are other important areas of contribution. The importance and proper use of sulfur dioxide and other agents such as sorbic acid, were studied at early points in their use. The comparative testing and proper use of such fining (clarifying) agents as gelatin, tannin, bentonite, casein, polyamide, polyvinylpyrrolidone (PVPP), and other products were studied as the products became available. Techniques for determining the dosage to individual wines for specific effects were first studied in the early 1940s. The identification of unstable proteins in white wines during the 1960s laid the foundation for the present understanding of the phenomenon. Adaptation of solubility product studies from physical chemistry to the problem of ensuring stable clarity with respect to potassium bitartrate or calcium tartrate supersaturation in wines succeeded in the early 1960s. Methods of preventing precipitation of these tartrates after bottling by controlled refrigeration and filtration or by ion exchange have been the subject of many experiments. The importance of copper and iron as precursors of haze in wine and the prevention of such occurrences in wine were elucidated. Fine filtrations to remove microorganisms from wine were evaluated before they were in common usage. That wines today are brilliantly clear and stable in that condition is the result of such studies.

Many University experiments have been related to aging of wine and brandy. The nature of different reactions during aging and some of their chemical and sensory results have been studied. Oxidation and its encouragement or prevention as important parts of aging have been clarified. Research showing the roles of cooperage and the contribution of vanillin, oak lactone, and some other constituents from oak to wine or brandy has made important contributions to this field. Some of the differences of cooperage oak from various sources have been quantified, and some of the time-temperature relationships in bottle aging have been evaluated.

We hope that future relationships of the University of California with its various constituencies will remain as productive as in the past. It behooves us at the University to redouble our efforts to achieve the most fundamental and complete understanding of grapes and wines as the sophistication of our clientele (public, students, growers, and winemakers) continues to grow. The people of California, the University, and the wine and grape producers can be justifiably proud of the excellence of teaching and research achieved in the fields of enology, viticulture, and related science and technology.

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