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Fermentation as Humankind's First Biotechnology. How the "Wine Culture" Reached Sicily and Beyond

Patrick E. McGovern

To place the topic of ancient fermented beverages in a universal context, astrophysicists using microwave and far infrared frequency telescopes have recently detected massive clouds of vinyl, methyl, and ethyl alcohol at the center of the Milky Way. They are generally observed in warmer star-forming regions. One cloud in particular, denoted Sagittarius B2N, which is some 26,000 light years or 100,000 million million miles away from the earth, has literally billions upon billions of liters of these alcohols, along with ethyl formate, which gives raspberries their flavor and smells of rum. The distant location assures that humans will not be mining extraterrestrial ethanol any time soon. But we might ask why is there an alcoholic "haze" at the center of our galaxy, and what role did alcohol play in jump-starting and sustaining life on our planet, especially the highly reactive vinyl compounds?

Coming down to earth, anaerobic fermentation or glycolysis is probably the earliest energy system on earth, going back some 4 billion years. Primitive single-celled microbes are hypothesized to have dined on simple sugars in the primordial soup, and excreted ethanol and carbon dioxide in the process. A kind of carbonated, alcoholic "beverage" would thus have been available right from the beginning.

Today, two species of single-celled yeast (*Saccharomyces cerevisiae* and *S. bayanus*), encompassing a large group of wild and domesticated strains, carry on in this grand tradition and serve as the worldwide work-horse fungi in making the alcohol in all fermented beverages. Although hardly primitive now—having most of the same specialized organelles that we do, including a central nucleus which contains the chromosomal DNA, similar to those of multi-cellular plants and animals—these yeasts thrive in low oxygen environments but, of course, not the oxygen-free atmosphere such as we imagine existed on earth when life began.

Saccharomyces cerevisiae in particular is superbly adapted to killing off competition and producing energy when needed. Because of the doubling of its genome, the yeast cell has two versions of its alcohol dehydrogenase (Adh) gene, which produces the enzyme that converts acetaldehyde, the end-product of glycolysis, into alcohol. The yeast literally swamps its enemy in alcohol; since most microorganisms cannot tolerate alcohol levels above 5%, they die. *S. cerevisiae* accomplishes this by turning on one version of the enzyme (ADH1) that reliably converts sugar into alcohol in a low oxygen environment. The trade-off is producing less ATP (adenosine triphosphate), the energy engine of the cell. The yeast cell can tolerate concentrations of 12-15%, sometimes more than 20%. Once the competition has been eliminated and oxygen levels start to rise again, the other form of *S. cerevisiae*'s enzyme (ADH2) goes into action. It converts alcohol back into acetaldehyde and ultimately generates much more ATP through the citric acid (Krebs) cycle that requires oxygen. The delayed gratification has been worth the wait, now that the competing microbes, often harmful, have been destroyed.

The stage was thus set for more advanced organisms to emerge, who depended partly on alcohol for sustenance, especially during the Cretaceous period of 145-66 million years ago (mya) or the dinosaur era (125-65 mya). A symbiosis or mutualism of sorts probably first developed then between the first fruiting trees and animals who were able to feed on and fertilize them, including birds (which are descended from dinosaurs) and insects, such as bees and fruit flies (whose young are nourished by alcohol).

In fact, nearly all animals are enticed by sugar and alcohol—from the lowly fruit fly, who nourishes its young with the compound, to the elephant. Birds are no exception. A brown owl was picked up in 2011 by German police in the vicinity of two schnapps bottles. It was said to sitting on the side of the road, completely oblivious to everything, and probably drunk. The police didn't breathalyze it, but it was taken to a local bird rehabilitation center, given lots of water, finally sobered up it was released. Elephants are not nearly so subdued—too much alcohol and they can go on a rampage: raiding beer factory in India.

Alcohol as a source of sustenance has long precedent among primates. The Malaysian tree shrews, which are classified as among the earliest primates on the planet going back 55 million years, have been documented binging all night long on fermented palm nectar—drinking the equivalent of 9 glasses of wine for an average human.

Moving up the primate ladder in our direction, it has been shown that modern primates generally have diets comprised of 75% fruit, and they are known to eat as much fermented fruit or drink as possible when given the chance, including chimpanzees which are closest to us genetically.

It doesn't take a great leap of imagination to posit that early hominids, our ancestors, some 100,000 years ago in Africa, were probably already making wines, beers, and extreme fermented beverages from wild fruits (maybe, a fig, kumquat, or marula fruit), honey, chewed grains and roots, and all manner of herbs and spices culled from their environments. After all, our ancestors probably had much the same sensory organs and brains as we do, and they would have known what they liked. Their teeth were adapted to eating fruit and other soft foods. Their digestive system would have handled predigested fermented foods and beverages well. At an even more basic level, we can metabolize alcohol into energy, since about 10% of the enzymes in our livers, including alcohol dehydrogenase, carry out this function.

Alcohol was the universal drug, produced by the microorganisms from sugar-rich natural products, before synthetic medicines. Its health benefits were obvious—alcohol relieved pain, stopped infection and seemingly cured disease. It can be readily administered by drinking or applying to the skin. Those who drank fermented beverages, rather than water which could be tainted with harmful microorganisms and other parasites, lived longer and consequently reproduced more. Herbal or tree resin compounds with medicinal properties could also be more easily dissolved in the alcoholic medium, and readily applied to the skin or by drinking.

Yet, the communities of “good” microorganisms provided much more than alcohol, including a range of flavors and aromas, colors, nutrients and energy, and pre-digestion of more complex compounds which continued in the human gut. Foods and beverages in general could be preserved by fermentation. Recent scientific research has been shown that alcohol lowers cholesterol and prevents some cancers.

Based on the available physical anthropological evidence of early hominids and humans and a host of physiological, dietary, medical, even culinary considerations, a case can then be made that “drinking is in our genes”, and this theory has been summed up in the “Drunken Monkey Hypothesis”, which is especially applied to explaining alcoholism.

Under such circumstances, we might imagine that our human ancestors co-opted the natural process of fermentation to make alcoholic beverages at a very early date—ushering in what was probably the first biotechnology on the planet.

For early humans, extending from the Palaeolithic period, which constitutes some 99% of our time on Earth and is as yet poorly represented in the archaeological, through historical times, fermented beverages eased the difficulties of everyday life (such as bringing down that woolly mammoth); induced sleep; lubricated the social fabric (*esprit de corps*) by bringing people and couples together; and contributed to a joyful exhilaration in being alive (*joie de vivre*).

But beyond these advantages of fermentation, the real trump card of a fermented beverage is its mind-altering or psychotropic effects in which a “pleasure cascade” of neurotransmitters -including dopamine, serotonin, and opioids- are unleashed in the human brain.

Both the mind-altering effects of a fermented beverage, as well as the mysterious process of fermentation, probably account for why fermented beverages came to dominate entire economies, religions (note the importance of wine in our two principal Western religions, Judaism and Christianity), and societies over time. The yeast cell was microscopic and too small for ancient humans to see (that had to await the discoveries of Van Leeuwenhoek and Pasteur), but it is responsible for converting the sugar in a fruit and honey, or that derived from a grain or root, into alcohol in a seemingly miraculous process. The carbon dioxide, evolved during fermentation and roiling the surface of the fermenting wort or fruit juice, must have amazed the earliest beverage-makers.

Wherever we look in the ancient or modern world, humans have shown remarkable ingenuity in discovering how to make fermented beverages and incorporating them into their cultures. For example, African cultures where our species began are awash in sorghum and millet beers, honey mead, and banana and palm wines. In these fermented-beverage cultures, everyday meals, social events and special celebrations, including rites of passage and major festivals, all revolved around an alcoholic beverage from birth to death. Ancestor worship entailed ceremonies at graveside in which a fermented beverage was poured out for the benefit of the deceased and large containers of the beverage were embedded in the ground above the dead, as illustrated by the custom of the Tiriki in western Kenya.

The living imbibed the beverage through long drinking-tubes, and suitable poems are recited for the occasion: "Our forefathers, Drink up the beer! May we dwell in peace". Often, breweries are sited at the center of the village.

After our ancestors came "out of Africa", they were confronted with a host of new plants, which they explored for their medicinal properties, learned how to ferment them, and eventually domesticated some of them. They would have traveled north via the Great Rift Valley, and then could have crossed the narrow strait of the Bab el-Mandeb at the southern end of the Red Sea to the Arabian Peninsula, or they could have continued north down the Nile River through the Sudan and Egypt to the Sinai. One route might have taken them to India, east Asia, and the Australia. The other took a direct bee-line to the Mediterranean coast, the Jordan Valley, and Lebanon.

Once over the Sinai desert hurdle, the travelers were greeted with a verdant land along the coast and in the inland Jordan Valley. Archaeological sites along the length of the valley show that humans were exploiting figs and dates, cereals and honey, likely for fermented beverages, as early as 9500 B.C. and possibly grape even earlier at the spectacular site of Ohalo II, dating as far back as ca. 18,000 B.C. The climate had begun ameliorating after the last Ice Age around 10,000 years ago, rainfall had increased, and pockets of subtropical vegetation had taken hold around oases, such as the one at Jericho.

Traveling farther north from the Jordan Valley, our ancestors entered the Beqaa Valley, bordered on the west and east by the Lebanon and Anti-Lebanon Mountains, which run parallel to the coast and extend north from Mount Carmel and the nearly 3000 meter high Mount Hermon. They would have looked out onto a broad, well-watered expanse of fields and forests, some 120 kilometers long and 16 kilometers wide. They would have seen trees, perhaps even the Lebanon (*Cedrus libani*) standing 45 meters tall, carpeted with the wild Eurasian grape (*Vitis vinifera* ssp. *sylvestris*), much like the early European explorers of North America were struck by the profusion of vines there and called the new-found land Vinland. The Beqaa Valley was later to become the center of one of the most successful winemaking industries in the Middle East).

On the assumption that the climate and range of plants that we see growing there today were in place in the immediate aftermath of the last

Ice Age, the Lebanese coast, mountains and inland Beqaa Valley are the first places that our ancestors came in contact with the wild Eurasian grape, which festooned its dense forests. They probably would have been amazed at its natural habit to grow high up in trees. Following their traditions of fermented beverage-making brought with them from Africa, the temptation must have been great to make some wine from the fruit. Once the juice of the grape was exuded or pressed from the grapes, it provides the perfect nutrient mix for yeasts, already present on some grape skins, to begin fermenting it to wine, especially in the hot climate of the Middle East.

It is also not beyond the realm of possibility that in the process they learned how to “tame” the plant by the layering (Fr., *provenage*) method in which a vine is diverted from the tree and buried so as to re-root it. Once the new, cloned vine had sprung up, it could be “trained” to grow up a nearby tree or even an artificial support. This innovation would have enabled an early viticulturalist to control the vine’s height and shape for easier harvesting. Thus would have been ushered in the first grape wine-making in the world!

The consequences of this new-found beverage were profound. The history of civilization is, in many ways, the history of wine. Each culture (whether Egyptian, Canaanite and Phoenician, Greek and Italian, even California and Australia) has its own story to tell about its relationship with wine and the vine. Together, they form a truly remarkable history of a truly remarkable plant and its product intertwining itself with human culture throughout the world.

DNA analysis is narrowing in on when and where the Eurasian grapevine was first domesticated, most likely in the mountainous region of the Near East (encompassing the mountains of Lebanon, the eastern Taurus Mountains, Transcaucasia, and the northwestern Zagros Mountains).

More exacting chemical analyses recently showed that the French, whose influence on the spread of grape cultivars and the “wine culture” has been most profound, received this bounty from the Italians, no doubt via Sicily (detailed below) and other Mediterranean and Near Eastern peoples, extending back to its beginnings in the Near East.

The available archaeological, biomolecular, archaeobotanical, and grape DNA evidence speak with one voice: by at least ca. 6000 B.C., the world’s

first grape “wine culture” was consolidated in the mountainous regions of the Near East—extending from the eastern Taurus Mountains of eastern Anatolia across Transcaucasia to the northwestern Zagros Mountains. In the millennia to follow, this wine culture, together with the domesticated Eurasian grape (*Vitis vinifera* ssp. *vinifera*) and horticultural techniques, radiated out to other areas on the western and eastern arms of the Fertile Crescent. Thus, it had reached Canaan by at least ca. 3500 B.C., to judge from grape seeds, wood, and even whole dried grapes (raisins) recovered from sites in the Jordan Valley. In Mesopotamia, transplantation of the vine and winemaking followed the spine of the Zagros Mountains and had arrived in Shiraz in southwestern Iran by at least 2500 B.C. Perhaps the most dramatic example of how the northern Levantine wine culture could “captivate” another people occurred in pharaonic Egypt around 3000 B.C. Once the Egyptian dynasts had developed a taste for Canaanite wine, they commissioned Canaanite viniculturalists to plant the Nile Delta with vineyards and began producing their own wine.

The Phoenician seafarers of the Iron Age, sailing in their “Byblos Ships” made of Cedar of Lebanon, carried on in the grand tradition of their ancestors, the Bronze Age Canaanites. Their huge shipments of wine, Purple textiles, and other exotic goods across the Mediterranean were much more than material goods. They also conveyed a new way of life, based on wine, which gradually permeated the societies, religions, and the economies of those they came in contact with. In the wake of Phoenician trade and colonization, native fermented beverages, including beers, meads and mixed fermented beverages of all kinds (“grogs”), were marginalized, modified, and displaced.

What was the ultimate destination of these Byblos Ships, such as the recently discovered late 8th c. B.C. *Tanit* and the *Elissa* which went down 61 kilometers offshore from Gaza with their large consignments of wine and other goods. These ships were about 14 meters in length and 5-6 meters wide, which compares closely to later shipwrecks of the classical period, such as that of the *Kyrenia* which went aground off the northern coast of Cyprus during the 4th c. B.C. When fully loaded, a boat of this size weighed about 25 tons (22,680 kilograms). If a full wine amphora averages 25 kilograms, then just the visible amphoras of the *Tanit* and *Elissa* amount to nearly 9 tons (8165 kilograms) each or roughly 15,000 liters of wine each. In fact, such shipments are relatively modest. An Egyptian customs docket of 475 B.C. records that a large Phoenician ship carried 1460 amphoras (40 tons or 36,290 kilograms) full of wine, in addition to four tons

(3630 kilograms) of cedar wood, copper, and empty amphoras.

Carthage, the largest Phoenician colony in the western Mediterranean, might well have been where many of the ships were headed. Classical sources trace the founding of this city to the late 9th century B.C. when the Assyrians threatened the Phoenician homeland city of Tyre, and Elissa (Dido), a Tyrian princess, fled by ship and founded the new colony. Ever-accumulating archaeological evidence approximately agrees with this dating. Dido and her band of compatriots from Tyre chose an ideal, strategic spot for their settlement on the tip of a peninsula into the Mediterranean, opposite the island of Motya where another Phoenician colony was established. The main occupation at Carthage was established on a high promontory with a port at its base and large lagoons to the north and south—a geographic setting to which they had long been accustomed in Lebanon. A vast hinterland of rich, fertile soils, very similar to the Beqaa Valley of their homeland, invited the Phoenicians to plant cereals and, above all, the domesticated grapevine.

The founders of Carthage entered a territory only sparsely occupied by Berber pastoral nomads, who offered little resistance. Unlike more populous regions of the Mediterranean, the Phoenicians could play the role of true colonialists by foregoing trade agreements and building a settlement totally to their specifications. As Carthage grew in the following centuries, it became the capital of the Punic empire and the breadbasket of the Roman empire. Its ships plied the waters from Carthage through the Tyrrhenian Sea, past Motya (an island off the western tip of Sicily occupied by the Phoenicians) and later known for its exquisite Marsala wine) and the Lipari islands, to the port of Rome at Ostia. Long lines of amphoras spread out on the sea floor at a depth of as much as 1000 meters, representing the cargo lost by foundering ships, mark the approximately 600 kilometer route, especially at Skerki Bank about 80 kilometers northwest of Sicily.

Wine was naturally the beverage of choice in ancient Carthage. One of the first treatises on viniculture and other forms of agriculture was composed by a 3rd-2nd century B.C. Carthaginian named Mago, who is quoted extensively in later Roman writings (Varro, Columella, and Pliny the Elder). Presumably, he drew upon Phoenician traditions extending back to the founding of the colony. To date, however, the earliest excavated evidence for the domesticated grape at Carthage is pips of the 4th century B.C.

Although the wild grape grows in Tunisia, special precautions had to be taken to assure that the domesticated vine survived in the hot climate. Mago advised on how to aerate the soil and plant vineyards (e.g. on north slopes to take advantage of rainfall coming from the Mediterranean) to compensate for the low rainfall. His recipe for raisin-wine involved picking the grapes at peak ripeness, rejecting damaged berries, drying out the grapes in the sun for several days under a reed-covering (taking care to cover them at night, so that they were not dampened by the dew), re-saturating the raisins with fresh juice, and then treading out the grapes. A second batch was prepared in the same way, and then the two lots were combined and fermented for about a month, finally being strained into vessels with leather covers. The end-result must have been a delicious, luscious elixir, much like a Tuscan or Santorini Vin Santo. The delicious Muscat wines of the island of Pantelleria, less than 100 kilometers from Carthage, likely carry on the ancient tradition, which is referred to in ancient Anatolian texts and later mentioned in Homer and Hesiod.

Carthage's influence eventually extended across the Mediterranean to Spain's Costa del Sol and as far west as the "Pillars of Hercules" (Gibraltar). Carthage aimed to exploit the rich tin, lead and silver ores of the Iberian Peninsula's inland Guadalquivir River. But once again, they discovered that the rich maritime plains were ideal locales for colonizing and transplanting their wine culture.

Greece itself, which was also to become a preeminent wine culture, had to be won over from its native "Greek grog," made from Pramnian wine, honey and barley, topped with cheese—the so-called *kykeon* of the Homeric epics, to focus primarily on grape wine. brought into the wine fold. This mixed beverage was prepared in large cauldrons and sometimes drunk from cups with handles surmounted by miniature doves, like the marvelous golden cup of Nestor found at Mycenae and described in Homer's *Iliad* (11.628-43), which was probably written down around 700 B.C.

Even after the Greeks had become seafaring merchants in their own right and had begun vying with Phoenicia for control of the Mediterranean, they expressed their lasting debt to the eastern Mediterranean wine culture in a profound way. They adopted the Phoenician alphabet, which is the ancestor of both the modern Western and Arabic scripts. They did not use this revolutionary writing system merely to inventory goods or log their sea journeys, but rather to express more profound sentiments about

wine. The earliest archaic Greek inscription, incised on a wine jug (*oinochoe*) in the 8th century B.C., reads: "Whoever of all dancers performs most nimbly will win this *oinochoe* as prize". Later in the same century, an even more amazing inscription is recorded on a Rhodian wine cup (*kotyle*) from the tomb of a young boy at Pithekoussai, an early Greek colony established on the island of Ischia in the Bay of Naples. It states in elegant dactylic hexameter poetry, the language of the Homeric epics, that "Nestor's cup was good to drink from, but anyone who drinks from this cup will soon be struck with desire for fair-crowned Aphrodite". The Dionysiac interweaving of wine, women, and dance, inspired by the Canaanite and Phoenician wine culture, jumps out at us from across the centuries.

During the early first millennium B.C., the Phoenicians ventured ever farther into the western Mediterranean where they founded more bases and colonies along the northern coast of Africa, on strategic islands (Malta, Corsica, Motya in western Sicily, Lipari in the Aeolian islands group, and Ibiza in the Balearics off the coast of Spain, etc.), and along the Spanish coast, even out into the Atlantic at Huelva, near Cádiz. A recent discovery of two 7th century B.C. shipwrecks in the Bay of Mazarron, near Cartagena, shows how crucial ship transport was in expanding Phoenician interest and eventually establishing the Punic Empire. These two ships are a third the length of a standard Byblos Ship, but would have served admirably for short hauls along the coast.

Greek traders entered the picture later, but operated similarly to the Phoenicians by parceling up many of the same islands (e.g. eastern Sicily and Corsica) and establishing colonies in southern Italy (Oenotria), northern Africa (e.g. Cyrene), and at Massalia (modern Marseille) in southern Mediterranean France.

A profusion of Iron Age shipwrecks, loaded with amphoras and wine-related cauldrons and other drinking paraphernalia have been located and excavated all along the Italian and French coasts. The Phoenician and Greek impact throughout the western Mediterranean was so pronounced that one can say that it was mediated by the wine culture itself.

The 8th century B.C. saw the climax of Phoenician influence on the hearts, minds, and palates of native people throughout the Mediterranean. The Etruscans of central Italy along the Tyrrhenian Sea illustrates the phenomenon and how it spread. This people likely first came in contact with the Phoenicians before the Greeks arrived on their shores, as shown by their "Orientalizing" industries, which closely reflect Phoenician style,

technology and iconography in metals, pottery, ivory, and glass. Their amphora was modeled after the Phoenician amphora, and where a similarity of form exists, it was likely because it served a similar function: primarily to hold grape wine, which was supplied by a nascent local industry.

The Etruscans already had a tradition of making a mixed fermented beverage, like other parts of Europe, before their culture was impacted by the Phoenicians. According to the available evidence, this “grog” might well have combined honey, barley and wheat, even pomegranates, hazelnuts, herbs such as rosemary and thyme, tree resins, wild grapes, and other ingredients. The traders lured them into the eastern Mediterranean wine culture by presenting them with cauldrons, kraters, and other drinking vessels. At first, the Etruscans probably adapted the vessels to their existing customs, using them for their native mixed beverage, like the Celtic princes and their coteries did farther to the north. They went on to make their own versions of the vessels—high pedestal-based “mixing bowls” in pottery and silver and gilded drinking-bowls of Phoenician-type—and with time were won over to the eastern Mediterranean wine culture. Again, the earliest inscription in Etruscan script mentions wine.

Once the Etruscans had taken up the banner of the wine culture, probably mainly from the Phoenicians at first and then increasingly from the Greeks, they became the principal conveyors of it by *ca.* 625-600 B.C. to coastal Mediterranean France. It is not surprising that the Celts there should have become equally entranced by the cultural and economic possibilities for wine and begun to substitute it for their native beverages, likely variously concocted beers, meads, and mixed fermented beverages.

The transfer of the wine culture followed a familiar pattern: first import Etruscan wine in amphoras, along with its other accoutrements, and then eventually begin making their own wine under Etruscan tutelage. The Celts might have had a general knowledge of the Eurasian grape, which grew wild along the northern Mediterranean shore and which they might have used to make a native fermented beverage, but any successful exploitation of the domesticated vine to make wine would have required much more horticultural knowledge and technological proficiency. The domesticated grapevine needed to be transplanted and successfully tended, and its grapes then vinified into wine using specialized equipment, which was preserved in sealed vessels with tree resins.

Plantings of the domesticated Eurasian grapevine in Mediterranean France were probably transported on Etruscan ships. A fourth century B.C. Punic shipwreck off the coast of Mallorca at El Sec illustrates how it might have been accomplished: grapevines on this ship were embedded in soil in the cool hull of the ship, which would have enabled them to travel well and be replanted.

This scenario has now been borne out by archaeological, chemical and botanical findings at the heavily Etruscan-influenced site of Lattes (ancient Lattara), near Montpellier, where numerous Etruscan wine amphorae were imported in the 6th c. B.C. and stored in harbor storehouses. As analyses by my laboratory and colleagues show, the wine was resinated with pine and laced with botanicals (probably rosemary and/or thyme). A century later, local winemaking had begun at the site, as shown by the finding of masses of grape seeds, commonly associated with treading activity, and what is so far the earliest winepress yet discovered in Mediterranean France.

The Etruscan role in the process was further revealed by a shipwreck (Grand Ribaud F), found off the coast of the Hyères Islands, east of Marseille, and dated to ca. 515-475 B.C. Its hold was filled with grapevines and some 700-800 amphorae. Significantly, all the Etruscan amphorae on-board this ship, which had been carefully stoppered with cork (among the earliest evidence for this technology, and also attested at Lattara) and stacked at least five layers deep in the hull, are of the same pottery type and contemporaneous with the Etruscan amphorae at Lattara. Possibly, the ship's final destination was Lattara.

Once in place, the wine culture of Mediterranean France spread inland after the Roman conquest up the Rhone and Rhine rivers to the rest of Europe, where centuries later, primarily monasteries, such as the Cistercian abbey of Vougeot in Burgundy, refined viticulture to such a degree that it became a model for the rest of the world. In the final analysis, however, it needs to be remembered that France has Levantine viticulture, as well as the intervening stages of the spread of the wine culture in its east to west migration across the Mediterranean, largely to thank for its bounty and influence.

Key Phoenician colonies in western Sicily and the Aeolian Islands, as well as native peoples who were drawn into the wine culture, likely played important roles in its transfer to the Italian mainland from whence it

spread to France and at a much later date to the New World. More archaeological and scientific research in Sicily and the Aeolians is clearly needed to elucidate these important developments.

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ABSTRACT

The purpose of this research is to explain how fermented beverages, especially wine, have long played a crucial role in the transfer of culture from one population to another around the world. The aspects that are explored address and portray the history of wine culture. They involve the most innovative biomolecular analysis and archaeo-botanical methodologies, in order to trace the DNA of first wines as well as evidence of its cultivation and distribution in the Mediterranean basin from East to West. This focus undermines the role of wine as the dominant creative force in humankind's first biotechnology, and it explains how "Wine Culture" reached and went beyond the region of Sicily.



Bacco e Arianna, gruppo fittile con tracce di sovradipintura, 50 a.C-50 d.C. (Sicilia), Oxford, Ashmolean Museum of Art and Archaeology.



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