BrewsNews

INSPIRED

Inspiring the future of the brewing industry with thought-leading academic research.

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OCTOBER 2022

Brews News' inaugural INSPIRED report aims to inspire the future of the brewing industry through showcasing thought-leading academic research.

This report is made possible thanks to the support of HPA and is a roundup of some of the latest and most innovative research projects being undertaken across Australian university institutions.

Academics across Australia are looking at the ingredients used in the brewing process, automation of the brewhouse and how we market, manage and create communities within the industry, with the aim of improving, inspiring and creating new knowledge around the brewing industry.

GET INVOLVED

The INSPIRED report aims to bring together all of the research so that industry can work closely with experts in their field to further the industry

Are you an academic taking part in any research in the industry and want to share it through our next INSPIRED – get in touch with the details below.

Are you working in the industry and want to support, or provide input into the research or speak to an academic? You can contact them directly or get in touch with our editorial team for a referral.

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COLLABORATION & TOURISM IN THE BREWING INDUSTRY

Researchers at Melbourne's RMIT and its Vietnam campus have focused on collaboration in the industry, as part of the "remarkable development" of the sector within Australia. Dr Abel Alonso and fellow authors suggested that collaboration in the brewing industry had direct implications on quality control "and potentially, for the delivery of a high quality, consistent end product, which has impacts for added value, and for breweries' competitive advantage". The research also highlighted the potential for breweries who have collaborated and partnered with businesses and sectors outside the immediate brewing industry.

Another study investigates the perceived potential and challenges of craft brewing tourism among 221 micro and small United States craft brewing operators. Overall, participants perceived the potential of craft beer tourism in their region or state. Pubs and bars selling locally crafted beer, packaged tours, beer–food pairings, tours, and trails were predominantly identified forms of craft beer tourism development, while limited logistics and lack of time were main perceived challenges. Various statistically significant differences were identified, particularly based on the level of production and age of the brewery. However, overall, most tests yielded similar levels of agreement.

"The craft brewing industry is quite creative, dynamic, and entrepreneurial," explained Dr Alonso.

"If done in a professional way, being a professional craft brewer can provide the means for making a living and creating a niche. In addition, many consumers are interested in this type of industry & product. So, it is interesting to follow issues related to this industry.

"The problem is drawing the interest and attention of craft brewers to participate in research.

"In 2019 and 2020, I tried to replicate the earlier study in Australia, but received almost no responses from the over hundred craft breweries."

INSTITUTION:	RMIT, Vietnam
RESEARCHERS:	Dr. Abel Duarte Alonso, Nikolaos Sakellarios,; Dr Alessandro Bressan.
FUNDING:	Edith Cowan University funding

OUTPUTS:

Collaboration and the Emerging Craft Brewing Industry: An Exploratory Study (2018)

Strengths, innovation, and opportunities in a burgeoning industry: an exploratory study (2018)

Stakeholders and Craft Beer Tourism Development (2017)

Exploring innovation perceptions and practices among micro and small craft breweries: A three-country study (2017)

THE INFLUENCE OF TRAINING ON THE PERCEPTION OF BEER

One project led by Dr. George Van Doorn and Dr. Justin Timora from Federation University Australia focused on how training can influence the multisensory perception of beer. The research showcased that while expert tasters were better at discerning beer types in comparison to novices, the performance reflected on experience with specific styles, rather than universal benefits of training, according to Dr. Timora.

“For example, expert tasters were found to be better at matching beers, discriminating between beers or the attributes of beer, and identifying beers. However, this level of performance was only evident for beers the experts were exposed to during training,” he said.

“This finding suggests that any benefits of training or expertise may not translate to situations where tasters are exposed to novel/unfamiliar beers.

“That said, the results of some of the research we reviewed might be influenced by methodological or statistical problems, and considerably more research is required to accurately determine whether people's perceptual abilities to taste beer can be trained.”

INSTITUTION: Federation University Australia

RESEARCHERS: Dr. George Van Doorn, Dr. Shaun Watson, Dr. Justin Timora and Professor Charles Spence.

OUTPUTS: Collaboration and the Emerging Craft Brewing Industry: An Exploratory Study (2018)

WILD FERMENTS, BARREL AGED BEERS AND MEAD

Brewers who are looking to expand their technical range and creativity are experimenting with barrel ageing and wild ferments, and researchers from Federation University are looking into several different areas of the fermentation process. Senior lecturer Dr David Bean said that the investigation, identification and characterisation of wild yeasts is a project borne from a love of beer and microbiology, and is looking to better understand yeast in the environment and its importance in spontaneous ferments.

“Having taught the fermentation side of brewing for 10 years, it has always fascinated me the different yeasts and the different flavour compounds they can create. It has provided a fascinating insight to see what these spontaneous ferments in barrel aging are doing over time as well, how they change and how they mature and if we can link that back to the metabolites that are being produced. I’ve been working with Dollar Bill Brewing, taking their slurries, and looking at this from a conventional microbiology perspective, pulling out the yeasts and trying to identify them,” he explained.

“Through my clinical background, I know there are a lot of methodologies for identifying yeasts based on clinical isolates, but they haven’t really been applied to food or brewery isolates.

“So I’ve been investigating these methodologies to see if they’ll be quick and easy of identifying and characterising yeast because we speak to brewers and we know they want to pull out the yeast, cultivate them, and identify, is this a Brettanomyces or a Saccharomyces, or something different?”

Meanwhile, Federation University's Dr David Smith has received a grant from the UK's Royal Society of Chemistry to identify and quantify the volatile aroma compounds produced during the fermentation of native Australian honey.

"The idea is to look at different eucalypt sources and use gas chromatography to identify and quantify the different aroma compounds that are produced from those different honey sources," explained Dr Smith.

"This will provide a greater understanding of how differing floral species impact the resulting mead products. We are also interested in hop aroma and character using the same characterisation techniques."

INSTITUTION:	Federation University
RESEARCHERS:	Dr David Bean, Dr David Smith
FUNDING:	Royal Society of Chemistry

PROTEOMICS WITHIN SORGHUM TO ANALYSE ITS FERMENTABILITY FOR BEER BREWING

Brewers are always looking for alternative processes and ingredients for their beer, and this project from researchers at the University of Queensland investigates proteomics and metabolomics within sorghum to analyse its fermentability for beer brewing. Researchers found that the naturally gluten-free alternative to barley required higher temperatures than barley malt for protein and enzyme solubilisation, but despite some of these challenges and with careful process optimisation, they also found that sorghum can be a viable grain for industrial beer production.

“We work with collaborators who do a lot of work on sorghum for food consumption because it grows really easily in arid areas, and it’s also gluten free. That’s why it’s one of the major alternatives to barley,” explained researcher Dr Edward Kerr.

“Traditionally it’s probably the most commonly-used gluten free alternative because compared to millet or rice, you don’t need to add as much enzyme - but it is a bit tricky. There was a lot of work on sorghum and looking at it from a brewing standpoint, but they were old studies using very traditional methods.

“We used more up-to-date methods and a big part of that was using proteomics and metabolomics, so that we could efficiently understand what was happening in terms of enzymes, how they were changing, things like the alpha and beta amylase, which you need to breakdown starch into fermentable. Sorghum is known to generally require a really high gelatinisation or starch solubilisation temperature. So we wanted to confirm that and wanted to see how these proteins change in abundance across a normal mash.”

"We found that alpha and beta amylase were considerably less abundant in sorghum wort compared to barley. Interestingly, we also found an alpha glucosidase present in sorghum and not barley wort, which is essentially an enzyme which could break down any kind of starch and release single glucose, which yeast is happy to consume. So that additional activity from that enzyme allows you to get more glucose in your wort than you'd expect, which can help with fermentation."

The research also highlighted the potential characteristics and features that could make sorghum a long-term alternative to barley in beer making. The next steps will be to look further into malting varieties and the proteins within them.

INSTITUTION: University of Queensland

RESEARCHERS: Dr Edward Kerr, Dr Glen Fox, and Dr Benjamin Schulz

FUNDING: Advanced Queensland Industry Partnership

OUTPUTS: Proteomics and metabolomics reveal an abundant α-glucosidase drives sorghum fermentability for beer brewing

EFFICIENCIES IN GRAIN MALTING

Another project undertaken by researchers at the University of Queensland focuses on efficiencies in industrial grain malting. Germination is a critical process within malting, but inefficiencies exist with some seeds failing to germinate which leads to wastage and economic costs. The research analyses the both germinating barley seeds and seeds which were unable to germinate, and the results provide a more detailed understanding of the changes in the barley proteome during germination and give possible target proteins for testing or to inform selective breeding to enhance germination or control dormancy.

Dr Edward Kerr and his team's innovations in the analysis of proteomics have made investigating ingredients such as barley at a small scale a possibility, thus resulting in far less wastage and making experimentation much more accessible to maltsters and the brewing industry at large.

"This project is looking at barley during germination, the key part of malting. The process is well understood, but no one has used proteomics for this kind of thing. When you malt barley seeds, a big portion of those seeds don't germinate at the same time and some don't ever germinate. No one is sure of the mechanics of why seeds don't germinate, but that generally causes an issue for maltsters. It's inefficient and it costs money.

"We looked at the things that were happening during germinating seeds, we found some really interesting proteomic changes - looking at the difference between seeds that were germinating and seeds that were unable to germinate.

"We found huge differences between germinating and non germinating of course, but also seeds that weren't able to germinate at all.

"[From this] we've come up with ideas about the cellular mechanics that could be behind that. The hope for this is that we better understand germination, and breed selection to enhance germination to make it quicker, and to better understand dormancy to better overcome it."

INSTITUTION:	University of Queensland
RESEARCHERS:	Dr Edward Kerr, Dr Sarah Osama, Dr Adel Yousif, Dr Toan Phung, Associate Professor Alison Kelly, Professor Glen Fox, and Professor Benjamin Schulz.

OUTPUTS: Proteomics reveals commitment to germination in barley seeds is marked by loss of stress response proteins and mobilisation of nutrient reservoirs

CO_2 RECOVERY, SUSTAINABILITY AND ENERGY USAGE IN THE BREWHOUSE

Researchers at UTS are also looking at practical projects which focus on sustainability in the brewhouse, such as Hawke's Brewing Co.'s vertical indoor farming and the Young Henrys' algae project.

In addition, part of their sustainability research focuses on how to reduce costs and energy usage generally in the brewhouse, The brewhouse consumes around one-quarter of the total energy in the form of vapour, which the team identified as a huge opportunity for recovering energy. Commercially available technology for heat recovery during wort boiling tends to be available at larger beer producers, but only for wort boiling, but not necessarily for smaller breweries.

The latest study from the UTS team looks at a number of proposed options for re-utilising recovered energy, such as pre-heating water for use in a subsequent process or a later brew. These processes could allow a brewery to spare 16 to 133 tonnes of CO_2-e (the number of metric tons of CO_2 emissions) from being released into the atmosphere annually.

INSTITUTION:	University of Technology Sydney
RESEARCHERS:	Dr Nick Bennett, Mrs Laryssa Raffa, Dr Lee Clemon, Dr Peter Ralph
FUNDING:	Innovation Connections (Department of Industry, Innovation and Science)

OUTPUTS: The team is presenting "Opportunities for Energy Efficiency Improvements in Small and Micro Breweries" at the International Mechanical Engineering Congress and Exposition in the US in November.

USING 5G-CONNECTED TECHNOLOGIES IN THE BREWPUB

Automation, the Internet of Things and bringing innovative technologies into the brewery is always on the industry's radar. As part of the University of Technology Sydney's state of-the-art research and development facility TechLab, Dr Nick Bennet has completed a 5G-connected microbrewery in collaboration with technology giant Nokia. The digitally automated brewhouse uses a cloud-based digital twin of an actual brewery with the aim of optimising the brewing process.

The Industry 4.0 Nano-Brewery, is part of its new Advanced Manufacturing and Industrial Data Science testbed and forms part of an international production network. It has an identical physical twin set up in TU Dortmund University in Germany. The 5G connected brewery captures and monitors production data and uses this data, together with data from the physical twin in Dortmund and a digital twin in the cloud, to optimise the process, with 5G connectivity provided by Nokia's FastMile 5G Gateways connected to a campus-wide Nokia Digital Automation Cloud 5G Standalone private wireless network. They have brewed Young Henrys beers on the systems, as well as a number of breweries in Germany.

"We're in partnership with a technical university in Dortmund, which has the same nanobrewery as us, so twins of the same hardware," explained researcher Dr Nick Bennett.

"We're trying to create a digital twin - a digital representation of both the breweries with which we can log data about the brewing processes we recreate. The longer-term idea there is that we can look at the quality of the beer during the process conditions. We can look at trying to be more efficient in the brewing process, and we can try to optimise key KPIs, like reducing energy or the amount of water we use."

It is already available at a very large scale, our focus has been working with craft breweries - we want to make these technologies accessible. That's one of our key aims, to work with independent breweries. You can buy expensive platforms, but you can create this from the ground up with free, open source software, which is something our excellent researchers can do."

As part of this project, the team is also working in the field of robotics.

"The idea is that you use 5G for very fast communication, and cut the cord of communication between your modem and your robot. You can have robots do operations within the lab, and we're working on demos at the moment where robots can pour the beer around with glasses and take away empty glasses. But to be able to have robots operate in that environment with people and do that safely, you need very low latency and very high reliability, so the robot doesn't lose connectivity."

In mid October, UTS announced that Young Henrys is currently in the research and development phase of a new craft beer and utilising the UTS Industry 4.0 Brewery as a test facility. The collaboration between UTS and Young Henrys ensures the research findings and machine learning techniques are directly transferable to industry.

INSTITUTION:	University of Technology Sydney
RESEARCHERS:	Dr Nick Bennett,
FUNDING:	Nokia, Australian 5G Innovation Initiative (Round 1)

OUTPUTS: Nokia and UTS target the perfect pint with world's first 5G connected microbrewery


Tech Lab


Tech Lab
Tech Lab

ETHICAL LABELLING AFFECTS THE EXPECTED AND PERCEIVED TASTE /FLAVOUR CHARACTERISTICS OF BEER

In 2021, Dr. Van Doorn and Dr. Timora collaborated with colleagues on a study looking at how ethical labelling affects the expected and perceived taste/flavour characteristics of beer. This study was conducted with Little Gippsland Brewing Co. and Sailors Grave Brewing Co in Victoria.

Ethical labelling refers to labels that provide information on ethical practices used in the production of the product. Some examples include carbon neutrality, sustainability and animal welfare.

“We found that people who saw themselves as more moral expected a more intense beer when it was presented with a label that advertised a high-quality product but contained no ethical information,” Dr. Timora said.

“People who rated themselves as more moral also perceived a beer as more refreshing regardless of the type of label they were exposed to.”

INSTITUTION: Federation University Australia

RESEARCHERS: Dr. George Van Doorn, Dr. Rose Ferguson, Dr. Shaun Watson, Dr. Justin Timora

OUTPUTS: A Preliminary Investigation of the Effect of Ethical Labeling and Moral Self-Image on the Expected and Perceived Flavor and Aroma of Beer

HPA

NEAR INFRA-RED HOP ANALYSIS

Understanding hop analyses and their significance is essential to making consistently high-quality beers. Brewers use alpha acid content to dose for target bitterness, and oil content, moisture content or Hop Storage Index to assess quality and freshness.

Industry standard methods of hop analysis such as Lead Conductance Value (LCV), High Performance Liquid Chromatography (HPLC) or Spectrophotometry rely on extraction using harmful and highly flammable solvents including methanol, toluene and/or diethyl-ether. In addition, moisture and oil content analysis take two to four hours respectively from time of sampling to result.

Hop Products Australia (HPA) set themselves a target to reduce the turnaround time for hop analysis. After investigating alternative methods to shorten drying and distillation, HPA determined indirect analysis was best suited to delivering the combination of accuracy and output required. Enter Near Infra-Red (NIR) Spectroscopy. By measuring spectral reflectance across a range of wavelengths, and associating variation in the spectra with analytical variation, HPA developed models that allow them to simultaneously predict the alpha acid content, beta acid content, oil content, moisture content and HSI of each sample in five minutes.

To develop this system, HPA hired biotechnology graduate George Webster, and teamed up with Sagitto who provided handheld NIR instruments and the capability to develop working predictive models from corresponding data sets. They started small in 2018, working with a single instrument at a single site for two years to satisfy initial models, eventually expanding to multiple instruments across three sites in 2020.

NIR has significantly reduced solvent inputs and analytical turnaround times, and the technology can be miniaturised so HPA can transport it to any point in the production process where analytical data is required. The key areas where it is currently employed include analysis of in-field metabolite accumulation, hop bales for kilning and pelleting process optimisation, and experimental hops from their breeding program. For crop 2022, of 5255 samples logged in their system, 4801 were analysed using NIR.

The data on HPA carton labels and certificates of analysis (COA) is still informed by industry standard methods of hop analysis. HPA will continue to benchmark their NIR analysis against American Society of Brewing Chemists (ASBC) and European Brewing Convention (EBC). Their ability to develop models and deploy NIR capability across multiple sites is already backed by a strong calibration system, including internationally recognised reference samples, participation in the ASBC international ring analysis, and inter-laboratory and inter-operator check systems. Plus, NIR has improved safety in HPA laboratories, reduced their environmental footprint, and improved their sampling rate and process control.

INSTITUTION: Hop Products Australia (HPA) and Sagitto

RESEARCHERS: George Webster (HPA), Simon Whittock (HPA), George Hill (Sagitto), Timothy Vogel (Sagitto), Tim Monigatti (Sagitto)

FUNDING: HPA

OUTPUTS: Our New Normal

HPA are working towards a kinder, greener future. Social responsibility & responsible sourcing, consumption and production now underpin their sustainability strategy. This is just the beginning of their journey towards minimising the business' environmental footprint while simultaneously meeting the demands of brewing customers.

This research has been provided by the supporters of the INSPIRED report – HPA.