Italy started early

S ANANTHANARAYANAN

The Italians had a wine making industry as far back as 3,000 years ago

There are suggestions that wine making may predate organised agriculture. This may well be true as many kinds of fruit, if bruised in storage, would ferment and result in wine. It is not the same with beer, or wine from grain, as this needs grain in quantity and a process. Even in the case of wine, however, accidental production would not amount to an industry. It would be so only if production is in quantity and the produce stored for later use.

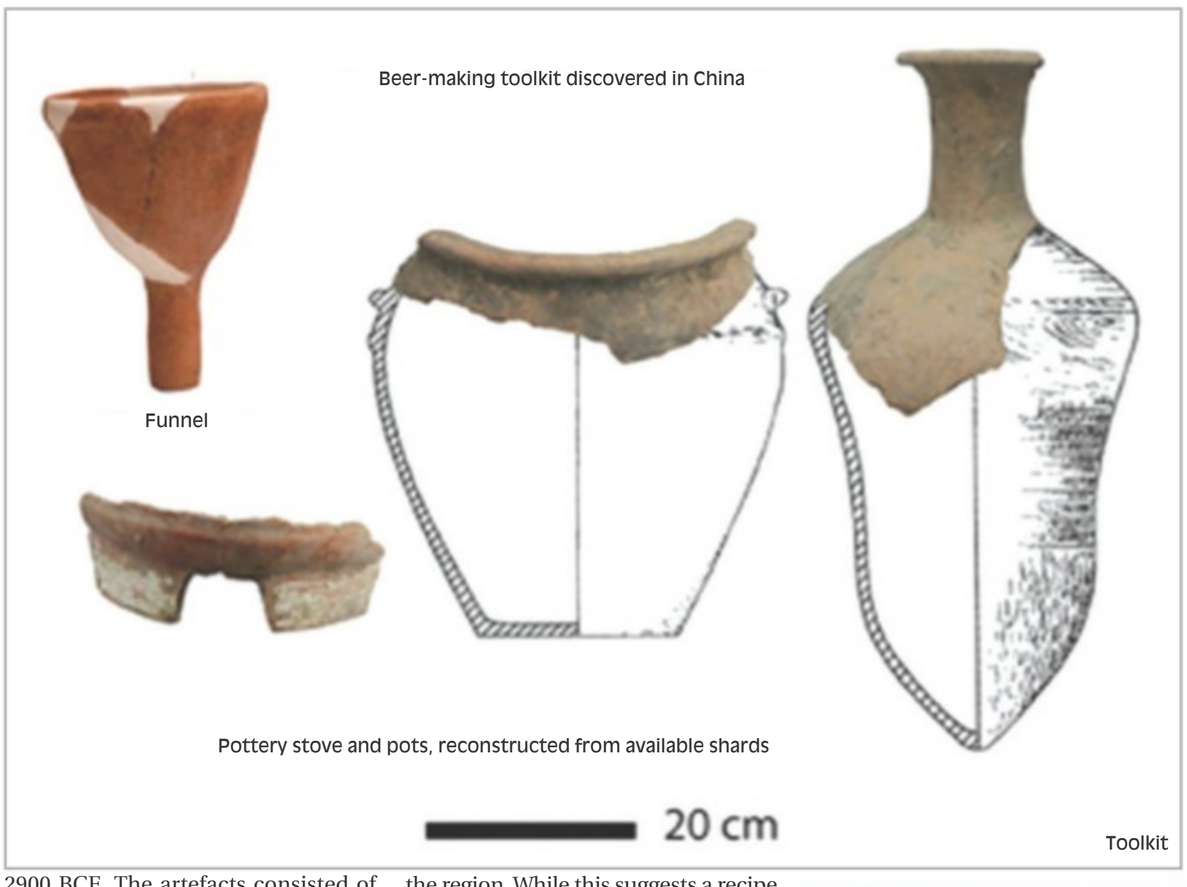
Davide Tanasi, Enrico Greco, Valeria Di Tullio, Donatella Capitani, Domenica Gullì, Enrico Ciliberto, from the universities of South Florida and Catania, Italy and institutes in Rome and Agrigento, Italy, report in Elsevier's *Microchemical Journal*, the evidence that wine was produced and stored in Italy by the first millennium BCE. The evidence has come from the deposits of organic matter found on shards of ceramic storage vessels in excavations at Monte Kronio, a limestone formation on the south-west coast of Sicily. The authors of the paper describe a new approach to archaeological studies, with the help of laboratory methods, to divine the culinary and dietary habits of ancient civilisations.

There have, of course, been other reports of alcohol production in ancient times. Instances are of the production of beer in the sixth century BCE in Rocquepertuse, north of Marseilles, in France and even earlier, as far back as 3000 BCE, of beer produced in the Shaanxi district in the north-west of China. In 2011, the journal *Human Biology* carried a report of scientists of the National Center for Scientific Research, Montpellier, having found raw material and equipment unmistakably for making beer in the excavation of the site of a Celtic monastery. The floor of one of the dwellings also contained half burnt barley grains, apparently left over from the kilning process that is used in making beer.

The dwelling contained the vessels where barley may have been steeped, before being spread out to germinate and then the remains of an oven, where germinating barley may have been dried. Grindstones, the hearth and containers suggested beer making activity, which may have been part of a local tradition as well as an item of trade and communication with other communities in the Mediterranean.

The discovery in China, which is even more ancient, is in the basin of the Yellow River, considered a cradle of civilisation and teeming with archaeological finds. The discovery reported in the *Proceedings of the National Academy of Sciences* in 2013, is of artefacts recovered from two pits, and which were carbon dated to 3400-2900 BCE. The artefacts consisted of intact, wide-mouthed funnels and pieces of wide-mouthed pots and amphorae and stoves, which appeared to be specifically for brewing, filtration and storage and for heating and temperature control.

Carbonised germinated barley grains recovered at Rocquepertuse



Toolkit

The residues found on the vessels contained specks of starch, which could come from grain, and particles of mineral, the phytoliths, which are commonly found in remains of decomposed plant material. The starch grains were identified as being almost all from millets and varieties of wheat or barley and partly from tubers, like yam, which are found in the region. While this suggests a recipe for beer with strength, stability and flavour, the grains of starch also showed signs of damage — pitting and being swollen or folded, which are like what is produced during the brewing process.

During malting, enzymes start the process of breaking down starch into sugars and cause pits in the starch grains. And then, during mashing, when the grains are in warm water, they swell and lose shape. "Thus, the damaged state of the starch grains in our archaeological sample provides strong evidence for the conclusion that those starch grains are residues from the brewing process," the *PNAS* paper had stated. Chemical analysis of the residue also showed traces of calcium oxalate. Calcium oxalate, which settles as "beerstone" on beer making equipment, is an unmistakable sign of beer brewing activity. The presence of oxalate hence confirms that the prehistoric vessels had been used for beer brewing.

The Italy-based study published in the *Microchemical Journal* undertakes detailed laboratory investigation of organic residues on the pottery remains at two prehistoric sites in Sicily. The goal, as the study states, was "to shed new light on the use of certain ceramic shapes and infer some hypothesis about ancient dietary habits". The remains covered the Middle Bronze Age (1550-1250 BCE) and till the Early Iron Age (1050-950 BCE).

The team concentrated on detailed analyses of the available archaeological material, using traditional as well as the latest methods. They carried out renewed carbon dating, structural study of animal skeletal remains and chemical and other analyses of ceramics and organic residues. And they further limited the study to an Early Iron Age cooking jar.

They used a combination of methods, including nuclear magnetic resonance, where organic compounds are identified by spikes in the absorption of specific frequencies of radiation, analysis of the spectrum of infra-red light absorbed by the residue and the use of the Scanning Electron Microscope.

Bringing to bear this brace of methods revealed, the authors say, much detail about the food and dietary habits of those ancient people. But one significant matter that the study revealed is that the residue on one of the vessels found in Monte Kronio had traces of tartaric acid and its sodium salt. Tartaric acid is an important component of wine and plays the role of ensuring its chemical stability. The acid is not very frequent among plants and fruit but it is present in grapes. This is surely the reason that wine is most frequently made from grape.

The presence of tartaric acid and its salts in the residue on the Monte Kronio vessels is hence an indicator that the vessels, circa 1000 BCE, were used for storing wine made from grapes. Italy is today the world's largest exporter of wine. It does look like they had an early start!

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The vessels found in Monte Kronio

Separating ourselves from bugs

'Non-stick skin' could be a new way to overcome antimicrobial resistance

PETER MONK

Across the world, there is a growing problem with antibiotics — there have been years of misuse by patients, doctors and even farmers seeking greater yields from livestock, with the result that microbes have learned to live with these once potent drugs.

Ramanan Laxminarayan, formerly of the Public Health Foundation of India and now director of the Center for Disease Dynamics, Economics and Policy in Washington DC, has highlighted how the greatest burden of resistant disease falls on low and middle-income countries. India, in particular, has an issue with antibiotic use, surpassing even China for the highest number of sales in 2014. Growing economic success may give India the dubious privilege of achieving not just the highest use in humans, but also in animals — in 2030 India is predicted to be the greatest user of antibiotics in livestock.

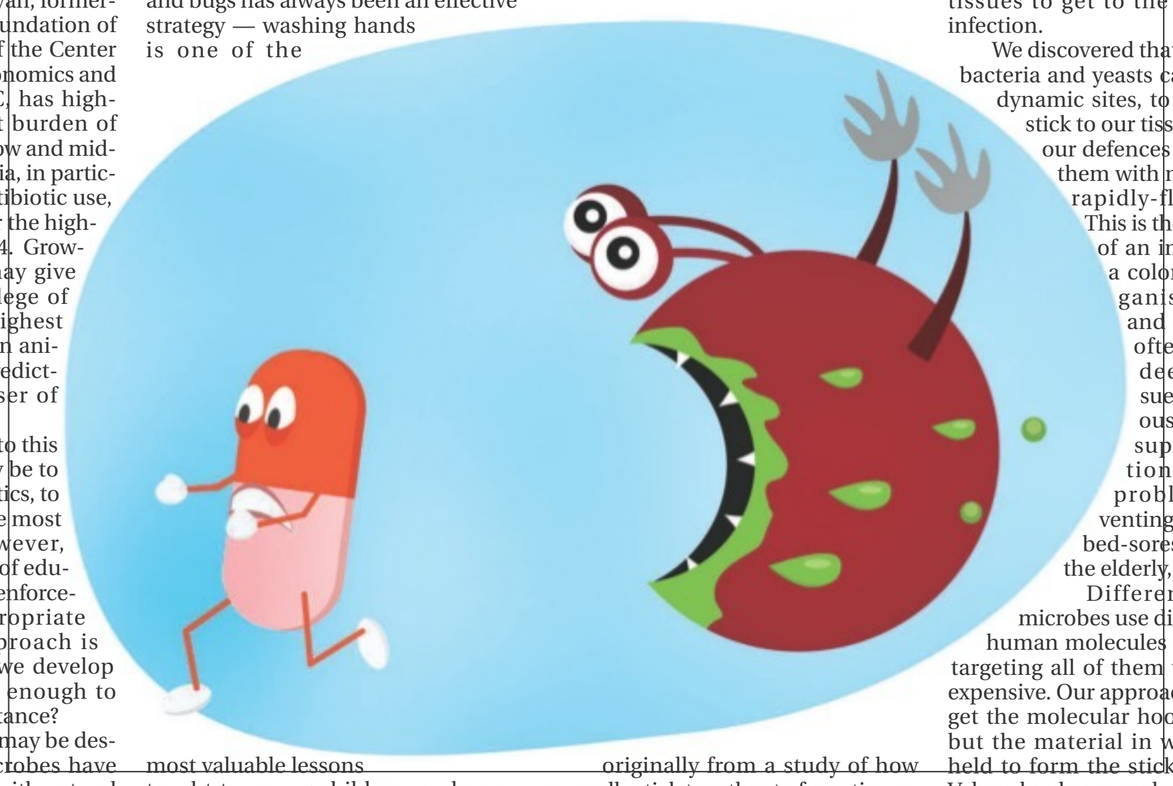
Clearly, one solution to this global crisis would simply be to use fewer doses of antibiotics, to help preserve them for the most serious infections. However, without a long campaign of education and the watertight enforcement of bans on inappropriate antibiotic use, this approach is doomed to failure. Can we develop new antibiotics quickly enough to overcome the rise of resistance?

Again, this approach may be destined to fail because microbes have been fighting each other with natural antibiotics for billions of years and somewhere in nature there probably already exists an answer to drugs that kill microbes, or slow down their rate of growth. Worryingly, many microorganisms have the ability to cooperate to build structures called bio-films that provide physical protection from drugs; bugs in bio-films live in sufficient proximity to each other to allow the exchange of the pieces of genetic information required for resistance. Resistance, then, seems an almost insurmountable problem.

Given such issues, many scientists are now looking for an alternative route to protection against microbes. Simply separating people and bugs has always been an effective strategy — washing hands is one of the most valuable lessons taught to young children, and campaigns such as SuperAmma have seen significant changes in behaviour that should lower the burden of disease.

Can we find other ways of separating ourselves from microbes that would be useful in preventing the infections of skin wounds such as burns, lowering the numbers of dangerous bacteria that we carry in our noses and throats (such as the bacteria that cause a form of meningitis or pneumonia) or that can protect our eyes from devastating fungal infections? Even better, can we do this without causing the microbes to fight back with drug-killing resistance?

The approach that we have taken at the University of Sheffield came originally from a study of how our cells stick together to form tissues such as skin. There are structures on the surfaces of cells that resemble Velcro — highly organised patches of adhesive molecules that enable cells to cling tightly together. In some cases, these are long-lasting and static, providing leak-proof seals around blood vessels. In other cases they are short-lived and dynamic, allowing mobility, for instance when our white blood cells are travelling through tissues to get to the site of an infection.



We discovered that some types of bacteria and yeasts can "hijack" the dynamic sites, to allow them to stick to our tissues even when our defences try to dislodge them with mucus, tears or rapidly-flowing blood. This is the starting point of an infection, when a colony of microorganisms attaches and starts to grow, often penetrating deeper into tissues to cause serious disease. Even superficial infections can cause problems, by preventing the healing of bed-sores and ulcers in the elderly, for example.

Different types of microbes use different types of human molecules to cling to and targeting all of them would be very expensive. Our approach is not to target the molecular hooks themselves but the material in which they are held to form the sticky patches. On Velcro, hooks are embedded in a base layer of woven material but on our cells this is formed by a sort of molecular raft called a microdomain.

We have discovered how to weaken one type of microdomain, in a way that is analagous to stretching Velcro, pulling the molecular hooks further apart and significantly lowering the stickiness of the patches on cells. By addressing only one type of microdomain, we have found that we do not affect the normal behaviour of our cells, but we do make bacteria and fungi much easier to wash away.

In a sophisticated three-dimensional model of human skin, we lowered the burden of a common hospital-acquired infection (Staphylococcus aureus, otherwise known as MRSA) using a cheap and simple application of natural protein fragments called peptides. These peptides did not prevent wound-healing in the skin and, importantly, they did not affect the growth of the bacteria. In the absence of a direct action on the bugs themselves, resistance cannot spread through a population and so the peptides should be an effective, long-term treatment for infections.

Our more recent work has also shown that combinations of peptides and conventional antibiotics are able to prevent infections, even when using drug-resistant bacteria such as MRSA. We believe that combinations of new and old approaches may be an important way of fighting infections in the future, giving new life to existing antibiotics and extending the life spans of new ones when they reach the clinic.

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PLUS POINTS

Hello Florence

The largest asteroid ever recorded has passed Earth at a distance of 145 million miles, giving scientists the opportunity to learn more about its physical characteristics.

The 2.7-mile wide astral body, called Florence, will not approach the planet this close again until 2500. It is classified as a "potentially hazardous" asteroid by the International Astronomical Union's Minor Planet Centre, although orbital calculations have found there is no risk of the asteroid colliding with Earth.

"While many known asteroids have passed by closer to Earth than Florence will... all of those were estimated to be smaller," Paul Chodas, manager of Nasa's Centre for Near-Earth Object Studies, said in a statement. "Florence is the largest asteroid to pass by our planet this close since the Nasa programme to detect and track near-Earth asteroids began."

The relatively close proximity of Florence provides astronomers with a rare chance to take measurements. Radar scientists will capture high-resolution images that could show its surface features. Little is currently known about Florence's properties.

During early September, the asteroid is so close to Earth that it is visible even with small telescopes as it passes through the constellations of Piscis Austrinus, Capricornus, Aquarius and Delphinus. Until 8 September, astronomers will be using the Goldstone Solar System Radar in California and the National Science Foundation's Arecibo Observatory in Puerto Rico to reveal more about it.

Radar images discovered that Florence has two small moons. The moons are estimated to be around 100-300 metres in diameter. It is fairly spherical, has a ridge along its equator and at least one large crater. The radar images confirmed the asteroid rotates once every 2.4 hours.

"If it were spinning any faster, it would fly apart," Chodas said. "What often happens is asteroids that are spinning this quickly rearrange into the shape of a top, where they have kind of a bulge at the equator."

Research also confirmed that the asteroid is only the third triple asteroid (with two orbiting moons) known out of more than 16,400 near-Earth examples discovered so far. Scientists are hoping to use the data collected to calculate the total mass and density of the asteroid.

Florence was discovered in 1981 by astronomer Schelte "Bobby" Bus at Australia's Siding Spring Observatory and named after Florence Nightingale, the nursing pioneer.

The independent

Bright pinwheel

Dwarf galaxy NGC 5949, seen here in an image taken by the Hubble Space Telescope, sits at a distance of around 44 million light years away from Earth, which places it within the Milky Way's cosmic neighbourhood. Hence, NGC 5949 is considered a perfect target for astronomers to study dwarf galaxies. With a mass of about a hundredth that of the Milky Way galaxy, to which our solar system belongs, NGC 5949 is a relatively bulky example of a dwarf galaxy. It is classified as a dwarf because of its relatively small number of constituent stars. The galaxy's loosely bound spiral arms also place it in the category of barred spirals — a structure that is just visible in the image, which shows the galaxy as a bright yet ill-defined pinwheel. Despite its small proportions, NGC 5949's proximity has meant that its light can be picked up by fairly small telescopes, something that facilitated its discovery by the astronomer William Herschel in 1801.

The straits times/ann