

TAIN'T misbehavin'

Making wine in areas of Australia plagued by bushfires is a risky business. *Simone Madden-Grey* reports on the scientific breakthroughs that could help to save grape harvests that have been damaged by smoke taint

WINE PRODUCTION in bushfire country is immensely challenging, and Australia's bushfire response has the latest in scientific and technological innovation at its core. Satellite imagery, machine-assisted learning, nanofabrication and nanofiltration are all being used by the Australian wine industry to manage fire-damaged vineyards and smoke-tainted fruit.

In South Australia a project using high-resolution satellite imagery and machine-assisted learning to provide rapid damage assessment has successfully demonstrated a good correlation between vineyard data from satellite imagery and data from ground-based, visual assessments. The project was built on an existing machine learning model that used satellite imagery to identify and map vineyard land in Australia. Frank Ouyang, technical product co-ordinator at Consilium Technology, says the model was first trained to distinguish vineyard land from other land by using software to label and classify the pixels in each image. To refine the process, the model also learned the visual patterns and spectral properties of

a vineyard, for example the unique patterns of vine rows or the spectral properties of a grapevine canopy.

For the bushfire project, satellite imagery was accessed, and vine-damage assessments were conducted on the ground by consultant Colin Hinze of agribusiness consultancy Pinion Advisory and Dr Cassandra Collins of the University of Adelaide. Participant vineyards were in the Adelaide Hills, and after the 2019/2020 fires, the ground-based team assessed and categorised the damage to every vine in the trial sites. The assessments were mapped, and together with site GPS co-ordinates were further processed by Green Brain, a subsidiary of Consilium Technology, which then compared the data with satellite images of each site. The alignment of data between the satellite images and the ground-based damage assessments was considered good enough to now work towards building a fire-assessment tool, helping to reduce the time that grape growers need to wait before accessing damage assessments after a fire.

Feature findings

- Australia has put the latest in scientific and technological innovation at the core of its response to bushfires in wine country.
- Satellite imagery has been accessed, and vine-damage assessments conducted on the ground.
- The alignment of data between the satellite images and the ground-based damage assessments was considered good enough to now work towards building a fire-assessment tool, helping to reduce the time growers need to wait before accessing damage assessments after a fire.
- Dr Cheryl Suwen Law is working to bring the laboratory to producers via a microfluidic chip. The science of nanofabrication and biosensors will be used by Law to explore creating a palm-sized device that will instantly assess smoke taint in juice or wine.
- A further process involves a permeate extracting the volatile phenols before recombining it with the concentrate until the taint characters are reduced or removed.

australia

Volatile phenols explained

Volatile phenols include compounds such as guaiacol, 4-methylguaiacol, cresol and syringol, which are associated with smoke taint characters in wine. They can exist in both free and bound form. When the vine is exposed to smoke it responds by binding some of the free volatile phenols to sugar molecules, creating volatile phenol glycosides. Free volatile phenols can be treated using nanofiltration but the bound form, or glycosides, cannot be removed by nanofiltration. However, while bound the glycosides do not cause taint characters in wine. After wine is treated, certain enzymatic activity may take place that can break the glycosidic bond, releasing the volatile phenol compound from the sugar molecule and returning it to a free, and sensorially active form.

As part of a new three-year industry-led research project, techniques for working with volatile phenols and smoke taint are being investigated. Dr Kerry Wilkinson, professor of oenology at the University of Adelaide, says the project will assess the efficacy of different adsorptive materials in removal of free and bound volatile phenols. The nanofiltration process and use of ultrafiltration, that is the use of multiple membranes, would also be considered. Ultrafiltration would include a membrane with a high molecular weight cut-off as a way of extracting the glycosides in a separate permeate fraction, which could then be treated or removed.

During the project, an adsorptive product from New Zealand company Ligar will be tested for the removal of specific volatile phenols during permeate fraction treatment. The product is made of molecularly imprinted polymers or MIPs, which are designed to target and bind to specific molecules. Wilkinson says: "The product data suggests MIPs are particularly good at scavenging the volatile phenol, cresol, and I think those are the compounds more likely to be responsible for taint than things like guaiacol and syringol." Referencing the concern that smoke taint may return in treated wine, Wilkinson says she is not convinced: "I think these glycosides or bound volatile phenols are more stable than we first thought, it may just be a loss of fruit that naturally occurs in wine over time," suggesting the natural evolution of wine may redistribute the characters that are at the forefront rather than new compounds appearing.

From the macro to the micro, or more accurately, the nano. Dr Cheryl Suwen Law, research associate at the University of Adelaide, School of Chemical Engineering and Advanced Materials, is working to bring the laboratory to the vineyard and winery by way of a microfluidic chip. The science of nanofabrication and biosensors will be used by Law to explore creating a palm-sized device that will instantly assess smoke taint in juice or wine.

The one-year project is currently focused on perfecting the surface chemistry to

'The science of nanofabrication and biosensors will be used to explore creating a palm-sized device that will instantly assess smoke taint in either juice or wine'

successfully identify smoke taint molecules using a lab-on-a-chip mechanism. The device platform is constructed of nanoporous photonic crystals coated with a unique binding protein. When juice or wine is added to the device, it is hoped that the bespoke protein will bind to any smoke taint molecules in the liquid, causing a spectral shift that is able to be detected by shining a light through the liquid. It is also hoped that the rate of binding will help quantify the degree of smoke taint.

Law says the surface chemistry is the most challenging part of the project, and to date the team has successfully applied a binding protein to the inner

surface of the photonic crystals. While the project is in the early proof-of-concept stage, the next phase will test the binding protein taint-molecule-adherence process followed by the detection of a spectral shift in the presence of taint molecules. The project will then move beyond generating a yes or no reading to a quantified measure of smoke taint molecules, providing the user with more specific data.

The final objective is to create a cost-effective tool that is not only portable and

australia



easy to use, but that also generates meaningful data to assist with timely and cost-effective decision making.

When it comes to wine, there are several treatments to remediate smoke taint. One process in Australia uses the principles of reverse osmosis to treat tainted wine. After years of working with the original technology, David Wollan, research and development manager at VAF Memstar, adapted the reverse-osmosis process to treat the volatile phenols associated with smoke taint. Although the machinery to separate the wine into different fractions is the same, the permeability of the membrane used is different.

Reverse osmosis and nanofiltration are membrane-filtration processes that separate wine into permeate (20%-30%) and concentrate (70%-80%) fractions. The concentrate retains nearly all of the major wine components, while the permeate consists of water, alcohol, acid and some of the less desirable components, such as smoke-taint compounds, which can be selectively treated as required.

Brand updates

Benchmark Drinks

The Benchmark Drinks Australian portfolio has welcomed a number of new releases, including Howard Park Miamup Chardonnay, crafted using French oak to create a layered and complex wine. A critical selection process of the highest quality grapes is used and all of the individual vineyards are vinified separately. The wine has gone on sale at Waitrose priced at £13.99 a bottle. Also new to the portfolio is Botham Series 77 Margaret River Sauvignon Blanc, which celebrates one of cricketing legend Sir Ian Botham's most significant years in the sport, when he made his Test debut against Australia and where England went on to regain the Ashes. The £11 wine combines notes of grapefruit and elderflower with flavours of passion fruit, lime zest and cut grass, culminating in a clean finish.

On the subject of stars, pop princess Kylie Minogue has expanded her wine range with two new Australian wines – a Margaret River Chardonnay and a Yarra Valley Pinot Noir, both of which scooped Gold medals with *db*. Available in the UK at Harvey Nichols, the Margaret River Chardonnay is priced at £25 and the Yarra Valley Pinot Noir costs £28. Completing the line-up is Mad Fish Cabernet Shiraz, which joins the Sauvignon Blanc and Chardonnay in the Mad Fish range. Made from grapes grown in the South West of Western Australia, the £9 wine features notes of dark cherry, ripe berries and anise and has silky tannins.



Australian Vintage

This year has seen Australian Vintage launch innovative new products, develop engaging new creative, and renew multi-million-pound sponsorship deals. At the beginning of July, McGuigan announced the renewal of its sponsorship deal with Timeless Entertainment on The Drama Channel, worth over £2 million in media value, for a third consecutive year. This follows a successful second year of the brand's sponsorship, which saw a 9% uplift in brand awareness and 20% conversion rate among viewers.

The new creative is expected to reach over 10 million viewers across the UK over the next 12 months and is the first look at the brand's new creative territory, 'Just Because'. Tempus Two, meanwhile, launched its Provence-inspired Fleur Rosé in time for the English summer. This is the brand's first wine made with French grapes, reinforcing its 'beyond borders' ethos and breaking into the increasingly popular rosé scene. Pale pink, the wine has aromas of ripe red berries and rose petals, and a crisp, dry finish.



During the Memstar process the permeate is passed through an adsorbent material to extract the volatile phenols before recombining it with the concentrate

During the Memstar process the permeate is passed through an adsorbent material to extract the volatile phenols before recombining it with the concentrate. The whole process is repeated until the taint characters are reduced or removed.

australia



Dr Cheryl Suwen Law is working to bring the lab to the vineyard via a microfluidic chip

In 2003 Wollan sourced, tested and categorised a range of membranes to investigate a broader application of separation technology, and he began working with a looser-structured nanofiltration membrane, rather than a tighter reverse osmosis membrane. Differences in molecular weight and membrane permeability are what allow wine to be selectively separated into fractions. Using the analogy of a molecular sieve with holes of a certain size to explain the difference in membrane structure, Wollan says the nanofiltration membrane has a higher molecular weight cut-off, allowing larger molecules such as free volatile phenols, to pass through into the permeate for treatment. The adsorbent material the permeate passed through after filtration was initially an activated carbon that could not be regenerated and needed to

‘I think it makes a difference the longer you can wait to allow more of those enzyme systems to break down the glycosides, allowing the wine to become more stable’

be discarded after it became saturated with taint compounds. After experimenting, Wollan replaced it with a regenerable, food-grade resin with a strong affinity for the volatile phenols being extracted.

One particular challenge in dealing with smoke taint is understanding and extracting free and bound volatile phenols. Volatile phenols are easier to remove in their free form because they have a lower molecular weight than the bound form and can pass through a nanofiltration membrane for treatment in the permeate. The higher molecular weight of bound volatile phenols, or glycosides, means they don't pass through the membrane. Research on this complex chemistry is continuing but, in the meantime, Wollan says that treatment timing is a key factor in managing this. He recommends waiting, saying:

“I think it makes a difference the longer you can wait to allow more of those enzyme systems to break down the glycosides, allowing the wine to become more stable.”

It is clear that fire-event management and response requires a multi-tool approach to address the unique season and character of each fire. The ability to adapt and incorporate new research is essential for

Brand update

Jacob's Creek

Jacob's Creek, has signed a three-year global contract as the official wine partner of the Cricket World Cup via the International Cricket Council (ICC). The partnership sees Jacob's Creek as the official wine partner of all ICC events throughout 2021 to 2023.

The brand has a long-standing connection to the world of sport and is working with the ICC to connect cricket fans and wine lovers globally through this pinnacle cricket event. The Indian market will be celebrating the ICC Men's T20 World Cup with a limited-edition bottle from October and other forthcoming activations surrounding the event in the UAE, Australia, New Zealand and the UK. The Jacob's Creek winery in South Australia is home to the largest combined solar winery installation in Australia and Jacob's Creek is the first winery of its size to use 100% renewable electricity. Meanwhile, the brand's Double Barrel range, which sees its Cabernet Sauvignon finished in aged Irish whiskey barrels and the Shiraz, Shiraz/Cabernet and Chardonnay finished in aged Scotch barrels, continues to be a global success story.



minimising impact from vineyard to bottle, and through innovative technology, scientific analysis, collaboration with industry partners and assessment of a broad range of management strategies, Australia continues to contribute to a rapidly growing toolbox. db