LALLEMAND

LALLEMAND BREWING

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THE OFFICIAL NEWSLETTER OF ALL THINGS LALLEMAND BREWING!

WE BREW WITH YOU.™

DID YOU KNOW...

42% of beer aroma compounds are produced by yeast?

Yeast is fundamental to the brewing process. It is thought that 950 compounds are involved in giving beer its aroma and flavor — and 400 of them are produced by yeast. However, the brewing process itself is not ideal for their growth and development. When yeasts are under stress, it can result in off-flavors or sluggish, stuck fermentations. On the other hand, offering bountiful nutrients and pleasant growing conditions can lead to consistent, reliable fermentations.

EDITORIAL

Yeast, what's next?

In 1928, Dr. Alexander Fleming observed that a mold growing on a petri dish of *Staphylococcus* bacteria seemed to be preventing the bacteria around it from growing. He soon identified the mold produced a self-defense chemical that could kill bacteria. This casual observation laid the foundation for the exploration of a group of compounds, now known as antibiotics, that have made one of the biggest impacts on human health in the history of mankind.

We live in times where the future of our planet — and every living organism on it — is facing an uncertain, perhaps even an unsustainable, future. Fortunately, we have resources at our disposal that have so far been largely untapped and may well hold the answers to several of the challenges before us. Microorganisms such as yeast and bacteria present us with huge opportunities to craft solutions to many of the sustainability issues we face.

At a relatively simplistic level, the scientists at Lallemand have engineered the genome of a brewing yeast to produce large quantities of lactic acid, which is very useful for brewers of sour beers but hardly significant when it comes to saving the planet. And yet there is enormous potential for manipulating the genomes of yeast (and bacteria) to produce molecules with far greater potential benefit for mankind. The humble yeast, a symbiotic partner of the human species for millions of years, has been studied, dissected, and manipulated perhaps more than any other organism on the planet. A yeast cell is a factory simply waiting for mankind to 'tool it up' and provide it with the necessary raw materials to provide sustainable solutions to today's biggest issues.

Just ponder the factors causing so much concern, such as fossil fuel use — imagine if we could have our little friend, the yeast, arrange the necessary hydrogen and carbon atoms into the correct configurations and present us with building blocks for materials in the modern world that are currently fossil fuel based.

Today, pesticides damaging to pests also may harm innocent 'bystander' species. These pesticides can, in many instances, be replaced with crop 'bioprotectants', which are potent cocktails of naturally occurring microorganisms, including yeast and bacteria.

At Lallemand Brewing, we strive to usefully employ yeast and bacteria to make great beers. However, there is much more at stake.

by Brent Jordan
President & General manager, Lallemand Brewing

R&D Update **By Joan Montasell** Technical Sales Manager - Spain & Portugal

WHAT ARE THIOLS AND WHAT IS THEIR ROLE IN HOP BIOTRANSFORMATION?

The interaction between yeast and hops during fermentation, better known as hop biotransformation, is a complex process that is currently of great interest to the brewing community. This biochemical process encompasses many types of reactions, such as:

- **Esterification of hop compounds,**
- **hydrolysis of hop glycosides to release monoterpene alcohols,**
- **the release of polyfunctional thiols from a non-aromatic precursors.**[1]

(Source: Lallemand Brewing Best Practices Biotransformation)

These reactions are catalyzed by different enzymes produced by the yeast during fermentation. The β-glucosidase enzymes that release aromatic terpenes are well characterized in brewing yeast, and pure forms of this enzyme (i.e. **AB Vickers Aromazyme**) are available to boost this activity during fermentation. The β-lyase enzymes responsible for releasing thiols have been less studied but are gaining interest in the brewing community due to their ability to contribute unique, tropical fruity aroma profiles. This article introduces the reader to the basics of thiols and how they can be released using LalBrew® Premium dry yeast strains.

WHAT ARE THIOLS?

Thiols are a family of sulfur-containing aroma compounds naturally found in hops, either as free aroma-active volatiles or as non-aroma-active (i.e. non-volatile) precursors. They represent only 1% of the total hop oil composition and are categorized as the sulfur fraction. Despite their low concentrations, thiols have very low sensory detection thresholds, meaning they are perceived at exceptionally low concentrations.

The main aroma-active thiols are:

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

Because bound non-volatile thiols exist as an amino acid moiety, the liberation of thiols through β-lyase activity plays an important role during periods of nitrogen scarcity for yeast. Figure 1 demonstrates the primary liberation mechanism of β-lyase, wherein bound, non-volatile thiols are released through nitrogen-mediated enzyme expression of the *IRC7* gene. Lower nitrogen concentrations present in grape must promote *IRC7* expression, and, therefore, β-lyase activity tends to be high in wine fermentation. The higher nitrogen levels present in brewers' wort tend to repress *IRC7* gene expression and reduce β-lyase enzyme activity. To promote thiol production in beer fermentations, it is important to choose a yeast strain known to have high β-lyase activity.

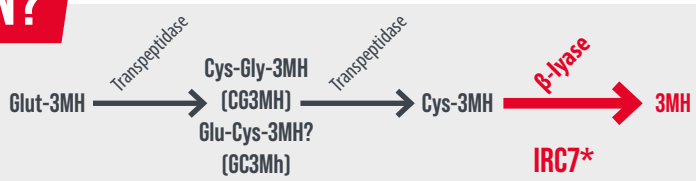

Figure 1. β-lyase enzyme mechanism and the *IRC7* expression. Not all brewing yeast have this ability. In this example, 3MH (an aromatic thiol) is released from a non-aromatic precursor.

WHICH STRAIN PRODUCES THE MOST β-LYASE ENZYME?

Each brewing strain has different enzymatic activities, suggesting that some are more suitable for releasing bound thiol precursors than others. At the Lallemand Brewing R&D Labs, we have characterized our LalBrew® Premium brewing yeast strains for β-lyase activity (Figure 2). By sharing this technical information, we provide brewers with tools to decide which strain would fit best in their recipes to promote thiol production.

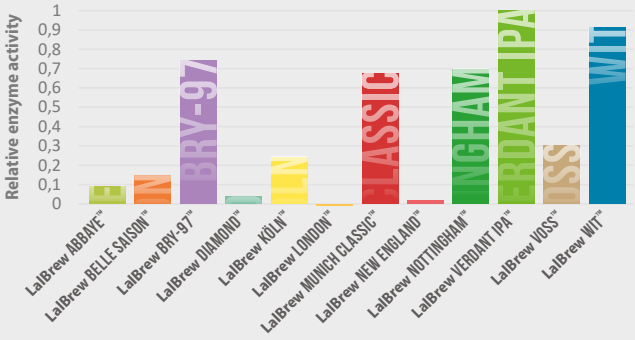

Figure 2. Relative biotransformation activities of β-lyase enzymes in LalBrew® Premium brewing yeast strains. β-lyase activity was measured by growth on selective media containing a specific sulfur-based precursor. *β-lyase activity was measured by growth

FUTURE TRENDS IN THIOLS?

Thiols are, despite their low concentrations, a fascinating group of aroma compounds that should be further explored in brewing. The wine industry has led the research on thiols and researchers are just beginning to explore β-lyase enzymes in the brewing industry. Recent research suggests thiol precursors are not only found in hops but also in malt (see the *bibliography* below), suggesting great potential for brewing yeast to release aroma compounds in beer from non-volatile precursors.

In addition, there are currently some solutions in the market based on ingredients containing a high concentration of precursors, such as grape skins, and some brewers are reviving older techniques, such as mash hopping and choosing hop varieties containing a high concentration of bound thiols (e.g. Cascade).

Brewers are always pushing boundaries in terms of new recipes and ingredients, looking for better quality beers and tropical-like flavors to attract customers. A greater understand hop biotransformation, thiols and β-lyase enzymes will certainly be a major contributor to brewing trends in the years to come.

BIBLIOGRAPHY

R&D Update **By Avi Shayevitz** R&D Research Associate

PERSPECTIVES ON THE FUTURE OF YEAST AND YEAST PRODUCTS

YEAST AS THE FOUNDATION FOR INNOVATION

Long-term scientific studies of *Saccharomyces cerevisiae* have revealed an astoundingly versatile, and malleable organism that has been used to advance human and animal health, produce commercially valuable compounds, and aid in the development of modern medical technology. One thing that should always be remembered, though, is almost all of this evolved from the human pursuit to brew better beer. So much so, that the science of microbiology itself was arguably founded to better understand and control spoilage in wine and beer. Companies like Lallemand Inc. continue this trend, delivering products for improved human health and quality of life, and (possibly most importantly) the production of high-quality beer and wine.

The key to innovative products stems from a company culture of information sharing. Business units like Brewing work closely with the interconnected R&D labs within Lallemand Inc., across multiple disciplines to develop a variety of novel products. The most exciting of which make use of cutting-edge genetic engineering techniques and computational biology.

WHAT WE CAN EXPECT FROM BREWING YEAST IN THE NEAR FUTURE

The manipulation and introduction of desirable traits using both hybridization and GMO techniques ensures widespread adaptation within the brewing industry to provide tangible benefits, such as significantly reduced aging time for lager beers, or safer and lower contamination risk among packaged beers. These technologies have led to the development of a non-*diastaticus* **LalBrew Farmhouse™**, and greatly contributed to the bioprospecting of new strains like **WildBrew Philly Sour™**. Other innovative approaches include non-GMO breeding to eliminate the production of hydrogen sulfide (H_2S) during normal fermentation.

Products such as **Mascoma Sourvisiae™**, **LalBrew Farmhouse™**, and **WildBrew Philly Sour™** emphasize key technological categories: bioengineering, non-GMO hybridization, and bioprospecting for the development of novel products. All of this made possible through the cooperation of all business units under the Lallemand umbrella. As brewing trends ebb and flow, the diverse array of people, technology, and yeast will continue to push innovation forward and into unexplored territories.

Siebel Institute of Technology Update **By Keith Lemcke** Education Consultant

BREWING EDUCATION IN A NEW AGE OF BEER

In the year 2000, the brewing industry in North America was poised to expand dramatically. After a "shake-out" period in the late 1990's when many craft breweries closed, the culture of craft beer caught on among consumers and sales began to boom. Initially, craft beer was mostly made with traditional ingredients and processes that were not much different than the more established lager beers, with pale ales, IPA's, stouts, and other familiar styles finding their way into brewery portfolios.

Today's brewing scene is a far cry different than 20 years ago. With more than 9,000 breweries across the USA, the very definition of what we call beer has become somewhat *fluid*. Drinkers still relish their all-grain beers with traditional yeast fermentation and a sense of balance, yet the excitement and, in many cases, profits, are being generated by innovative ideas of beer. Previously, we may have worked to make beer as clear as possible. Now, we strive to find ways to make styles like "hazy IPA" as consistently opaque as orange juice. Nurturing mouth-puckering sourness is now common brewery practice in sour beer production, as is the addition of lactose and ingredients like peanut butter and marshmallow. The "Anything goes!" reality of today's brewing environment makes for some great drinking experiences, but it also makes consistency and quality more difficult to achieve in these New World ideas of beer.

As America's oldest brewing school, Siebel Institute has always worked to stay on top of brewing trends so we can anticipate the needs of students who will be working in a highly diverse commercial brewing industry. Our faculty is composed of industry experts who bring complete understanding of established and emerging technologies to the classroom, and our co-workers at Lallemand Brewing provide in-depth understanding of yeast and fermentation control. While the definition of beer has evolved, breweries still need to rely on a *scientific approach* to making products that are high quality, shelf stable, delicious, and profitable. Siebel Institute has a 150-year history of helping students to define and maintain the benchmarks of beer quality, and we continue to uphold those standards in our campus and online courses.

Corporate Update **By Richard Chamberlin** Technical Sales Manager - Australia

BRINGING R&D TO AUSTRALIAN COMMERCIAL BREWERS WITH THE R&D SKID

During the height of the COVID-19 pandemic, breweries in Australia, like many around the world, found themselves having to drastically scale back or even halt production on their main kit. Whilst a challenging time for all, this created an opportunity that many would not have during regular production; the opportunity to carry out R&D test brews. The hurdle that remains for many, however, is having the investment to put into small scale brewing equipment.

WHAT IS THE R&D SKID?

Devised by the Australian Technical team at Lallemand Brewing, the R&D Skid is a small-scale, mobile R&D brewing facility that would be able to be deployed to any brewery in Australia to carry out these trials. The R&D Skid is born and consists of a 70-L, all-in-one brewing system with two 50L conical fermenters, glycol cooling, and full temperature control within a stainless-steel cabinet. Consideration was given to ensuring that connections, CIP, and setup were familiar and straightforward for commercial brewers of all sizes.

WHY IS IT INTERESTING FOR BREWERS?

Brewers are often cautious to change something as significant as the yeast strain for a core range beer. Being able to spin off 50L of wort from their main brew to the R&D Skid keeps the number of variables in the recipe and process to a minimum. The beers can then be assessed side-by-side and all performance parameters compared, including sensory characteristics of the final product. The inclusion of the all-in-one brewing system allows the brewer to assess how process changes can influence yeast performance and the final beer.

At the time of writing, the R&D Skid has assisted four breweries in the state of Victoria to trial and evaluate the performance of new Lallemand yeast strains including **LalBrew Voss™**, **LalBrew Farmhouse™** and **LalBrew Belle Saison™**. The unit has also been displayed at a brewing conference in Western Australia and is now set to be utilized by several breweries in the state before continuing its journey around other Australian states.

Homebrew update **By Natalie Anderson** Events & Logistics Marketing Manager

HOMEBREW CON – A RECIPE FOR FUN

If you've never been to **AHA HomeBrew Con**, you are truly missing out on one of the most fun events of the year. It's no secret the homebrew community plays a vital role in driving beer style evolution and innovation within the brewing industry, and HomeBrew Con is a showcase of this. For the event, we paired up with a local club., B.O.M.B. — or Band of Media Brewers homebrew club — and we poured members' beer exclusively at our booth. They used Lallemand Brewing products in their beers, and we were ecstatic to showcase the homebrewer's skills at our booth.

"Club Night" was an unforgettable party where we all used the theme "It's always sunny in Philadelphia" where B.O.M.B. held a tasting of 18 beers made with Lallemand yeast. One standout beer from club night was "A Love Letter to Chase Utley," which was a very well received sour saison made by Sean Mellody using a two-step fermentation process with **WildBrew Philly Sour™** followed by **LalBrew Belle Saison™**. Sean told us after the event "I was excited to brew this beer, it was brewed as a celebration of my 5-year wedding anniversary. I brewed the original recipe with **LalBrew Belle Saison™** for my wedding guests and was excited to brew this version with **WildBrew Philly Sour™**. I aimed for a balance of both yeasts to celebrate the style." What a beautiful way to celebrate an anniversary (and also one of the best beer styles!) The next AHA HomeBrew Con will take place in San Diego in 2023, and we cannot wait to be a part of the fun once more.