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Researchers in Iran Raise Yeast Biomass to 100.04g/L by Optimizing Culture Conditions

The team screened 54 indigenous yeasts and reported 7.01g/L of carbohydrate in an extracted cell-wall fraction.

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Researchers in Iran have found that culture conditions can significantly change how much biomass and cell-wall material some indigenous strains of Saccharomyces cerevisiae produce, according to a study published September 23 in Scientific Reports.

The work focused on improving production of yeast biomass and an alkali-insoluble cell-wall fraction, a material that can contain substantial amounts of beta-glucan and is used in a range of food and biotechnology applications.

The study was carried out by scientists from Ferdowsi University of Mashhad, Javaneh Khorasan Company, the Research Institute of Food Science and Technology, and the Agricultural Sciences and Natural Resources University of Khuzestan. The team screened 54 previously isolated yeasts collected from diverse natural sources and narrowed the group to four S. cerevisiae strains for more detailed testing after identifying them as strong biomass producers.

Saccharomyces cerevisiae is one of the best-known industrial yeasts. It is widely used in food processing and fermentation, and it is also a common source of cell-wall components that can be separated and processed for other uses. In this study, the researchers examined how three variables in the culture medium and process design affected output: glucose, ammonium sulfate, and inoculum size, or the amount of yeast used to start the culture.

To sort through those variables, the team first used a Plackett-Burman design, a screening method often used to identify which factors matter most, and then used response surface methodology to refine the conditions. Under one selected set of cultivation conditions, the researchers reported a biomass concentration of 250.01g/L in wet weight and 100.04g/L in dry weight. They also measured 7.01g/L of total carbohydrate in the extracted alkali-insoluble cell-wall fraction, expressed as glucose equivalents.

The authors were careful to note that this carbohydrate figure should not be treated as a direct measurement of purified beta-glucan. They said the phenol-sulfuric acid assay used in the work is non-specific, which means it measures total carbohydrate equivalents in that extracted fraction rather than isolating one polysaccharide alone. That distinction matters because beta-glucan is often the component of greatest commercial interest, but this study did not claim a direct purified beta-glucan yield.

The paper also included microscopy work to examine how the selected yeasts looked under the tested conditions. Scanning electron microscopy showed dense clusters of cells with mostly oval-to-round shapes and generally intact surfaces, which the researchers said matched the typical morphology expected for S. cerevisiae.

The team then looked at how the yeasts responded to stress conditions that can affect survival and performance. When 5% sorbitol was added, biomass fell by about 18%. Under 0.005% SDS, a stronger chemical stress, biomass declined by 36%. Viable counts also dropped. The control culture measured 9.07 Log CFU/mL, compared with 8.83 Log CFU/mL under sorbitol and 8.20 Log CFU/mL under SDS. Those results suggest that the selected strains maintained a degree of tolerance, but not without losses in growth and viability.

The researchers also moved beyond flask-scale work and tested the process in a 3L stirred-tank bioreactor with a 1L working volume. There they compared two common downstream drying methods, spray drying and freeze drying, to see how each one affected recovered material and live-cell survival. Spray drying produced a higher recovered dry powder concentration, 144.75±2.90g/L, versus 125.12±2.50g/L for freeze drying. But freeze drying performed better when the researchers looked at viable-cell recovery after rehydration and 24 hours of incubation. The paper reported 0.2×10^9CFU/mL for freeze drying and 0.9×10^8CFU/mL for spray drying.

That tradeoff is important for manufacturers because yield and cell survival do not always move in the same direction. A process that produces more dry powder may not preserve living cells as well, while a gentler method may protect viability at the cost of lower immediate powder recovery. The authors described the bioreactor findings as preliminary feasibility evidence under the tested conditions rather than a fully optimized industrial process.

They also said more work is needed before the approach can be considered ready for broader scale-up. Among the issues they identified were oxygen transfer, hydrodynamics inside the reactor, reproducibility, and scalability. Those are standard but significant hurdles in industrial fermentation, especially when promising results from small systems are moved into larger and more complex production settings.

Although the paper did not focus on beverage manufacturing, the findings could still draw interest from that sector. S. cerevisiae is central to beer, wine, and spirits production, and improvements in yeast biomass generation or recovery of cell-wall fractions could eventually have relevance for fermentation management, starter culture production, or the handling of yeast-derived materials such as lees-related fractions used in some winemaking processes. Any direct industrial use in beverages would still require additional validation under commercial fermentation conditions.

The article adds to a broader effort to identify yeast strains that are both productive and resilient, especially strains sourced from local environments rather than standard industrial collections. By combining strain selection with statistical optimization of the growth medium, the researchers aimed to show that output can be improved without relying on a single commercial strain. The work was received by the journal on September 22, 2025, accepted on September 14, 2026, and published online on September 23, 2026. The authors declared no competing interests.