

WE BREW WITH YOU.™

THE OFFICIAL NEWSLETTER
OF ALL THINGS LALLEMAND BREWING



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EDITION #13

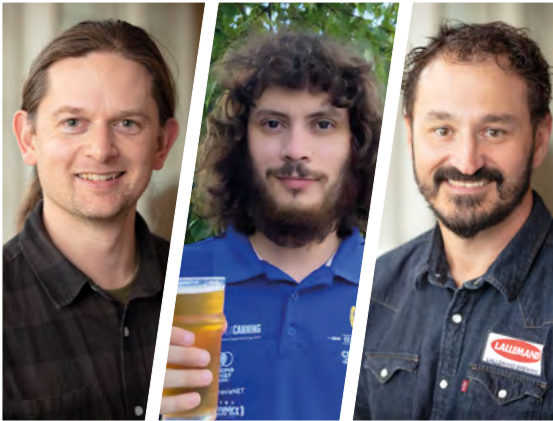
2023

as Seen by Industry

LEADERS



BE PASSIONATE BE LALLEMAND



The Lallemand Brewing team is expanding! We are delighted to introduce you to Scott Sharp-Heward, our new Technical Sales Manager for New Zealand, and Ignacio "Nacho" Lomeli, our first Technical Sales Manager for Mexico. We also welcome Andy Diacetas as Regional Sales Manager for North America. Join us in wishing our new team members the best in their roles supporting you.

[#bepassionatebelallemand](https://www.lallemand.com/#bepassionatebelallemand)

Over the past year, the Lallemand Brewing team has had the great pleasure of interacting with different industry leaders and opinion formers for our We Brew With You™ newsletter and technical webinars. It is difficult to predict exactly which brewing trends will be popular in 2023. In this edition we thought we would ask some past contributors, experts and world-renowned brewers to give us their opinions on what we might expect to see happening in the world of brewing this year.

The articles range from specific technical topics that have attracted much interest, including biotransformation of hop compounds and the application of bioengineered organisms (GMO, let's call it what it is!) to a wider discussion on the global brewing market trends in general.

To give you a sneak peek into their answers, brewing trends in 2023 may include the continued popularity of sour beers, lagers, hazy IPAs and experimentation with unusual ingredients and flavors. Another trend mentioned across expert feedback was the huge growth potential of low-and-no-alcohol beers. Sustainable and environmentally friendly practices, as well as alternative fermentation methods are also expected to be important trends in the brewing industry.

The beauty is that it's a diverse and ever-evolving blend of art, science and innovation. There may be new trends and new beer styles that emerge in 2023 that are unpredicted and unprecedented. We can't wait to find out what they will be and hope you enjoy this edition!

EDITORIAL

by Brent Jordan

President & General manager, Lallemand Brewing

HOP BIOTRANSFORMATION BY BREWING YEAST

By Richard W. Molitor & Dr. Thomas H. Shellhammer,
Department of Food Science, Oregon State University

A FOCUS ON RELEASING POLYFUNCTIONAL THIOLS DURING FERMENTATION




While historically hops (*Humulus lupulus*) were added for their preservative properties and aroma and flavor was a side benefit, consumers' current interest in hop-forward styles like the IPA has placed aroma front and center in terms of hops' importance to beer. With upwards of 1,000 different aromatic compounds found within their essential oil fraction, hops contribute a broad range of aromas to beer ranging from woody and herbal to spicy and floral to citrus and tropical.^{1,2}

The importance of yeast in hop biotransformation

Regardless of beer style, yeast have a tremendous impact on beer flavor. While the main end products of fermentation are alcohol and carbon dioxide, yeast contribute a vast array of different fermentation byproducts, such as esters, higher alcohols, carbonyls, and sulfur containing compounds that contribute significantly to beer flavor. Yeast also have the ability to modify components coming from wort and/or hop-derived precursors via enzymatic biotransformations. These flavor precursors include fatty acids, carbonyls, glycosidically-bound terpene alcohols and cysteine-bound thiols. This last set of compounds, thiols, are currently the focus of much attention within the brewing community and the term "biotransformation" is most often referring to the release of free thiols from their odorless bound precursors.

Aroma potential of thiols in brewing

Thiols represent a broad class of aromatic compounds containing a sulfhydryl functional group (R-SH). While this classification contains many different compounds, three polyfunctional thiols have received considerable attention from brewing scientists:

-  **4-mercapto-4-methyl-pentan-2-one (4MMP or 4S4MP)** Black currant. Threshold: 6ng/L
-  **3-mercaptohexanol (3MH or 3SH)** Exotic, citrus, grapefruit. Threshold: 55ng/L
-  **3-mercaptohexyl acetate (3MHA or 3SHA)** Passion fruit. Threshold: 5ng/L

All three are extremely potent. For example, the sensory detection thresholds in beer of 3MH and 3MHA are 55 and 5 ng/L, respectively.³ These three compounds possess intense aromas such as boxwood and black current (4MMP), grapefruit and rhubarb (3MH) and guava and passionfruit (3MHA) and can contribute to a beer's fruity and tropical aroma profile.

While free thiols are found in hops and vary based on hop variety, they are accompanied by their odorless, bound, precursor forms, as cysteinylated- or glutathionylated- conjugates. Quite interestingly, the pool of thiol precursors is much larger than the free forms -- 100-1000 times larger in some instances.^{4,5} This huge pool of odorless precursors represents untapped aroma potential from these potent compounds, and this is where brewers and/or brewing scientists interested in hop biotransformation are currently fixated. Yeast possess the ability to

cleave the thiols from their precursors via a carbon-sulfur beta lyase enzyme thereby releasing thiol-driven aromas.

Enhancing the fruity characteristics of beer with yeast

If scientists and brewers can utilize the power of yeasts' biochemical pathways to release 3MH and 4MMP from their cys- glu- conjugate form(s), they can theoretically increase the fruity/tropical characteristics of beer. This is driving the recent attention on thiols specifically as they relate to biotransformation. Add to this is variability in yeast to esterify 3MH to 3MHA via acetylation⁶, which while equally important, does not rely on the same biochemical pathways as releasing thiols from their precursors, but is nonetheless a different type of biotransformation.

The search is on for yeast that have high beta lyase activity and for the best fermentation conditions, media/wort composition, and/or timing during fermentation or post fermentation to facilitate yeast releasing thiols from their bound precursors. Additionally, yeast vary in their ability to produce esters and it is likely that the interplay between esters, and thiols influence the hoppiness of beer beyond thiol production alone. Thankfully, the diversity of available yeast strains offer brewers a deep toolbox for creating interesting flavors.

Scan this code to read the full article with references



FOCUS ON THE LEADING AMERICAN MARKET WITH MITCH STEELE

Mitch Steele of New Realm Brewing Co. and chairman of the Board of Directors for the Georgia Brewers Guild shares his vision of the American market.

You have been through many stages of the brewing industry in the United States, what future trends do you think we should look out for?

It looks like IPA is still going to be the king of craft styles for the continued future, but also looks like lager brewing and lighter styles are taking a real stronghold. I always look to what brewers are gravitating towards, and right now, that's lager. Still, alternative beverages are being brewed by more and more traditional breweries. I told someone recently that yeast is the new hop, and what I meant by that is that brewers and beer drinkers are talking about the yeast strains with increasing frequency. In addition, the ongoing research into hop biochemistry and reactions in fermenting beer have given brewers new avenues to explore.

Do you think any of these trends will have permanency?

I think most of what I mentioned will. Not sure about the long term strength of ready-to-drink cocktails, they could fade fast like seltzers or be a major player for many years. Cold IPAs may follow the same trend of other IPA offshoots, I'm not sure about the staying power of that style yet, though I like them!

"I always look to what brewers are gravitating towards, and right now, that's lager"

What beers styles did your customers gravitate to this year?

We brewed an American Lager with the Rock Band Blackberry Smoke, and the response to that beer has been phenomenal. IPAs are still big for us, but we're seeing that our customers want choices, so we're doing many different beer styles and more lagers than I ever thought we would.

What beer styles most excite you to make?

Honestly, any style I've never brewed before, or a beer using a new yeast, hop or malt. I love being early to the game on innovation.

What is your favorite beer experience of all time?

I have so many, but I pick this one:

Shortly after I published the IPA Book, hop grower John Segal reached out to me and said he had a bottle of Ballantine Burton Christmas Ale brewed in the 1940s that was gifted to his late father in the 1960s. He wanted to share it with me. I had written extensively in my book about Ballantine, and also about Segal Ranch and their contribution to the popularity of the Cascade hop. He brought this incredibly rare beer with him to the American Hop Convention at Sierra Nevada in 2013, and we popped it open and shared it with several brewers that were there. It was nectar. It had lost some carbonation, but was smooth and flavorful as could be.

If there is one person you could have a beer with who would it be and why?

Ted Lasso.¹ I love Fuller's pubs, and would love to sit with him and Beard for a bit of time over good beers.

About Mitch Steele

Mitch has been brewing beer professionally for more than 34 years, studied brewing science at the University of California Davis and practiced home brewing prior to becoming a professional brewer. Since 1988, Mitch has managed brewing operations and innovation with four different breweries, including 14 years with Anheuser-Busch followed by 10 years at Stone Brewing in San Diego county. He managed brewing operations at Stone Brewing as they grew from a 50,000 bbl operation to one of the top 10 largest craft brewers in the country, operating 4 separate breweries in 2 countries.

In 2012, Mitch authored the Brewers Publications book *IPA: Brewing Techniques, Recipes and the Evolution of India Pale Ale*, and in 2014 the Brewers Association awarded Mitch with the prestigious Russell Scherer Award for innovation in craft brewing. In addition to his duties at New Realm Brewing Co., Mitch currently chairs the Brewers Association Supply Chain Sub-Committee and sits of the Board of Directors for the GA Brewers Guild.

¹: Ted Lasso is a fictional character from the eponym sports comedy-drama television series

BREWING-DISTILLING INTER-RELATIONSHIPS (OF THE YEASTY KIND)

By Prof. Graeme Walker,

Professor of Zymology, Abertay University, Dundee, Scotland

Brewing and distilling are sister industries

After all, as a Scottish distiller once told me: Beer is just whisky waiting to be made! There are many similarities, and of course some salient differences, between beer and spirits production processes. Nevertheless, the common denominator for all alcoholic beverages is yeast, most notably the species, *Saccharomyces cerevisiae*. This is the preeminent microbe responsible for bioconversion of starch and sugar substrates to ethanol, carbon dioxide and a myriad of secondary fermentation products that are collectively called flavour congeners.

There are many brewing strains of *S. cerevisiae* — no one really knows the total number, but I would guess there are several thousand ale brewing yeast strains (although not nearly so many *S. pastorianus* lager strains, which are the new kids on the block). However, for distilled spirits there is by comparison a very limited number of commercially available distilling strains of *S. cerevisiae* (e.g. only a handful for Scotch whisky producers). It goes without saying that choice of yeast strain for beers and spirits is of paramount importance, not just for ensuring efficient alcoholic fermentation of the sugar or starch based substrate of choice but also to ensure the final organoleptic characteristics and consistency of the beverage. In addition, careful consideration of strain purity, yeast management, handling, propagation and pitching are critical for both brewers and distillers, together with microbiological control to prevent undesired contamination by bacteria and wild yeasts.

Although distillers strive primarily to achieve high ethanol yields in the wash prior to distillation, like brewers, they also need to produce a flavoursome wash that will result in a flavoursome distillate. The exceptions to this are when distillers aim to produce so-called “neutral” alcohol destined for spirits such as gin and vodka. This is also a pertinent consideration for brewers aiming to produce a neutral alcohol base for hard seltzers. Therefore, both brewers and distillers should pay careful attention when selecting yeast strains for specific fermentation applications whether they be for a flavoursome or flavourless beer/wash.

The following comments aim to highlight selected areas, mainly relating to yeast and fermentation aspects, where brewers and distillers can learn from each other, with a particular focus on new developments in these respective sister industries.

What can brewers learn from distillers?

There have been some very interesting research and development initiatives over recent years that have benefited the distilled alcohol sector. The following represents a few selected examples that may potentially benefit future brewing practices.

- **Neutral alcohol producing yeasts:** As mentioned above, distillers producing neutral spirit destined for gin and vodka production, can select yeast strains that produce reduced levels of secondary fermentation metabolites (acids, alcohols, esters, etc.). Some commercial strains (eg. US corn ethanol plants) can routinely produce over 20% alcohol by volume following controlled fermentation practices (i.e. prior to distillation). Would this be of interest to brewers?
- **Yeast strain engineering:** The introduction of *S. cerevisiae* strains genetically engineered to produce starch-degrading enzymes such as glucoamylase have revolutionised corn-to-bioethanol production processes. These novel amyolytic yeasts could similarly lead to transformational changes in brewing and distilled spirits operations. Of course, some bioengineered yeasts have also been introduced to the brewing industry for sour beer fermentations, most notably **Mascoma Sourvisiae™**. Even [newer developments](#) in yeast gene editing and synthetic biology are on the horizon.
- **Climate positive beverages:** A Scottish craft distiller, **Arbikie**, has broken the mould in using the humble pea to produce the world's first [climate positive gin and vodka products](#). The use of legumes as adjuncts also for brewing has also found appeal since cultivation of such crops does not require application of environmentally-unfriendly fertilizers. For example, Barney's brewery [Cool Beans – faba bean IPA](#).

**What can distillers learn
from brewers?**

Scan this code to read the full article



LEARNING FROM 2022 TO BUILD 2023 WITH DR. INA VERSTL



Dr. Ina Verstl, German-based brewing publication, Brauwelt International's editor and author, gives her point of view on the pandemic's effect on the brewing industry, the challenges ahead and the major trends for 2023.

What were the biggest takeaways from the COVID years for the brewing industry?

When the world went into lockdown in 2020, there was widespread, near-hysterical fear that beer consumption would nosedive and thousands of small breweries would go out of business. Luckily, this doomsday scenario did not materialise. Brewers found ways and means to pivot their sales to the off-premise, their curb sides or their web shops, despite their facing all kinds of supply chain issues. Remember the container ship that blocked the Suez Canal in March 2021, which massively disrupted global trade?

Unfortunately, the cost-of-living crisis came hot on the heels of the pandemic. That's why I fear we could be stuck in crisis mode for years to come. How this will impact beer consumption, I can only guess. In recent weeks, there has been much talk about corporations using the cover of inflation to jack up prices by more than their own costs knowing consumers have come to expect a supersonic rise in shopping bills. An English friend of mine has joked that the "20-pound pint" is a real possibility in London. I do hope that brewers' price hikes in 2023 will be reasonable and not excessive.

What trends can you see lasting or becoming more apparent in the next few years for big brewers and craft brewers?

If there is one overarching trend that has been talked up by the big brewers, it is "Beyond Beer" (non-alcoholic and low alcoholic beers). Call me a spoilsport, but I have been wondering for a while if the eventual size of the Beyond Beer segment warrants all the hype around it. When the big brewers started snapping up craft brewers in the past decade, we were led to believe that a hike in their craft beer sales would boost the big brewers' sales overall. A decade on, the big brewers seem to have reverted to pushing big premium brands. Heineken is a case in point. The Dutch brewer is spending millions of dollars rolling out its Heineken Silver globally, not least thanks to having axed the number of focus brands that receive their TLC.¹ I suspect that despite all the talk

about Beyond Beer's diversity, the big brewers secretly still consider it as synonymous with non-alcoholic beer. And as we have seen, the growth in that category is far from limitless. AB-InBev admitted last year that they will miss their self-set target that by 2025 one in five of their beers should be low or non-alcoholic.

"If there is one overarching trend, it is Beyond Beer"

The craze for hard seltzer seems to be over in the US and nonexistent or not yet taken off elsewhere in the world – do you have any comments?

Personally, I fail to understand the appeal of hard seltzer. I did enjoy Zima, Sub Zero (does anybody remember them?) and plenty of alcopops when they came out in the late 1990s. They tasted like a soft drink and contained alcohol. They were naughty but oh so nice. I cannot say the same about hard seltzer. I can appreciate them as a cultural phenomenon, though. They caught on in some markets and floundered in others. In effect, they underline that any fears of a homogenous world, where all people have the same tastes, are unfounded. And that's a positive.

Tell us about a favorite and personal recent beer experience:

Christian Artzner, the founder of the Strasbourg craft brewery Perle, presented me with his advent calendar of beer, when I paid him a visit in December. It included several beers he had made in honor of the builders and craftsmen who helped build his new brewery. I thought these special releases were a really nice touch.

About Dr. Ina Verstl

Verstl was born in Munich and educated in England. She studied economics, philosophy and literature in Munich, Hull, and Oxford. Her doctoral thesis "The Quarry of the Self – Bildung and the Subversion of Identity" was accepted by the University of Zurich.

Until 1997, she was press officer at the Munich Trade Fair Corporation, one of the world's leading trade fair organisations. She has been a freelance journalist ever since and is currently a special feature writer and commentator for Brauwelt International.

¹: When you give someone extra compassionate, thoughtful attention, you provide TLC, or "tender loving care".

FOCUSING ON THE FUTURE OF THE BREWING INDUSTRY WITH MARK DREDGE

Mark Dredge is a beer writer and creator of the [BeerDredge](#) beer flavour wheels. He answered a few questions for us about his vision of where the industry is headed.

As a well-known beer writer with knowledge from history to sensory, what is your vision of the future of the industry?

I'm terrible at predicting the future of beer. I thought Hazy IPAs were a fad that'd last a few months and then disappear! How wrong was I?! There's definitely a few things that I think will be important in the coming years.

I think, and I hope, we see more great alcohol-free beer, especially in modern styles that we love (like the Hazy IPA!), and that we see them on draft more often. I already drink a lot of alcohol-free beer, and it's become something that I look for when I visit breweries and taprooms.

Speaking of taprooms, I think these are increasingly important as they can become a place that's more than just somewhere to get beer. They can become important social centres and develop a sense of community, where they bring people together. Around this, brewery-centred activities, like run clubs, yoga, craft classes, and so on, will be nice ways of bringing more people into breweries, and having them use the spaces in ways beyond just the beer.

What do you think will be the biggest beer style trends for 2023 and beyond?

I think the Hazy IPA revolution will continue, but we'll see more brewers experimenting with yeasts, hop varieties and brewing processes to give us different expressions of hops and fermentation. Alongside that, we'll see West Coast IPAs more prominently, both as an alternative to the hazy beers and also as a

throwback to the beers of a decade ago. We might even see a nostalgic interest in classic IPAs, which sees a renewal in those older brands.

More great lager is a trend I always seem to repeat, and it's clear that more brewers are focusing on great lagers today, and not just as a simple, refreshing beer to have in their taproom. Lager brewing has got serious. I like how there's interest in authentically recreating classic European styles, and serving properly in the correct glasses with lots of foam. But I also like how breweries are making their own versions of crisp light American lagers as well as IPLs, cold IPA and dry-hopped pilsners.

Beyond styles, I think we're seeing more interest in the service of beer. It's a challenging global economy right now, which might see more people drinking at home, so when we do go out to bars we'll go to places where they do a great job of the service, whether that's nice glassware, great staff knowledge, or by utilising special ways of serving beer: casks of ale that have been properly conditioned; side-pour faucets for lagers; and having smaller glasses for styles like Kölsch and Altbier. It's adding value and quality to the drinking experience.

Big industrial players have always led the market, but we see craft beer brewers more interested in producing lagers these days, what is your opinion on this?

This is one of the most exciting things to me in craft beer. I love great lager, and the great varieties of lagers that are made around the world. It's amazing to see brewers making their own versions of classic styles (especially if the brewers have spent time travelling to really learn about those styles and drink them locally in Europe), and also innovating by creating contemporary lagers.

It's also exciting to see brewers making use of classic brewing techniques like decoction mashes, and also installing taps to specifically serve these beers in the best way. No matter how well the beer is brewed, the service of it in bars will determine how well a drinker enjoys it.

Your recent book "Beer: A Tasting Course" is a wonderful example of a global movement of brewers and consumers wishing to educate themselves. What impact do you see this having on the beer industry as a whole?

Education is something I'm really passionate about in beer, and it's important across the beer industry, and not just for new drinkers. Even the most experienced drinkers and brewers should be looking at beer education and trying to learn how to speak with the people who might want to buy their beer.

For me, the simplest way to judge success in beer education is about whether someone gets the beer they are most likely to enjoy in that moment. If the consumer is able to describe that beer, and the person serving or selling the beer is able to understand that and make the right suggestions, then everyone is going to be happy.

I think all beer education should begin with a broad knowledge of classic styles. The [beer tasting book](#) is about understanding where flavour comes from, from each of the main ingredients and through brewing processes, and then describing how classic beer styles taste.

Scan this code to read the full interview and his bio



FERMENTATION, WHAT IS NEXT? WITH DR. LAURA BURNS



Discover what Laura Burns, a renowned scientist in the industry and Director of Research at Omega Yeasts, can teach us about the future of fermentation.

Your brewing journey has been very expansive, from production to working for a yeast company, what are some of the biggest takeaways or advice you can give to brewers?

Brewing is the best kind of experiment. Be observant. Track all of your brews and fermentations with meaningful data, isolate variables and pay attention to what you see, hear, taste and smell.

Of course, it's awesome when it goes perfectly, but when it doesn't, you still can learn something. If something seems off, it might actually be more interesting than you think.

"Genetic engineering is an extremely robust tool in many ways"

The North American beer scene is always seen as a trendsetter — what are your trend predictions for 2023? What styles would you like to see not be so trendy?

Trends... argh... I love a crisp lager or a kölsch and fresh takes on hop-forward styles. No doubt these trends will keep trending! Otherwise, I love seeing breweries putting efforts into bettering their communities and reducing their impact on the environment. Non-alcoholic options are a good example for providing a more inclusive beer drinking community. Continuing to see advances in the NA market will be exciting. Working towards more environmentally friendly beers, from sourcing raw materials closer to the brewery, using less water and CO₂, bringing in flavors from yeast, and shifting to more sustainable packaging materials. And if I were to drop a trend, it would be milkshake IPAs... I'd rather treat myself to a real milkshake.

You recently co-authored a paper for the MBAA TQ¹ on genetic engineering — what are the key takeaways from this paper?

One of the major goals for this TQ review was to provide a resource for people looking to further understand genetically engineered yeast. If readers take anything away, it is that we are here to help explain this. If you have questions, you can look to this review or write to any of the authors. We hope that it takes some of the mystery out of the process and helps provide brewers with the information to evaluate these products when deciding on whether or not to use them in their brewery.

Where do you see genetic engineering developing in the brewing industry?

I see genetic engineering as both a research tool and a breeding tool. Yeast companies have been successful in using genetic engineering to make brewing more economical and sustainable with yeast that make new flavors, make processes more efficient and reduce losses due to quality issues. For agricultural products like hops and barley, we have seen increasing drought and disease pressures with climate change. Genetic engineering can help narrow in on the genes that are

important in providing climate resilience and help develop more targeting breeding efforts. Genetic engineering is an extremely robust tool in many ways, and it has the potential to bring our industry solutions faster.

What beer style is your favorite to brew and to drink?

That is a super hard question for me, but I like a challenge. I really admire brewers that have perfected a lager or an English bitter. It takes really knowing your ingredients, process and yeast. My favorite beer to brew is probably a hoppy pale ale. No crystal, just a nice silky, bready, nutty base to put a spotlight on the nuances of the hops.

Who would you like to have a beer with and where?

Definitely overthinking this one. How about for a celebrity, Reese Witherspoon. For a scientist, Rosalind Franklin. But in reality, just some old friends that I don't get to see anymore!

About Dr. Laura Burns

Laura Burns, Ph.D., is the Director of Research and Development at Omega Yeast. After studying stress responses in *Saccharomyces cerevisiae* for her graduate thesis at Vanderbilt University, she decided the best place to apply this knowledge was in brewing. She worked in production brewing for five years as Head Brewer and Director of Quality Assurance before heading back to the bench at Omega Yeast. Her undeniable curiosity drives her to tackle difficult questions that brewer's face daily.

¹: Master Brewers Association of the Americas Technical Quarterly