

# Wine

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Wine is the result of the fermentation of the grapes of *Vitis vinifera*. When the skin of the berry is damaged, for instance by crushing, yeast feeds on the sugars in the juice, breaking them down into ethanol and carbon dioxide. Uncontrolled fermentation often starts with wild strains of yeast, but most of them die when the alcohol concentration reaches 5 percent, after which *Saccharomyces cerevisiae* dominates.

The wild wine-producing grape, *V. vinifera sylvestris*, is native to a region between the Black and Caspian seas that includes Azerbaijan, Armenia, Georgia, eastern Turkey, and northwestern Iran. When mature, the berries contain enough sugar (at least 10 percent by weight) to produce wine. *V. v. sylvestris* is dioecious (separate male and female plants) and propagates by seed. The female plant produces small clusters of grapes with loose berries, attractive to birds which eat them and propagate the seeds through their digestive system. The pips of the dioecious female are short and round. A few percent of the plants are wild hermaphrodites, the result of a single genetic mutation. They produce more clusters with larger, more tightly bound berries, and their pips are more elongated. These hermaphrodites propagate vegetatively and are not successful in the wild because the offspring grow too close to the parent.

When man began to grow food in Neolithic times, the wild grape of choice for cultivation was the better-looking and more productive hermaphrodite. Since fermentation is a natural and unavoidable process, it is likely that the first wine followed the first harvest accidentally. The cultivated wild hermaphrodite soon evolved into the domesticated *V. vinifera vinifera*. All of today's wine cultivars are its descendants. Archaeologists determine if an accumulation of grape pips at a Neolithic site comes from wild or cultivated plants by measuring the

length-to-width ratio of the pips. A large proportion of hermaphrodite pips implies cultivation.

The word for "wine" changed very little over millennia. It was *woi-no* (or *wei-no*) in Proto-Indo-European, *wijana* (or *wiyana*) in Hittite, *inu* in Akkadian, *wainu* in Proto-Semitic, *oinos* (οἶνος) in ancient Greek, *vinum* in Latin, *fin* in Old Irish – close to today's French *vin*, German *wein*, or English *wine*.

The earliest evidence of viticulture dates back to the sixth millennium BCE at the Shulaveris-Gora site (Georgia). The reddish residue in jar fragments has been shown to include tartaric acid. Stronger proof of winemaking was unearthed at the Neolithic site Hajji Firuz Tepe, dated to between 5400 and 5000 BCE, in the ZAGROS MOUNTAINS of northwestern Iran. The residue in the six jars found (capacity about 9 liters each) showed the presence of high concentrations of tartaric acid and calcium tartrate. Tartaric acid is the principal acid found in grapes, and its presence is a chemical proof that wine was stored in these jars for some length of time.

The inside of the jars was coated with resin from the terebinth tree (*Pistacia terebinthus*), common in the area, and all the ancient wine jars were partially or fully coated with it. PLINY THE ELDER called it the "best and most elegant resin." The resin from this tree has antibacterial properties. In a wine jar, it inhibits the growth of the vinegar bacteria, thus preventing the wine from quickly turning into vinegar. (Today's Greek retsina wine involves pine tree resin added for flavor.)

The earliest known winemaking set-up comes from the Neolithic cave Areni-1, dated 4100–4000 BCE, in southern Armenia. A shallow clay basin with elevated ridges was positioned such that grape must would flow into a buried clay jar for fermentation. Fresh grapes were probably crushed by foot. The shape of the grape seeds at the site indicated cultivated *V. v. vinifera*.

Evidence for the rapid spread of wine and viticulture throughout the Near East comes

from numerous resinated wine jars showing traces of tartaric acid and other wine residue – as in the large (approximately 30 liters) wine jars at Godin Tepe (3500–3100 BCE) – and additives such as dates to sweeten the wine and/or mask its odd flavors – as in the tomb of Scorpion I in Abydos (3150 BCE). The 360 resinated Abydos jars contained pips, resin, stems, and, in some cases, sliced figs and biological traces of *S. cerevisiae*. The clay stoppers were made of Egyptian clay while the jars themselves originated in southern Palestine or the Jordan Valley. This suggests that empty jars were imported, filled with local wine, and then stoppered. However, the oldest evidence of winemaking in Egypt dates to a much later date, ca. 2800 BCE.

In ancient Egypt, wine was a luxury item and most Egyptians drank beer. Numerous amphorae, with clay stoppers often marked with the quality and origin of the wine, have been found in pharaonic tombs. Thousands of wine amphorae were buried with Amenhotep III (ca. 1350 BCE) with markings such as genuine, good, very good, or very very good. Some wines were labeled northern; others came from *Abesh*, *Sunu*, *Hamm*, and *Imet*. The location of these regions or wineries is unknown.

The Egyptians perfected the design of the amphora. Ancient amphorae came in many shapes and sizes but had common features: a pointed tip allowing them to be partially buried in sand, a narrow mouth, and the characteristic two handles. *Amphora* derives from the Greek *amphoreus* – earlier *amphiphoreus* (ἀμφιφορεύς): *amphi* (both sides) and *phoreus* (carry), in reference to the two handles. As amphorae became mass produced with capacities of about 10, 20, or 30 liters, it became common for markings to be imprinted into the clay prior to firing, in order to identify the content, origin, and/or merchant (Figure 1).

The first widespread dissemination of wine and viticulture started with Phoenician traders from city-states such as TYRE on the coast of Lebanon. They established trading centers and settlements on islands, on the coast of North Africa, and in southern Spain. CARTHAGE was established around 800 BCE



**FIGURE 1** Greek amphora handles ca. 300 BCE. Top: cluster of grapes and “Themisionium” (a Phrygian city). Bottom: stamp of the Rhodian manufacturer Argotanax. Photo by the author.

and, at about the same time, the Phoenicians established Gadir (Cádiz) on a small island in southwestern Spain. While it is not known if the indigenous inhabitants of southern Spain cultivated *V. vinifera* prior to the arrival of the Phoenicians, there is no doubt that the newcomers brought vines and viticulture with them. The oldest wine press in the region, at Castillo de Doña Blanca (halfway between Cádiz and Jerez), consists of a shallow basin of hardened clay in which fresh grapes would be crushed (presumably by foot), and a hole through which the juice would flow into an amphora for fermentation (Figure 2).

Around 800 BCE, the Phoenicians brought wine and viticulture to southern Italy, Sicily, Sardinia, as well as to regions controlled by the Etruscans (Tuscany, Latium, Umbria). The design of the Etruscan amphora was inspired by the Phoenician one.

Since its earliest days, wine was very important for religious, sanitary, medical, and trade reasons. It is likely that mature (sugar-rich) grapes were harvested and that the ancients did not know how to stop an ongoing fermentation. Thus, it would stop when no more sugar was available or when the alcohol level became high enough to kill the yeast. This depends on the strain of yeast, but a plausible figure is in the range 14–15 percent alcohol by volume. This is



**FIGURE 2** Phoenician wine press ca. 600–500 BCE at Castillo de Doña Blanca. The hole at the far end allows the juice to flow into an amphora. Photo by the author.

at least three times as much as in beer, the other most widespread alcoholic beverage at the time. (It should be noted that fruits other than grapes, as well as rice, can also ferment, and evidence for ancient mead exists.) Wine was the strongest alcoholic beverage until the distillation of wine produced nearly pure alcohol (first in Persia, late ninth–early tenth century CE).

Since the earliest times, man has invented gods to explain natural phenomena. Almost all ancient civilizations associated gods with wine, grapes, vineyards, winemaking, wine presses, and even drunkenness. The best known is DIONYSOS (Greece) or Bacchus (Rome), who originates from an ancient god of vegetation and

reproduction. He played important roles in many civilizations well into Roman times.

Wine contains a sufficiently high concentration of alcohol to kill many harmful bacteria in water. Water is easily contaminated, but the addition of wine makes it safer to drink. Until the first century CE, wine was drunk mixed with water (with the exception of Jerusalem and Judah: Isa 1:22, “your silver has become impure; your wine is diluted with water”). In the oldest codification of ancient Greek law by ZALEUKOS OF LOKROI (ca. 650 BCE), the punishment for drinking “unmixed wine without a physician’s prescription” was death. This indicates how much people were concerned about

running out of wine (a safe drink) before the annual grape harvest in the fall.

The ancient Greeks and Romans used a special container, the krater, into which water was poured and then wine added. Everybody dipped their cup into the common mixture. The water-to-wine ratios (4:1 up to 2:3) varied with the type of wine and the wealth of the host. The Romans scorned the Celts, who exchanged Roman wine for slaves but drank the wine unmixed. Today, Catholic priests still mix wine with water during mass, a symbolic gesture that originated in Neolithic times.

Wine was also abundantly used in medicine. The writings attributed to HIPPOCRATES OF KOS (ca. 460–370 BCE), the father of medicine, contain many wine-based prescriptions, even for infants. But it was known long before his times that wine should be used to clean wounds.

Finally, wine was important for trade. Three of the 282 articles of Hammurabi's Code (ca. 1750 BCE) regulate wine shops (or taverns) or the wine trade. Wine, wine jars, vine cuttings, and terebinth tree resin were undoubtedly already traded throughout the Near East in Neolithic times. Amphorae filled with nodules of terebinth tree resin have been found in ancient shipwrecks. HERODOTUS (ca. 484–425 BCE) documents wine being shipped up the NILE and down the EUPHRATES and TIGRIS rivers. The containers for the latter shipments, *bikos phoinikeios*, are often mistranslated as “barrels of date-palm wood” instead of “Phoenician amphorae.” The first wooden barrels date back to the Celts, and the use of barrels became widespread only in the first century CE.

The earliest civilization in Greece is Minoan (ca. 3600–1370 BCE). It flourished on CRETE (centered in Knossos) and the CYCLADES ISLANDS, with an important center on THERA (today Santorini). The earliest wine jars from Greece, ca. 2200 BCE, are from the Minoan palace at Myrtos Fournou Korifi. The Minoans produced a blend of wine strengthened during fermentation with barley (for starch), honey (for sweetness), and minor flavoring elements such as saffron. The same chemical signature was found in containers in the tomb of King MIDAS (ca. 700 BCE).

The Mycenaeans (ca. 1600–1100 BCE) became the dominant power starting around 1350. In the *Iliad*, Homer reports that they always drank wine mixed with water and never drank water unless it was mixed with wine. The exception was water from the Nile, which had the reputation of being very clean (it is no longer the case). During the Greek Dark Ages, writing was forgotten but not winemaking.

In the age of city-states and classical Greece (fifth–fourth centuries BCE), viticulture was abundant in all regions and islands of Greece. Wine was consumed at all levels of society. Ancient Greece, more than any other civilization, made wine a very democratic drink. Many sweet and flavored wines were produced, sometimes even flavored with sea water. The reputation of the wines from Samos, Lesbos, Chios, or Santorini survives to this day.

The preferred wines were strong (high alcohol content) and sweet, a combination that allows them to age for a long time. In order to concentrate the juice, the Greeks twisted the stems on the vine to cut the flow of sap, left the harvested grapes in the sun, or even cooked the wine or must to generate a sweet syrup that could strengthen other wines. The Romans followed similar recipes, and sometimes smoked the wine, hoping to give it the color or feel of an older wine. The smoke itself did not do much, but the fire that created the smoke increased the ambient temperature and the oxidation rate.

The ancient Greeks traded wines and established settlements in southern Italy, Sicily, and southern France. The city of MASSILIA (MARSEILLE) was founded by Greeks from PHOKAIA in 600 BCE. The so-called Massiliote amphora was developed shortly thereafter and was most likely used for local wine.

A huge Spartan bronze krater, the krater of Vix, was unearthed in a Celtic tomb (ca. 490 BCE) in the winter of 1952–3. It is the largest one ever found. It was manufactured in Taranto (a Spartan colony in southern Italy), cut, transported to northern France, and then reassembled. Vix (Châtillon-sur-Seine) was a major trading center, including trade in tin



**FIGURE 3** Left: DOLIUM from a shipwreck. Right: buried dolia for fermentation and storage, Ostia Antica, near Rome. Photo by the author.

from Cornwall. The Spartans desperately needed tin to make bronze for weapons and shields, and to reinforce their ships for the expected Persian invasion. One can speculate that they traded the krater for tin. There is no evidence of wine production in northern France until the first century CE.

At the time, Rome was emerging as a local power. Several of its kings were Etruscan. It is now established that the Etruscans brought wine ca. 500 BCE to Lattara (Lattes), not far from Massilia, and then viniculture ca. 425 BCE. The earliest wine press in France (425–400 BCE) was found in Lattara together with Massiliote amphorae, some of which were stoppered with corks. The earliest known use of cork stoppers came from an Etruscan shipwreck (515–475 BCE) off the coast of southern France. There is no proof of wine production in Massilia predating Lattara.

By the turn of the first century CE, wine consumption in the Roman Empire was substantial. Rome was at or near its peak population until modern times and the annual consumption of the city was over 85 million liters. This estimate comes from amphorae remains at MONTE TESTACCIO in Rome. The needs of the Roman army in the provinces have been estimated at close to

2 million liters a year. Wine imports came from Spain, then North Africa, and a smaller volume from Greece. Winemaking moved far beyond the small-scale production typical of earlier times. The Romans vastly improved wine-pressing technology, introducing lever- and screw-presses. They manufactured huge clay jars, dolia (Figure 3), in which wine could be fermented, left to age, or transported.

Various qualities of wines were consumed by the Romans. Wines from Setinum, Caecubum, Surrentium, or Falernum were famous and sometimes aged for decades. The reputation of Falernum was such that GREGORY OF TOURS, in his *History of the Franks* (591 CE), long after the fall of Rome, writes that the wines produced on the hills near Dijon “yield so noble a Falernum-type wine.” The production of the best Roman wines from the first-run juice of unpressed grapes was very small. Other expensive winemaking techniques involved soaking almost dry raisins in wine to add sugar and induce a second fermentation (*passum*). The Romans also commonly added resin from exotic trees to good wine, especially myrrh and frankincense.

Second-quality wines were obtained from grapes pressed by foot. The third quality

involved a mechanical press. Some of these wines were manipulated to mimic the color or flavor of the great aged wines. The Romans would also fumigate amphorae with rosemary or sweet bay. Many other additives were used. Cheap wines from a second pressing of the grapes were for common people and soldiers. These wines had a much lower alcohol content, and there is little doubt that this wine turned to vinegar quite rapidly. Wine or must was sometimes boiled in lead pots to concentrate the sugars, and the concentrate was used to sweeten and strengthen other wines. The wines for slaves were obtained by adding water to whatever solid material was left in the wine press. The mixture was left to ferment as much as it could, and the result would be pressed one last time.

The Romans planted vineyards along the banks of the RHÔNE and RHINE – from where they spread to the rest of western Europe – after Julius Caesar’s invasion of Gaul. This is also the period when amphorae (well suited to transport by ship) were replaced by wooden barrels (better suited to overland transport), a Celtic invention.

The eruption of Mount Vesuvius in 79 CE resulted in the destruction of POMPEII and HERCULANEUM, and of substantial wine stocks as well as many vineyards in the region. New vineyards were planted, often at the expense of food crops, and Rome began to import large volumes of wines from its northern provinces. This wine was lighter, more acidic, and drunk unmixed with water. This led to wine surpluses and food shortages. Emperor DOMITIAN (81–96 CE) ordered half the vineyards in the provinces to be uprooted. His edict was only occasionally enforced but remained on the books until rescinded by emperor PROBUS (r. 276–82 CE).

When the Western Roman Empire collapsed (mid fifth century CE), the climate was colder

(until the medieval warm epoch, ca. 800–1300 CE), the population had dropped, and few large cities remained. The technology associated with the mass production of wine was no longer needed and promptly forgotten. Quality wines were still produced in southern Spain or Greece, but the production of quality wines in most of western Europe would only resume in the eleventh century with the Cistercian monks.

SEE ALSO: Abydos, Egypt; Agriculture, ancient Near East; Agriculture, Byzantine; Agriculture, Greek; Agriculture, Pharaonic Egypt; Agriculture, Roman Empire; Agriculture, Roman Republic; Anthesteria; Bacchanal(ia); Dionysia; Symposium.

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