EVALUATION OF THE POTENTIAL OF YEAST STRAINS FOR USE IN SOURDOUGHS

Honchar Y.R.[1], Naumenko O.V.[2], Chizh V.M.[2], Marynchenko L.V.[1, 2]
[1]National Technical University of Ukraine
[1]"Igor Sikorsky Kyiv Polytechnic Institute", honchar.yelyzaveta@lll.kpi.ua
[2]Institute of Food Resources of the National Academy of Agricultural Sciences of Ukraine

Abstract
This study assessed four pre-isolated Saccharomyces cerevisiae strains for sourdough suitability, focusing on fermentative capabilities, osmo- and thermotolerance. Results revealed robust fermentation of diverse sugars and resilience under adverse conditions, indicating promising prospects for efficient and consistent sourdough production.
Keywords: *sourdough, Saccharomyces cerevisiae, fermentation, osmotolerance, thermotolerance.*

Introduction. Bread is by far the most significant food product for most people, and its production is almost a form of art, that is more than 5,000 years old [1]. Traditional bread sourdough consists only of water, flour, and microflora obtained naturally – from the ingredients and the environment. Lactic acid bacteria and yeast are typical representatives of microorganisms associated with sourdoughs. The most common yeast species is *Saccharomyces cerevisiae* [2].

The production and maintenance of sourdoughs requires daily meticulous work. Still, they have numerous advantages: bread made with sourdough has a higher content of vitamins B1 and B2 [3,4], and minerals Ca, K, Fe, Zn, and P [5]. It contains an elevated amount of antioxidants [6] and makes the bioavailability of biologically active substances higher [5]. Yeast and lactic acid bacteria boost the safety of bread due to their antimicrobial [7] and fungicidal properties and can also help detoxify mycotoxins [8].

While sourdough offers distinct advantages, large-scale bread production often prioritizes speed and cost-effectiveness. This is partly due to the inherent variability of sourdough, which makes standardization difficult. The specific microbial consortium within a sourdough, along with its interactions with flour and water, significantly impacts the final product. For instance, yeast activity during fermentation produces CO_2 and ethanol, both crucial for bread quality. CO_2 bubbles give bread its rise and airy texture, while ethanol affects dough rheology, making it stiffer and less extensible [9]. Additionally, yeasts contribute to the unique flavor and aroma of bread through the production of aroma precursors [10].

Since nutrient availability and yeast strain selection influence metabolite production, sourdough success hinges on choosing the right microorganisms. The strains must be well-suited for baking and deliver the specific characteristics manufacturers desire in the final product. Therefore, this study investigated the potential of *S. cerevisiae* strains for sourdough applications.

Materials and methods. Yeast strains were selected by the screening method from spontaneous rye sourdoughs. Four strains were identified as representatives of the *S. cerevisiae* species.

An experiment was conducted to evaluate the ability of strains to ferment different types of sugars using Dunbar tubes, that contained a nutrient medium with 0.5% yeast extract and 2% sugar (4% in the case of raffinose). The tested sugars used are glucose, raffinose, galactose, sucrose, maltose, trehalose, and lactose. The yeast culture was grown for 28 days at a temperature of 26-28°C. The ability to ferment was determined by assessing the degree of displacement of the medium from the fused part of the tube. For comparison, a negative control was used - medium without any sugar.

The osmophilicity was assessed visually by observing the presence of growth on a medium with 50% glucose, of the following composition: yeast extract - 5 g/l, glucose - 500 g/l, and agar - 20 g/l, as well as on a medium with 10% sodium chloride, with the following composition: NaCl - 10%, glucose - 5%, YNB (Yeast Nitrogen Base) - 0.67%. Cultures were grown at 25-26°C for 14 days.

Thermotolerance was determined visually by the presence of growth of cultures on Sabouraud's agar medium after 3 days of cultivation at a temperature of 37°C.

Results and discussion. The isolated yeast strains (Nos. 1-4) displayed remarkable fermentative abilities across a range of carbohydrates, as evidenced by their complete displacement of the medium from the Dunbar tubes (Table 1) for glucose, sucrose, maltose, raffinose, and galactose. This broad substrate utilization signifies their potential effectiveness in sourdough fermentation, where they can efficiently contribute to the rise and flavor development of the dough through the production of carbon dioxide for leavening, and organic acids and aroma compounds that enhance the sensory profile of the bread. Notably, the strains were unable to ferment trehalose and lactose, suggesting specific limitations in their enzymatic repertoire.

Table 1. The activity of strains in the fermentation of various carbohydrates ("++++" - complete displacement of the medium from the Dunbar tube; "-" - the complete absence of fermentation)

Yeast strain	Carbon source						
	Glucose	Saccharose	Maltose	Raffinose	Trehalose	Lactose	Galactose
No. 1	++++*	++++	++++	++++	-	-	++++
No. 2	++++	++++	++++	++++	-	-	++++
No. 3	++++	++++	++++	++++	-	-	++++
No. 4	++++	++++	++++	++++	-	-	++++

Furthermore, all strains exhibited thermotolerance and osmophilicity, crucial traits for thriving in the demanding environment of sourdough fermentation. This tolerance ensures their viability and function under the combined stress of elevated temperatures and high concentrations of sugars and salts, which are naturally present in flour or added according to specific bread recipes. These stressful conditions can hinder the activity of less robust strains, potentially compromising the consistency and quality of the final product.

Conclusions. The isolated yeast strains possessed a compelling combination of traits – extensive carbohydrate fermentation activity, thermotolerance, and osmophilicity. This synergy suggests their exceptional suitability and potential effectiveness for sourdough fermentation and various baking applications. Their broad substrate utilization promises efficient fermentation, while their stress tolerance ensures consistent performance even under challenging conditions encountered in sourdough fermentation. These findings warrant further investigation into the specific fermentation profiles and dough-leavening abilities of these strains to fully establish their value in the baking industry.

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