

FDE 437

FERMENTATION TECHNOLOGY

Wine Production-Part I



Viticulture and Enology

- ▶ **Viticulture** is the science of **grape-growing**
- ▶ **Enology** is the science of **wine-making**
- ▶ **Vinification** is the conversion of fruit juices (such as grape juice) into wine by fermentation; winemaking

Grape Wines



- ▶ **Wine** is by common usage defined as a product of the “normal alcoholic fermentation of the juice of sound ripe grapes”.
- ▶ According to the shortest possible definition, **wine** is fermented grape juice.
- ▶ According to the International Organization of Vine and Wine (OIV) International Standard for the Labelling of Wines - edition 2022, «wine is exclusively the beverage resulting from the complete or partial alcoholic fermentation of fresh grapes, whether crushed or not, and from the grape must». «Its actual alcohol content shall not be less than 8.5% vol.»
- ▶ According to the Turkish Food Codex Communiqué on Wine (2009), the actual alcohol content of the wine by volume should be at least 9% and the total alcohol content should be at most 15%.
- ▶ Nevertheless any fruit with a good proportion of sugar may be used for wine production.
- ▶ Thus, citrus, bananas, apples, pineapples, strawberries etc., may all be used to produce wine. Such wines are always qualified as **fruit wines**.
- ▶ If the term is not qualified then it is regarded as being derived from grapes, *Vitis vinifera*.

- ▶ Wine is today principally produced in countries or regions with mild winters, cool summers, and an even distribution of rainfall throughout the year.
- ▶ In North America, **the United States** is the leading producer, most of the wine coming from the State of **California** and some from **New York**.
- ▶ In Europe the principal producers are **Italy, Spain and France**.
- ▶ In South America, **Argentina, Chile, and Brazil** are the major producers.
- ▶ In Africa, they are **Algeria, Morocco, and South Africa**.
- ▶ Other producers are **Turkey, Syria, Iran, and Australia**.

- ▶ Although about 99% of the wine produced throughout the world is made from **grapes**, juice from other fruits can also be made into wine.
- ▶ Berries, including **raspberries, boysenberries, and strawberries**, are common substrates.
- ▶ Many wines also are made from tree fruits, including **apples and pears**.
- ▶ The only requirement is that the fruit and the juice from that fruit must contain enough free sugars to support growth of the yeast and to yield a sufficient ethanol concentration (about 12% by volume).

Top 20 wine-producing countries in 2016 and their total consumption

Country	Production (L × 10 ⁶)	% of world total	Consumption (L × 10 ⁶)	% of world total
Italy	5090	19	2040	8
France	4350	16	2700	11
Spain	3930	15	990	4
United States	2390	9	3180	13
Australia	1300	5	540	3
China	1140	4	1730	7
South Africa	1050	4	440	2
Chile	1010	4	220	1
Argentina	940	4	940	4
Germany	900	3	1950	8
Portugal	600	2	460	2
Russia	560	2	930	4
Romania New	330	1	380	2
Zealand	310	1	92	< 1
Greece	260	1	230	1
Austria	200	1	240	1
Hungary	190	1	190	1
Brazil	160	1	290	1
Bulgaria	120	1	100	< 1
Switzerland	100	< 1	280	1
Total	26,700	100	24,514	100

Source: The International Organization of Vine and Wine (<http://www.oiv.int/en/>).

Viticulture and grape science

- ▶ The starting material for most wines is grapes.
- ▶ The main wine grape grown in temperate zones throughout the world is *Vitis vinifera*.
- ▶ Another grape, *Vitis labrusca*, grows well in northeastern regions in the United States and is frequently used for Concord varieties. This grape is also used in authentic Balsamic vinegar.
- ▶ It is important to note that, despite the existence of only a few major grape species, there are many different grape cultivars grown throughout the world.
 - For example, many of the “famous” grapes, including Cabernet Sauvignon, Chardonnay, Gamay, Gewurztraminer, Grenache, and Sangiovese all refer to different varieties or cultivars of the *V. vinifera* grape.
 - These grapes not only have different compositions, sugar contents, and pigmentation, they also grow better in different climates and soils and are used for different types of wine. This point forms the basis of **«terroir»**.
 - Thus, most Bordeaux wines (those produced in the Bordeaux region of France) are made from the grapes that grow particularly well in that region, namely Cabernet Sauvignon and Merlot. Those same grapes, however, can be grown in California or anywhere else in the world, for that matter, and used to make Bordeaux-style or other types of wine.

Terroir

- ▶ **Vineyard management** also affects grape maturation. Important factors include vine spacing and density, pruning and thinning, training and trellising, use of canopies, and application of pesticides.
- ▶ These vineyard practices, together with the combined effects of **soil, climate, moisture, terrain, sun, and season** have a profound influence on grape composition and quality. The collective contribution of all of these factors has led to the concept of “**terroir**,” a term that translates from the French as “earth” or “land”.

Grape Varieties for Wine



- ▶ Grapes can be eaten fresh as table grapes, used for making wine, jam, grape juice, jelly, grape seed extract, vinegar, and grape seed oil, or dried as raisins, currants and sultanas.
- ▶ Commercially cultivated grapes can usually be classified as either table or wine grapes, based on their intended method of consumption: eaten raw (**table grapes**) or used to make wine (**wine grapes**).
- ▶ While almost all of them belong to the same species, *Vitis vinifera*, table and wine grapes have significant differences:
 - **Table grape cultivars** tend to have large, seedless fruit with relatively thin skin.
 - **Wine grapes** are smaller, usually seeded, and have relatively thick skins (a desirable characteristic in winemaking, since much of the aroma in wine comes from the skin).
 - **Wine grapes** also tend to be very sweet: they are harvested at the time when their juice is approximately 24% sugar by weight.
 - By comparison, commercially produced "100% grape juice", made from **table grapes**, is usually around 15% sugar by weight.

Grape Varieties for Wine

- ▶ Grape varieties are classified according to their composition properties as table, dried and wine grapes.
- ▶ Wine can be made from any grape, but the prerequisite for producing quality wine is the use of wine grape varieties.
- ▶ There are many wine grape varieties used in wine production in the world.
- ▶ Of these, the four most important **red wine grape varieties** in terms of prevalence in the world and wine quality are **Cabernet Sauvignon, Pinot noir, Shiraz and Merlot**; and the four most important **white wine grape varieties** are **Chardonnay, Sauvignon Blanc, Riesling and Semillon**.

Grape Varieties for Wine

Domestic Varieties		Foreign Varieties	
White wine grape varieties	Red wine grape varieties	White wine grape varieties	Red wine grape varieties
Narince	Öküzgözü	Chardonnay	Cabernet Sauvignon
Emir	Boğazkere	Sauvignon Blanc	Merlot
Bornova Misketi	Kalecik Karası	Riesling	Cabernet Franc
Akdimrit	Çalkarası	Semillon	Syrah/Shiraz
Beylerce	Dimrit	Bourboulenc	Bastardo
Dökülgen	Horozkarası	Chasselas	Barbera
Hasandede	Karalahana	Chenin Blanc	Carignan
Kabarcık	Karacakız	Clairette	Cinsault (Cinsaut)
Sultaniye	Papazkarası	Colombard	Dolcetto
Sungurlu	Sergikarası	Dourado	Gamay
Yapıncak	Adakarası	Fetyaska	Grenache
Rumi	Kösetevек	Furmint	Malbec
Vasilaki	Patkara	Harslevelu	Meunier
Aküzüm		Mauzac	Nebbiolo
Ketengömlek		Muller-Thurgau	Pinot Gris
		Muscadelle	Pinot noir
		Palomino	Petit Verdot
		Pedro Ximenez	Ruby Cabernet
		Rkaziteli	Sangiovese
		Sylvaner	Souzao
		Gewartraminer	Tempranillo
		Trebbiano	Tinta Amarella
		Verdelho	Touriga
			Zinfandel

Domestic Wine Grape Varieties

▶ White wine grapes:

- **Altıntaş** - Marmara region and Bozcaada
- **Beylerce** - Bilecik area
- **Bornova Misketi** - İzmir area
- **Emir** - Nevşehir (Cappadocia) area
- **Hasandede** - Ankara and central Anatolia
- **Narince** - Tokat area
- **Rumi, Kabarcık, Dökülgen** - Southeastern Anatolia region
- **Sultaniye** - Aegean region
- **Yapıncak** - Thracian region

▶ Red wine grapes:

- **Adakarası** - Marmara region and Avşa Island
- **Boğazkere** - Elazığ and Diyarbakır areas
- **Çalkarası** - Çal, Denizli area
- **Dimrit** - central Anatolia and eastern Aegean region
- **Horozkarası, Sergikarası** - southeastern Anatolia region
- **Kalecik Karası** - Ankara area
- **Karalahna** - Tekirdağ region, Bozcaada
- **Karacakız, Kuntra** - Çanakkale region
- **Öküzgözü** - Elazığ area
- **Papazkarası** - Kırklareli area

Grape composition

- ▶ **Grape** is the fruit of the plant called **vine**, whose genus name is ***vit**is* in botany.
- ▶ **Grape** is the most raw material of wine.
- ▶ All well-known **wine grapes** belong to the species *Vitis vinifera* L.
- ▶ A good understanding of grape composition is essential to understanding the winemaking process and producing higher quality wine.

Grape composition

- ▶ The two major constituents of wine, water and ethanol, have no flavor, color, or aroma.
- ▶ Thus, the other grape components contribute so much to the organoleptic properties of wine.
- ▶ Some of these substances, however, can be problematic, causing a variety of defects.
- ▶ In addition, the composition of grapes changes during growth and maturation on the vine, such that the time of harvest can have a major influence on the chemical constituents of the grape as well as the wine. For example, the sugar concentration increases as grapes ripen on the vine, due to increased sugar biosynthesis, and to a lesser extent, to water evaporation and subsequent concentration of solutes. In contrast, acid concentrations decrease during maturation.
- ▶ Finally, in discussing the composition of wine, it is often more useful to consider the liquid juice just after the grapes have been crushed as the starting material, rather than the intact grape.
- ▶ As listed in the table in the next slide, the juice, or “must,” consists of several major constituents and many other minor components that are important, but which are present at relatively low concentrations.

Constituents of juice and red table wine (g/100mL)

Compound	Juice	Wine
Water	70-85	80-90
Carbohydrates	15-25	0.1-0.3
Glucose	8-12	0.05-0.1
Fructose	8-12	0.05-0.1
Other (mainly sucrose and various pentoses)	1-3	0.1-0.2
Organic acids (mainly tartaric, malic, citric, lactic and acetic)	0.5-2.0	0.3-0.6
Glycerol	0.0	0.7-1.0
Inorganic salts (mainly potassium, magnesium and calcium)	0.3-0.5	0.2-0.4
Nitrogenous	0.1-0.4	0.01-0.1
Phenolics	0.1-0.2	0.2-0.3
Ethanol	0.0	8-15
Other alcohols	0.0	0.01-0.04