

## FOOD SCIENCES

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NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, A DIVISION OF THE NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, A STATUTORY COLLEGE OF THE STATE UNIVERSITY, CORNELL UNIVERSITY, ITHACA

# Experimental Wine Production

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A major portion of the wine research program at the New York State Agricultural Experiment Station, Geneva is concerned with the evaluation of grape varieties for suitability for wine production in New York. The viticultural characteristics of each variety or selection are assessed in the Experiment Station vineyards by the staff of the Department of Pomology and Viticulture, and enological evaluation is done by the Department of Food Science and Technology. In order to evaluate the enological merits of each variety, a wine production procedure suitable for small batches (1 to 50 liters) has been developed. The goal of wine production for this program is to obtain a consistently sound wine representative of the varietal potential. Presently, over 500 experimental lots are produced annually. This report describes the standard procedure used to produce these experimental wines.

### RAW PRODUCT HANDLING

As the grapes ripen (early September through early November), they are harvested by hand into plastic trays holding about 20 kg and brought to the pilot plant. Processing begins immediately so that biochemical changes in the fruit during storage are minimized. Washing the grapes prior to processing is rarely necessary except when samples are taken from young vines where the clusters hang near the ground. If washing is necessary, the grapes are sprayed with cold water to remove the soil and allowed to drain.

The first step in must preparation is that of separating the berries from the stems and leaves in a Healdsburg type stemmer (10). The pitch and speed of the blades and the clearance between the blades and the lift bars are adjusted

to give maximum separation efficiency while avoiding fragmentation of vegetative tissues which may contribute off flavors to the finished wine (5). However, recent reports indicate that this may not be so important as previously thought (11).

The stemmed fruit is collected and weighed to the nearest 0.1 kg, and enough sulfur dioxide (SO<sub>2</sub>) is added to bring the must concentration to 100 ppm. Sulfur dioxide is added in the form of potassium metabisulfite solution prepared by dissolving 18.3 g of anhydrous potassium metabisulfite in 100 ml of water. One ml of this solution added to 1 kg of must yields a concentration of 100 ppm. Sulfur dioxide is added at this stage for two reasons. First, as an antioxidant, the sulfur dioxide prevents browning of the must and the development of off-flavors (4). Second, it is an effective antiseptic and so prevents the growth of most of the organisms that are naturally present on the berries. Although some wineries rely upon the natural microflora of the fruit for alcoholic fermentation, a pure culture fermentation is superior for research purposes since the natural microflora is variable and populations of unknown flavor producing organisms are kept to a minimum. After the addition of sulfur dioxide, the stemmed grapes are crushed in a fluted roller-type crusher in order to facilitate juice extraction (17). Small berried varieties may have to be crushed twice to insure that all berries are broken. If desired, a large portion of the free run juice can be separated at this time by placing the crushed fruit back in the hopper of the crusher with the motor off and allowing the juice to drain into an appropriate receptacle. The remaining details of the vinification depend upon the type of wine to be produced.

### VINDICATION

Three different wine types are commonly produced at

this Station. These are white wines, red wines fermented on the skins, and red wines produced by thermal vinification (hot pressing). An outline for these procedures is given in Table 1.

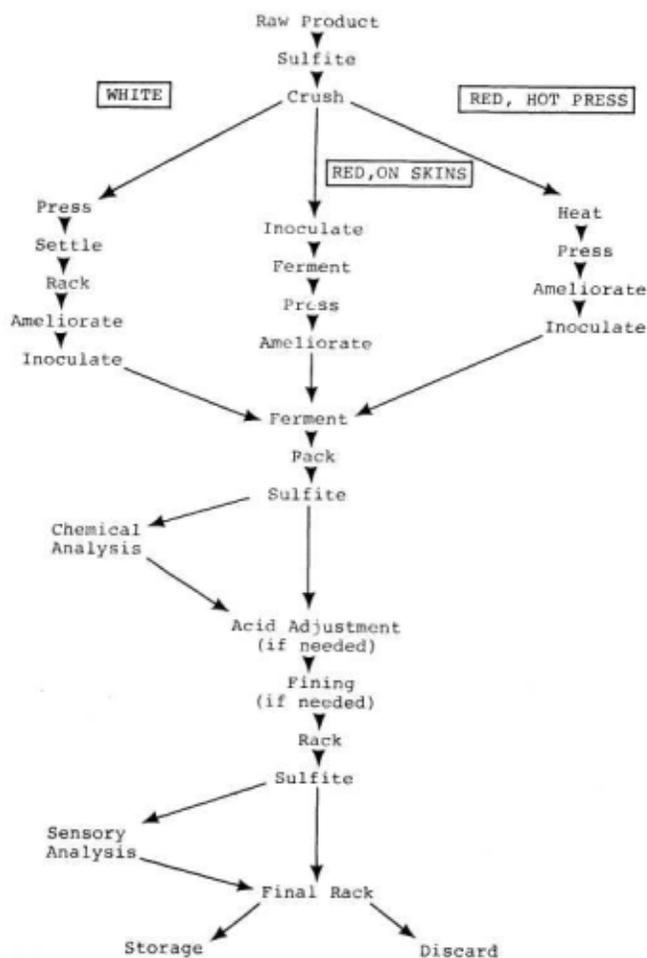


Table 1.—Outline for experimental wine production.

**White Wines**—After crushing, the white juice is immediately expressed using a hydraulic rack and cloth batch press. For the smaller batches, a press having a capacity ranging from 2-30 kg is used while another press with a maximum capacity of 100 kg is used for larger lots. Pressing is accomplished by layering the crushed fruit in nylon press cloths lined with cheesecloth. The cheesecloth prevents the grape pulp from sticking to nylon cloths during pressing making cleaning of the press cloths far easier. Cheesecloth liners are used once and then discarded. The fruit is enclosed in the cloths and several "cheeses" can be stacked and separated by wooden racks in order to increase the capacity of the batch. Only moderate pressure (about 35 kg/cm<sup>2</sup>) is applied during pressing since severe pressure can extract undesirable flavor components.

The juice is then allowed to stand in closed glass containers at room temperature (22C) for 24 hours. During this period, most of the insoluble solids settle to the bottom of the container. The settling step has been included in the procedure for white wine production since it has been

found that wines produced from these juices are generally cleaner and fruitier (16). The clear juice is racked into clean glass containers (1/2, 2/3, 1, 2, 3, 5, and 6-1/2 gal) for fermentation. Regardless of the method of vinification, fermentors are filled to only 50-75 per cent of capacity in order to prevent overflow during active fermentation. Amelioration consists of raising the juice solids to 21 ° Brix with sucrose and then adding an amount of 21 per cent sucrose solution equal to 15 per cent of the weight of the sugared juice. The juice is then inoculated with a warm water slurry of Montrachet 522 yeast (Universal Foods, Milwaukee, Wis). The level of inoculum is 1 g. dry yeast/gal. The inoculated juice is then fitted with an airlock and held at room temperature (22C) until active fermentation begins. The fermentation is then completed at 13C in a refrigerated room.

**Red Wines**—Varieties for red wine are transferred to the fermentation vessel immediately after crushing if they are to be fermented on the skins. Small lots are fermented in 15-liter square polyethylene tubs while larger lots are fermented in cylindrical stainless steel containers (28, 38, or 115 liters). Inoculum is then added at the same level as in white wine production, and fermentation is conducted at 22C. Fermentation on the skins is continued until a drop of 10° Brix is obtained in the must. During this period, the increasing ethanol concentration produced during fermentation extracts sufficient color from the skins, yet excessive tannin extraction is avoided. A good fermentation on the skins requires careful control of the floating layer of skins and seeds (called the chapeau or cap) that is brought to the surface by the escaping carbon dioxide and the decreasing must density. The rate of fermentation in the cap is far greater than in the liquid below. Consequently, the temperature in the cap can be much higher than that in the liquid phase (13). High temperatures (>30C) and excessive oxygen can inhibit the growth of wine yeasts and encourage the growth of undesirable microorganisms that can cause rapid acetification of the wine. Temperature control becomes more difficult as the size of the fermentation increases while aeration control is more difficult with small fermentations. For these reasons, the cap is "punched down" at least three times each day using a wooden plunger. In punching down, the wine and skins are thoroughly mixed, and the bulk of the trapped carbon dioxide escapes.

After the Brix has dropped 10°, the fermenting juice is separated from the skins using the pressing technique described for white wine production. However, little or no pressure is required to obtain adequate juice yield since the cell structure of the grapes is broken down during fermentation and all of the liquid released. In addition, partially fermented wine is far less viscous than the original sweet juice. After the skins and seeds are removed, the fermenting wine is ameliorated in the same manner as for white wine production, and the fermentation is completed in glass at 22C using a suitable airlock.

**Thermal Vinification**—Only a limited number of experimental wines are produced by thermal vinification, although the technique is commonly used in the New York

wine industry. Thermal vinification provides rapid color extraction and eliminates the problems of cap management. However, these wines have distinctively different flavors from their counterparts fermented on the skins. The desirability of these flavors varies with the grape variety used and the type of wine to be produced.

For thermal vinification, the crushed and sulfited fruit is heated in a steam kettle at 50-60C for 15 minutes. The must is then pressed and allowed to cool. The cooled juice is ameliorated, inoculated, and fermented following the same procedures as used for white wine production.

### SANITATION

Regardless of the method of vinification, one of the most critical factors in the production of consistently sound wines is careful sanitation. The stemmer, crusher, and press are carefully washed after each batch in order to avoid contamination of one variety with the juice of another. This is especially important in New York since many of the varieties tested are strongly flavored. For example, it takes very little Niagara juice contamination to seriously affect the flavor of any of the more neutral flavored juices such as White Riesling or Cayuga White. Furthermore, unclean equipment harbors potentially harmful populations of undesirable microorganisms and contributes to the problem of fruit flies in the winery. For the same reasons, all waste material (leaves, stems, skins, seeds) is removed from the premises promptly. All fermentation vessels and miscellaneous hardware are washed after each use. All porous equipment, in addition to being washed with water after each use, is rinsed with a strong metabisulfite solution daily. Press cloths are washed in a washing machine between each batch and machine dried. No detergent is used on any of the equipment since the residue contributes an undesirable flavor to the finished wine.

### NEW WINE HANDLING

Soon after completion of fermentation, the new wine is racked from the lees and 20 ppm sulfur dioxide added. At this stage, sulfur dioxide serves primarily as an antioxidant, for oxidation is the most common malady of wines produced in small lots. Prompt racking and sulfiting also discourages the occurrence of the malo-lactic fermentation. Although this secondary fermentation is considered desirable in the production of many commercial wines (7, 8,14,18), it is not desirable in the production of experimental wines that are intended to exhibit a distinct varietal character that is free of other complicating flavors. For this same reason, many other common commercial practices, such as varietal blending and barrel aging, are not used. At the time of the first racking, 190 ml (1 /20 gal.) of each lot is drawn off for chemical analysis. The several analyses routinely performed on each lot of wine are listed in Table 2.

Following chemical analysis, any supplementary treatments found to be necessary are performed. These are kept to a minimum in an effort to preserve the maximum varietal character. The treatment most commonly required is that of total acid reduction. This is done using potassium

**Table 2.—Chemical analysis of experimental wines.**

Analysis	Method	Reference
Ethanol	gas-chromatographic <sup>1</sup>	9
Total Acid	titration	1
pH	pH meter	2
Extract	evaporation	6
Tannin	Folin-Ciocalteu	15
Color	optical density <sup>2</sup>	12

<sup>1</sup> The procedure is a modification of the methanol determination cited.

<sup>2</sup> Optical density is recorded at 525 nm and 400 nm rather than 520 nm and 420 nm.

carbonate solution (K<sub>2</sub>CO<sub>3</sub>) which will precipitate out tar-taric acid as its potassium salt. The carbonate solution (46g K<sub>2</sub>CO<sub>3</sub> per 100 ml water) will reduce the acidity of the wine by 0.1 per cent when added at the rate of 1 ml per kg of wine. Larger reductions in acidity are achieved by adding proportionately greater quantities of the carbonate solution.

Fining is seldom required except for wines prepared by thermal vinification samples where a commercial pectinase enzyme preparation (Wallerstein Co., Morton Grove, Ill.) is added at the rate of 0.2 ml per gallon. Other fining agents such as bentonite, gelatin, and PVP are rarely used.

### SENSORY EVALUATION AND STORAGE

Sensory analysis of the finished wine is the most critical aspect of the wine variety evaluation program. Since no objective methods are suitable for flavor evaluation, a taste panel is employed for this purpose. Taste panels are, of course, subjective, but design considerations are intended to provide maximum objectivity. Some of these considerations are: (1) Panelists do not know the identities of the samples being evaluated. (2) Discussion among panelists occurs only after scoring is completed. (3) Commercial wines are occasionally included in order to provide references for the panelists. (4) The number of samples to be evaluated is limited to 20 wines or less for each session. (5) Panelists do not swallow the wines.

The Panel consists of six trained judges, and the same judges participate throughout the year. While untrained panelists are suitable for preference testing, trained panelists are required for difference testing (3). That is, only experienced judges can consistently detect and identify many of the subtle variations in wine flavor.

A nine-point general quality scale is used for scoring, but the actual score only indicates the overall relative merits of each wine. In judging most commercial wines, there are accepted standards of excellence, but for the evaluation of varietal aroma in new varieties no strict standards exist. For example, most experienced tasters have a good idea of what constitutes varietal character in Delaware or Cabernet Sauvignon wines, but there are no similar references available in the case of new varieties. Occasionally, when the goal is to improve an established variety (as in the present search for a replacement for the Ives variety), the task of aroma evaluation is simplified, but this is not usually the case. For these reasons, the most im-

portant part of the wine evaluations is not the score of the wine but the descriptive comments that are assigned to the sample by each judge. These comments, when taken in conjunction with the numerical scores over a number of years, give a reliable indication of the potential of each new grape variety for wine production under our conditions. Information collected in this manner is the basis for determining the fate of new wine varieties.

Approximately 60 per cent of all wines produced annually are discarded because of quality defects detected by the panel, and of the remaining varieties, only a selected few are ever considered for commercial release. The retained wines are stored in glass at 13 C without headspace for possible future use. Wines cellared in this manner will generally remain sound for 10 years.

### SUMMARY

In addition to the evaluation of new varieties, research in the Department of Food Science and Technology is also conducted to identify basic enological techniques that will increase the quality of wines produced in New York from established varieties. Included are studies on pressing technique, fermentation temperature, time on the skins, malo-lactic fermentation, barrel age, corrective treatment for common odor defects, and identification of chemicals responsible for wine flavor. However, for the purpose of varietal evaluation, the wine production procedures described above are strictly adhered to in an effort to control all variables that contribute to wine flavor other than varietal differences. In this way, wine exhibiting a distinctive aroma contributed by the grapes is obtained. The procedure that is described in this report has been developed and refined over many years and appears to be well suited to the production of consistently sound and representative lots of experimental wines.

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