New Yeasts, New Beers: No New Beer Flavours (Part 1)

DESCRIBING FLAVOUR | Continuing our series on the topic Better Yeast, Better Beer, here we provide the first part of a three-part article explaining yeast's significant potential in developing revolutionary new beer tastes and flavours to meet rising consumer demands for innovative beer tastes. In part two, we examine the many variables that brewers can exploit to modulate yeast impact on beer flavour and aroma. And finally, in part three, we explore the idea of developing novel brewer's yeast strains, using classical non-GMO techniques, to help deliver better yeasts for better beer.

EXPERIENCING BEER has become a refined art for today's savvy beer drinkers. Terms like "hoppy" have been replaced with descriptors such as "menthol", "floral", "citrus", "woody aromatic" and "cream caramel" [1], to name a few. In fact, the palates of some beer enthusiasts are probably sophisticated enough that they could moonlight as professional sensory panelists. The divide between enthusiast and professional has narrowed remarkably, with many passionate beer drinkers ultimately starting up their own successful breweries [2].

The art and science of brewing has also become increasingly complex. While at its core brewing beer has remained unchanged for thousands of years, the modern brewer has at their disposal a deeper scientific understanding of brewing and fermentation, as well as advances in brewing technology that allow for precise control of the multitude of biological, environmental and chemical factors at work in the makeup of a beer.

And brewers need every bit of help they can get, too. As the beer industry (specifically the craft market) matures, so does the beer consumer. The beer consumer today not only has a more cultivated palate but also, and importantly, a greater level of direct engagement with breweries via social media and beer ranking websites [3, 4].

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GC-MS Technology

The question then becomes, how can brewers respond in order to satisfy consumers who are increasingly demanding high-quality choices with unique flavours and aromas? The most logical solution would be to empirically measure, and then modulate, the sensory profile of beer with an eye to meeting the most exacting of standards. Most breweries accomplish this through in-house trained sensory panels, but some of the more forward-thinking breweries also have the benefit of gas chromatography-mass spectrometry (GC-MS) technology.

Briefly, gas chromatography – the first step in the analysis – takes volatile chemical compounds from a beer and binds them to a substrate that is then heated. Since chemical compounds will disassociate from the substrate at different temperatures based on molecular interactions, this separates them from other compounds. These separated chemical compounds are then sent for mass spectrometry that identifies and quantifies the chemical compounds based on their mass-to-charge ratio.

In more beer-specific terms, GC-MS technology allows brewers to identify and quantify every chemical compound responsible for the sensory profile in beer, with a degree of accuracy and precision simply impossible even for the most well-trained sensory panel. Brewers can use this information to measure sensory consistency over multiple batches of beer, or to evaluate how changes in recipe/process may accentuate positive sensory compounds and/or mitigate negative ones.

Of course, the major barrier of entry for most brewers in using GC-MS technology is cost and complexity, as even standard GC-MS instruments can be prohibitively expensive to acquire, run and maintain. Larger breweries, although they may have the required capital resources, are often constrained by tight production schedules and their typically large number of batches. Meanwhile, smaller breweries that focus on craft styles would benefit greatly from the ability to identify novel sensory profiles, but are restricted by the resources required to properly leverage GC-MS technology.

Leveraging the Brewer's Expertise

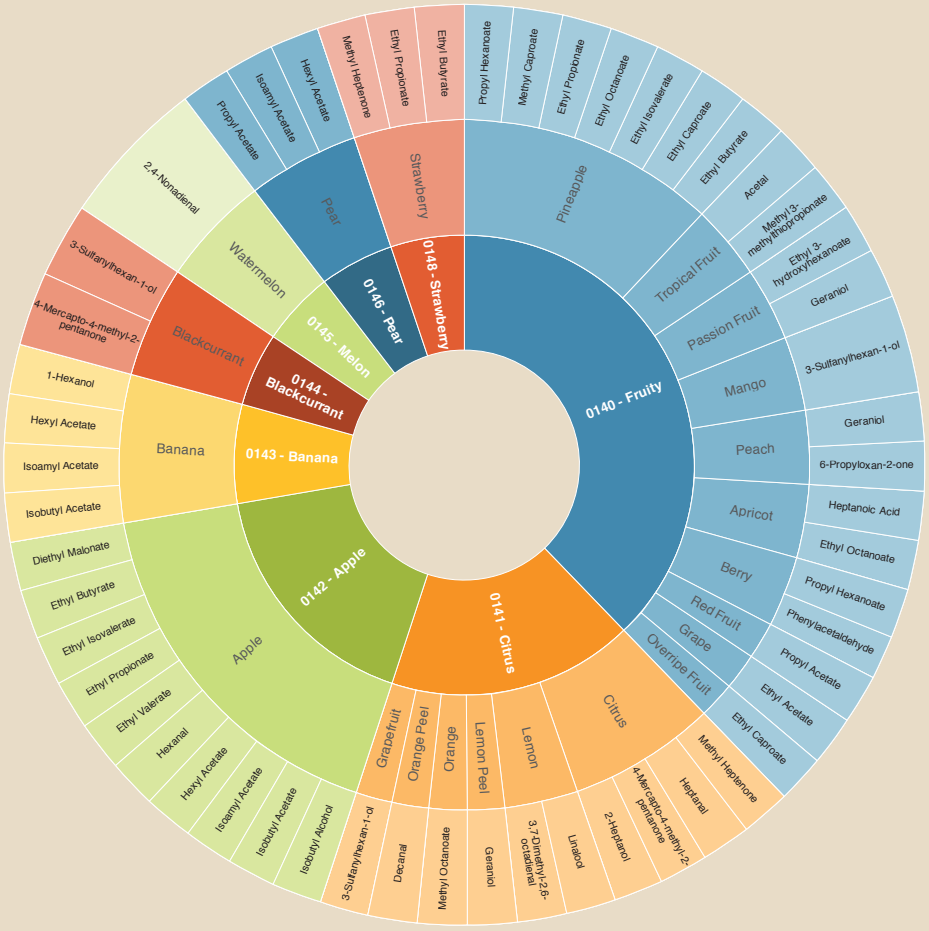
There is, however, an attainable middle-ground strategy: merge the power of GC-MS

n-GMO Technologies for

technology with the accessibility of the human nose and palate. By combining trained sensory panels with pre-existing GC-MS and bioinformatics processes, it is possible for brewers to turn their noses into a mini-GC-MS system by matching specific sensory descriptors to specific chemical compounds. To highlight this concept, we have chosen to reproduce the familiar Meilgaard et al. [5] flavour wheel – broadly used in beer sensory analysis – specifically for yeast-derived chemical compounds.

Brewer's yeast (*Saccharomyces cerevisiae/pastorianus*) is the major driver of the sensory profile of beer and, arguably, picking the right yeast for fermentation has far greater consequences in the final sensory profile of beer than hops or malt. Most importantly, *Saccharomyces cerevisiae* is one of the most well-studied organisms on the planet: every chemical compound derived from yeast metabolism, as well as what genes and (most importantly for brewers) what environmental conditions drive their production, are well known.

Leveraging this information, we have created a database of all yeast-derived "sensory-active" compounds. Specifically, chemical compounds found in or produced by *S. cerevisiae* were compiled from the Yeast Metabolome Database [6] (curated by Genome Canada) and matched with chemical data from the PubChem Project [7] (curated by the US National Institutes of Health), and descriptors from the US-based Flavor Extract Manufacturers Association [8]. In total, 16 402 yeast-derived chemical compounds were analyzed, and pared down to 183 that contained descriptors, with 510 unique chemical compound-descriptor combinations. Descriptors were then assigned to groups based on Meilgaard et al. to produce a yeast-derived flavour wheel.



Yeast Flavour Wheel

A Yeast-Derived Flavour Wheel

For the sake of legibility in print, the flavour wheel published in this article contains only chemical compounds grouped under 140 – Fruity with a tier 2 classification. However, the entire database and high-resolution flavour wheel are available by contacting Bright Brewer's Yeast Inc. at hello@brewingbright.com. Using the yeast-derived flavour wheel is essentially like using standard beer flavour wheels, and is perhaps most informative when read from the inner ring outward.

For example, a brewery runs a beer through its sensory profile, notes pineapple and wishes to exaggerate this sensory attribute. Based on the yeast-derived flavour wheel, five of the compounds associated with pineapple descriptor are ethyl esters (ethyl propionate, ethyl octanoate, ethyl isovalerate, ethyl caproate and ethyl butyrate). A quick search of brewing literature reveals increasing temperature will have a positive effect on these ethyl esters, whereas increasing sugar concentration would have a more moderate effect [9].

Conclusion

This is just one example that solidifies yeast's contribution to the sensory profile of beer and illustrates how brewers can leverage yeast metabolism via environmental (recipe/process) control to achieve their desired results. In fact, in the same way that hop farmers and maltsters have control over their respective ingredients, yeast is the only ingredient over which brewers have complete control. By using tools such as the yeast-derived flavour wheel, brewers can make more informed and directed changes to their brewing that will not only produce more consistent, higher-quality beer, but will also provide greater control of the finer points of yeast fermentation. The result is new and exciting beer styles that will appeal to the vast and rapidly evolving array of sophisticated consumer tastes.

The next part of this series will be published in BRAUWELT International No. 6, 2018. Its focus will be on the variables under the brewer's control that can drastically change the sensory profile of a beer.

Sources

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