TOPIC: PRODUCT INNOVATION, QUALITY

EFFICIENT APPROACHES TO IMPROVE NO- AND LOW-ALCOHOL BEER PRODUCTION

10 min read

Only a few years ago, the rapid rise of the no- and low-alcohol beverages category across the globe was big news. Today, it's a widely accepted fact. According to IWSR, the sector is now valued at approximately USD 13 billion and is expected to grow at a compound annual growth rate (CAGR) of 6% between 2023 and 2027 in 10 key markets. In Europe, for instance, 29% of consumers have purchased no- and low-alcohol drinks in the past year – compared to 37% who have bought alcoholic drinks. Younger drinkers–Gen Z are leading the charge in non-alcoholic purchase penetration, indicating that this trend is unlikely to slow down anytime soon.[1]

In this landscape, no- and low-alcohol beer (NABLAB) often emerges as a key component of the no- and low-alcohol beverages category. A recent report from the British Beer and Pub Association revealed that NABLAB is now the UK's fastest-growing beer segment. By January 2024, 87% of pubs across the country were offering at least one NABLAB option, either in bottles or cans, and 8% now even have it on draught—up from just 2% at the end of 2019.[2] The no- and low-alcohol category is poised for continued strong growth in North America, too, fueled by the increasing trend toward moderation.[3] As its growth is set to continue, NABLAB products should be top of mind for brewers of any size.

NABLAB PRODUCTION

Lower-alcohol beer can be produced through various methods, including limiting fermentable sugar formation during mashing, halting fermentation before all sugars are converted, using yeast strains unable to ferment certain sugars, and removing alcohol via vacuum distillation or membrane filtration.

Each of these methods has particular advantages and disadvantages. For instance, stripping alcohol from fully fermented beer via reverse osmosis or vacuum distillation can cause a significant loss of flavor and aromatic compounds. These processes are also capital-intensive, requiring specialized equipment that is often beyond the reach of smaller brewers.

Using maltose-negative yeast, on the other hand, allows for the production of fully fermented lower-alcohol beers. Maltose-negative yeasts are strains that cannot metabolize maltose and maltotriose, the primary sugars that conventional yeast convert into alcohol. Because they cannot process these sugars, maltose-negative yeasts are capable of fully fermenting the wort while producing only minimal amounts of ethanol. This derives from the conversion of simpler sugars like glucose, sucrose, and fructose, which are present in smaller quantities in the wort. A disadvantage of this option is the fact that the finished beer will have considerable levels of maltose present, which can become a microbiological stability concern for the packaged or kegged beer, which, in turn, will require careful pasteurization. Maltose-negative yeasts include strains of *Saccharomyces*, such as *Saccharomyces chevalieri*, as well as a variety of alternative yeast species, including *Saccharomycodes ludwigii*, *Torulaspora delbrueckii*, *Zygosaccharomyces lentus*, *Metshnikowia reukaufii*, and *Pichia kluyveri*.[4]

The primary advantage of this approach, on the other hand, is its cost-effectiveness; it simply involves replacing conventional yeast without requiring additional brewing equipment, making it accessible to smaller craft brewers—and even homebrewers—with limited budgets.

This solution is also regarded as more sustainable: “in a conventional fermentation, all sugars must be metabolized, generating significant heat that requires cooling, resulting in high energy consumption,” says Olaf Morgenroth, Head Brewer at France-based fermentation solutions firm Fermentis. “In contrast, using maltose-negative yeast allows for a shorter fermentation time—typically just one or two days—during which maintaining a consistent temperature is the main requirement. This is a substantial benefit of this method. If you produce NABLAB through vacuum distillation, that consumes a lot of energy too, and also increases your water usage.” Further information on this work is available from the 2024 World Brewing Congress.[5]

“From a sustainability standpoint,” adds Mike Gerhart, Senior Advisor, Technical Services at First Key Consulting, “this reduced metabolization of sugars also results in far less carbon dioxide production which is routinely off gassed during fermentation in smaller breweries commonly using these yeast.”

Furthermore, these yeasts produce less or no alcohol in the first place. This allows breweries to simply avoid the complexities of alcohol management—such as storage, disposal, reprocessing, or repurposing of the alcohol removed—which helps streamline their production process and reduce costs.

The numerous benefits of using maltose-negative yeast have led major yeast providers, including Fermentis itself, Lallemand, and White Labs, to incorporate these yeast strains into their portfolios. Fermentis offers SafBrew™ LA-01, for instance, a *Saccharomyces cerevisiae* variant of *Saccharomyces chevalieri*, while Lallemand provides a *Saccharomyces cerevisiae* strain. “Our LoNa™ is a top fermenting yeast that performs exactly like any other ale yeast: the only difference is that it does not convert maltose into alcohol,” explains Carlos de la Barra, Technical Manager at Lallemand. “It produces a clean and neutral aroma profile, so it’s suitable for a range of different styles.”

While several examples are already available commercially, the increasing interest in this area is driving research aimed at overcoming some of the current drawbacks of maltose-negative strains and developing new expressions to better meet the growing market demand.

New research also aims to provide the global brewing industry with a wider range of options to meet the diverse needs of brewers. As noted by researchers at the University of Arkansas, “NABLAB yeasts are not one-size-fits-all and will produce different metabolites.” [6]

GOING LOWER

A major drawback of maltose-negative yeast is its inability to produce 0.0% alcohol beer—a particularly notable limitation given the worldwide popularity of the no-alcohol category. In the U.S., for example, no-abv beer and cider account for 81% of servings in the no- and low-alcohol segment and saw a volume increase of 30% over the past year.[7] "Maltose-negative yeasts generally produce 0.4-0.8% ethanol," explains Satoshi Maeda, a researcher at Asahi Breweries. "This comes from the small amount of sugars other than maltose and maltotriose present in the wort, so to produce 0.0% non-alcoholic beer using these yeasts, it is necessary to use some specific equipment."

To tackle this issue, Maeda is developing a non-*Saccharomyces* culture capable of producing beer with an ethanol content as low as 0.05% ABV, which would qualify as no-alcohol beer in most markets. "We tested 11 strains of *Kluyveromyces lactis* suitable for NABLAB production and found one that can make 0.0% beer with good flavor without the need of special equipment," he says. However, the process Maeda is working on presents a crucial downside. Unlike other maltose-negative strains, his *Kluyveromyces lactis* strain does not assimilate any types of saccharides—glucose and fructose included. As a result, the finished beer is comparatively sweeter than if it were fermented with conventional maltose-negative yeasts. "The issue is that the end product is quite sweet, which is a significant problem," he admits. "You can balance sweetness with the hops, but I haven't gone down this route yet. We are still doing trials."

Fermentis has been exploring an alternative method to counterbalance overly sweet beer fermented with maltose-negative yeast. "Maltose-negative yeast leaves a lot of maltose in the beer, which contributes to its sweetness, so we have to find a way to balance this," says Morgenroth. "Just like cooking, it all comes down to adjusting flavors and tastes, and in this case, we aimed to counteract the sweetness through kettle souring." To produce his low ABV sour, Morgenroth added lactobacillus to the kettle, which he maintained at a temperature of 37°C for about 36 hours. The lactobacillus metabolized the sugars and produced lactic acid, which helped lower the pH. "This process introduced a slight sourness to the wort, which we then boiled and fermented. In the end, we got the sweetness from the maltose, balanced by the sourness of the lactic acid." Brewers can also preemptively lower the pH of wort prior to fermentation with lactic or phosphoric acid. Not only does this help offset the sweetness in the final product, but it allows the beer to finish with a pH of around 4.2, which otherwise would not be possible given the reduced fermentation occurring with a maltose-negative yeast.

SPECIALTY MALTS AND ADJUNCTS

In an effort to enhance the organoleptic properties of NABLAB made with maltose-negative yeasts, a research team at the Innovation Centre for Brewing & Fermentation at Ghent University in Belgium has been examining commercially available strains in combination with alternative grains.[8] The team produced test beers using blends of barley with oat flakes, rye malt, buckwheat, Einkorn wheat, and Khorasan wheat and compared them to 100% barley recipes. The test beers were brewed on a 20-liter scale and fermented with three different maltose-negative yeasts: SafeBrew LA-01™ from Fermentis, SMARTBEV™ NEER® Punch by Novonesis, and WLP603 by WhiteLabs. "This approach enabled us to evaluate the effects of replacing barley malt with selected alternative ingredients on the final quality of NABLAB and to assess compatibility with maltose-negative yeasts," says Elia Myncke, the study's lead researcher. "Our research resulted in the development of NABLAB with distinctive properties and appealing characteristics, including lower alcohol content, of course, but also enhanced fullness, higher protein content, improved foam stability, increased viscosity, and diverse flavor profiles."

More ongoing studies are examining new methods and solutions to support brewers in producing NABLAB through alternative yeasts. A recent investigation by the Polytechnic University of Marche created NABLAB using low-sugar wort sourced from brewers' spent grains in combination with non-conventional yeasts, with satisfying results from an organoleptic perspective.[9] Another recent study published in the academic journal *Fermentation* successfully trialed a *Saccharomyces cerevisiae* strain (CCM 9181), typically used for winemaking, to produce a fully fermented 0.5% ABV beer. The paper claims that this strain is suitable for large-scale commercial production of NABLAB and may even exhibit probiotic properties.[10] Meanwhile, a collaboration between various Finnish institutions and Italy's University of Perugia investigated new maltose-negative strains found in sourdough cultures. This effort led to the identification of 56 yeast types from ten different species, all showing promise for fermenting low-alcohol beer.[11]

A recent study by the University of Arkansas, in collaboration with VLB Berlin, explored the use of rice as an adjunct in NABLAB production. The report highlighted how rice can help reduce the worty character of the finished beer.[12]

In addition to academic research, private laboratories are also actively innovating in this field. "The yeast we currently offer at Lallemand is fairly neutral," says De La Barra. "So, the next step for us is to focus on developing maltose-negative strains tailored for specific styles, such as low-alcohol lager." Lallemand expects to be able to launch one of such products in the next six to twelve months.

By that time, the world of maltose-negative yeast and NABLAB is likely to showcase even more exciting innovations. "The larger breweries can afford dealcoholization techniques, so these aren't going away," Myncke points out. "However, dealcoholization strips away not only the alcohol but also the aromas, plus small breweries cannot typically afford these techniques. That's why I think the future of NABLAB will certainly involve a combination of dealcoholization and low alcohol yeast, an area where improvements to enhance the quality of the finished product are continuously being made."

Whatever approach breweries choose to adopt, new technologies and scientific advancements alone won't necessarily lead to success: a well-planned, holistic strategy is essential to ensure that any new product positively enhances brand image, financial performance, and green credentials too. "Creating NABLAB goes beyond simply implementing new technology," says Gerhart at First Key, "it requires a comprehensive understanding of how each choice affects the entire brewery. From sourcing raw materials to fermentation and yeast management, pasteurization, stabilization, side-streaming, effluent, and utility consumption, every aspect must be carefully considered to maintain quality, efficiency, and sustainability throughout the entire process."

Dr. Jacopo Mazzeo

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[1] https://www.innovamarketinsights.com/trends/no-alcohol-beverage/; https://www.mintel.com/insights/food-and-drink/gen-z-sober-curious-generation/

[2] https://beerandpub.com/news/low-and-no-beer-is-now-the-fastest-growing-beer-category-in-the-uk/

[3] https://www.theiwsr.com/whats-driving-the-growth-of-no-alcohol-in-the-us/

[4] https://www.mdpi.com/2311-5637/8/6/273; https://www.mdpi.com/2076-2607/11/2/316

[5] Eduardo Liza-Diaz, et.al. "Crafting Distinctive NAB: Worty Flavor Mitigation through Kettle Souring and Dry Hopping Techniques", WBC 2024.

[6] Andrew Maust, Rahul Sen, Scott Lafontaine, "Evaluating Commercial Non-Alcoholic Yeast Strains For Their Impact on Sensory and Chemical Properties in Beer", WBC 2024.

[7] https://www.theiwsr.com/whats-driving-the-growth-of-no-alcohol-in-the-us/

[8] https://biblio.ugent.be/publication/01H3VZM9XF35FFE8XD1SY7NDC4

[9] https://www.sciencedirect.com/science/article/pii/S0023643823011076?via%3Dihub

[10] https://www.mdpi.com/2311-5637/9/9/805

[11] https://doi.org/10.1016/j.fm.2020.103629

[12] "On the Effect of Varying Barley Malt and Rice Portions in Non-alcoholic Beer Production", WBC 2024.