Evaluation of Lipase Production, Lipid Accumulation and Biosurfactant-Producing Potential in Yeast Strains

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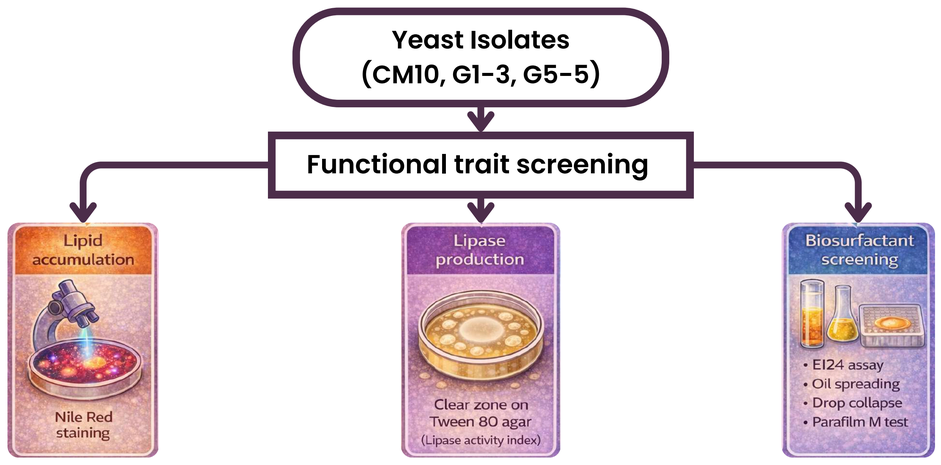
Abstract

The capacity of yeasts to produce extracellular lipases, accumulate intracellular lipids, and synthesize biosurfactants makes them attractive candidates for integrated lipid-based bioprocesses in the food and biotechnology industries. This study aimed to preliminarily assess lipase activity, lipid accumulation, and biosurfactant-producing potential in three yeast isolates (CM10, G1-3, and G5-5), with reference strains included as controls, using qualitative screening approaches. Lipase activity was screened on Tween 80 agar and expressed as a halo-based lipase activity index. CM10 exhibited the highest activity (8.53 ± 0.12), followed by G1-3 (3.95 ± 0.08) and G5-5 (3.42 ± 0.07). In contrast, the reference strain *Yarrowia lipolytica* TISTR5212 showed minimal activity (0.09 ± 0.04). Lipid accumulation was examined using Nile Red staining and fluorescence microscopy. Intracellular lipid bodies were observed in CM10, G1-3, and G5-5, whereas the lipid-negative controls (*K. marxianus* DMKU3-1042 and *S. passalidarum* CMUWF1-2) showed no evident accumulation. Biosurfactant production was assessed using the emulsification index at 24 hours (EI24), together with oil spreading, Parafilm M, and drop collapse assays. The positive control (1% SDS) showed the highest EI24 (65.63 ± 3.13%). Among the isolates, G1-3 (49.43 ± 1.99%) and G5-5 (42.53 ± 1.99%) demonstrated moderate emulsification, while CM10 showed lower EI24 values (31.36 ± 2.97%). Overall, the evaluated isolates exhibited distinct functional profiles in lipase activity, lipid accumulation, and biosurfactant-related traits.

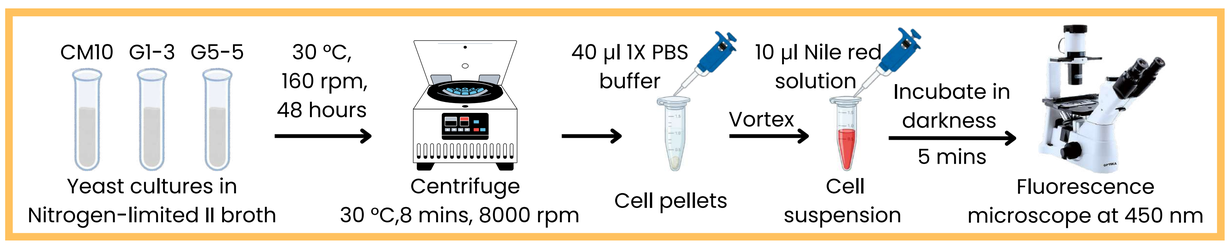
Objectives

1. To evaluate lipid accumulation, and lipase production in yeast isolates
2. To assess the biosurfactant production potential of yeast isolates

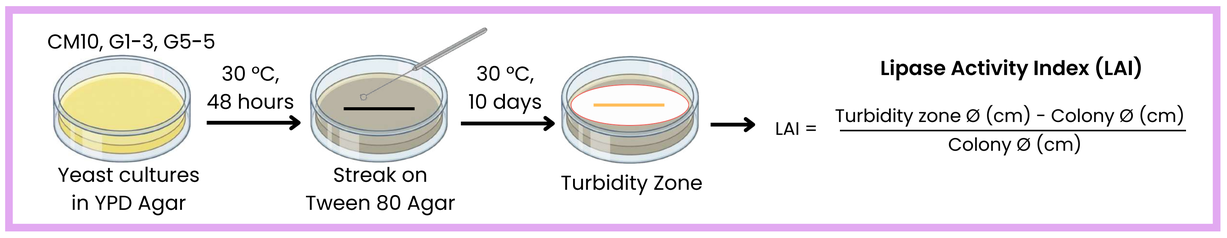
Methodology



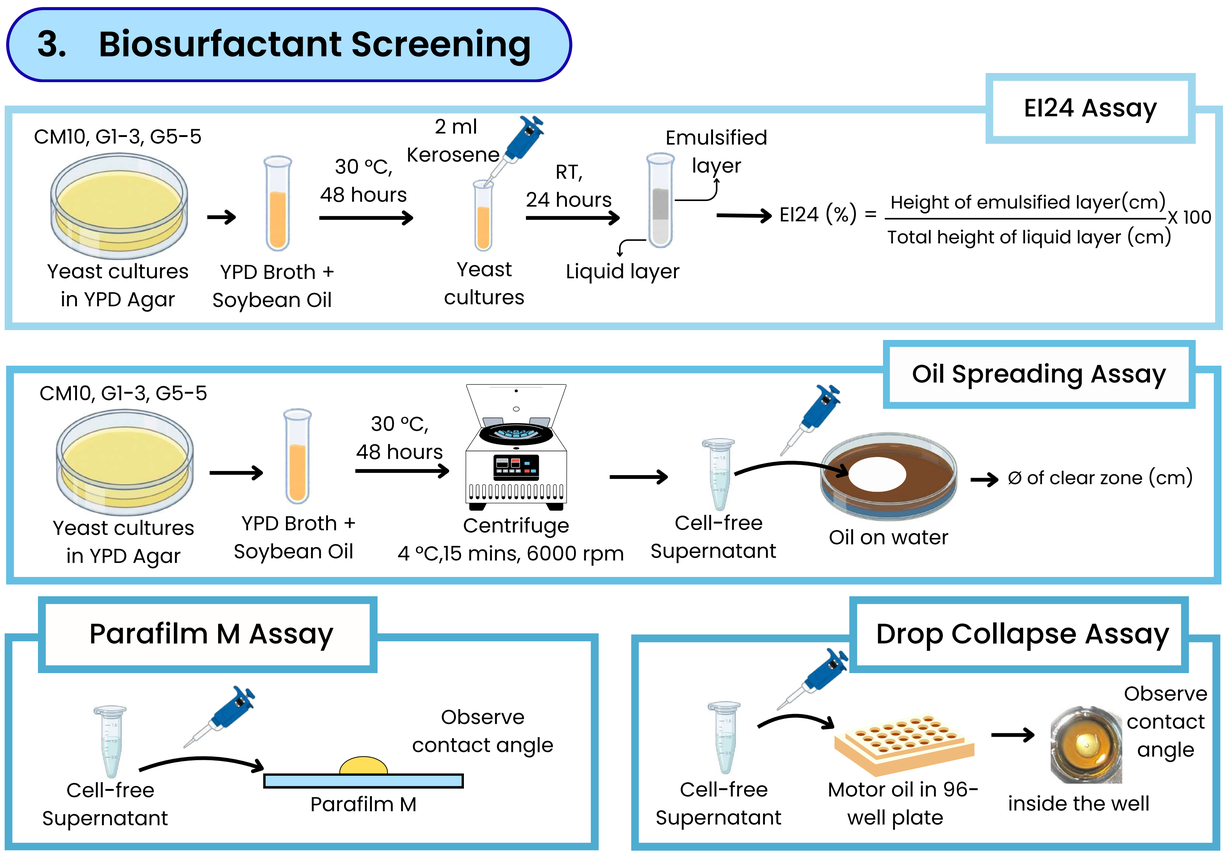
1. Lipid Accumulation



2. Lipase Production



3. Biosurfactant Screening



Results

1. Lipid Accumulation

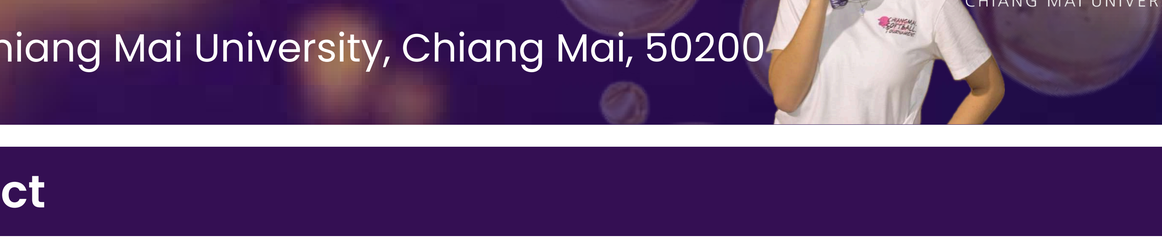


Figure 1. Lipid accumulation in yeast isolates detected by Nile Red staining and fluorescence microscopy. Lipid bodies were observed in CM10, G1-3, and G5-5 compared with positive and negative controls. Scale bar = 50 µm

Result: All isolates showed intracellular lipid accumulation.

2. Lipase Production

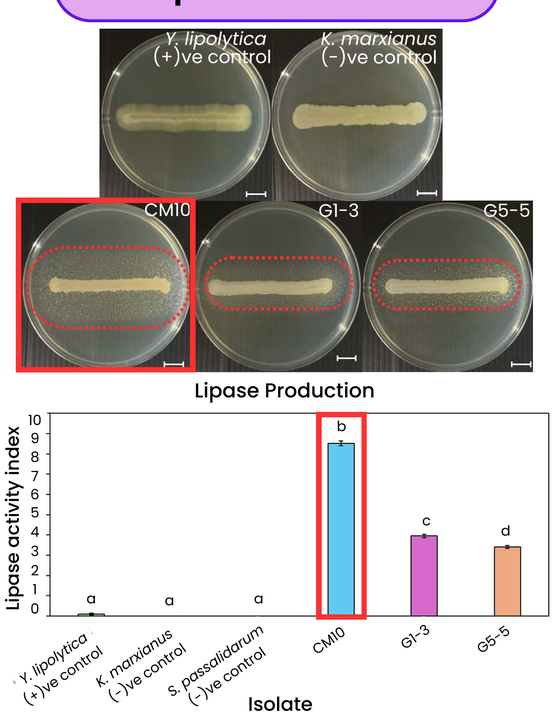
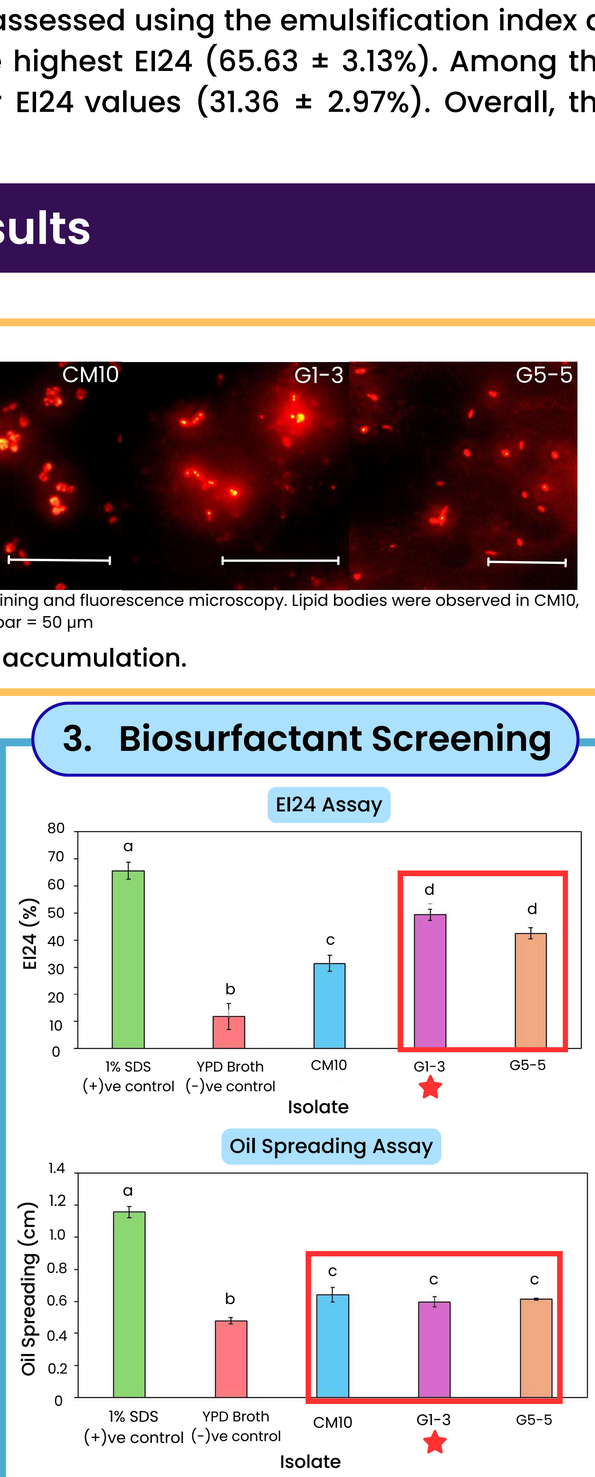


Figure 2. Screening of lipase production on Tween 80 agar. Lipase activity was evaluated based on clear zone formation and expressed as the lipase activity index. Different letters indicate significant differences ($p < 0.05$).

Result: CM10 exhibited the highest lipase activity among the tested isolates.

3. Biosurfactant Screening



Isolate	Parafilm M	Drop Collapse
1% SDS (+)ve control	+++	+++
YPD (-)ve control	-	-
CM10	+	+
G1-3 ★	-	+
G5-5	-	-

Figure 3. Biosurfactant production evaluated using EI24, oil spreading, Parafilm M, and drop collapse assays compared with positive (1% SDS) and negative (YPD broth) controls.

Result: G1-3 showed the highest emulsification capacity among the isolates.

Key Findings

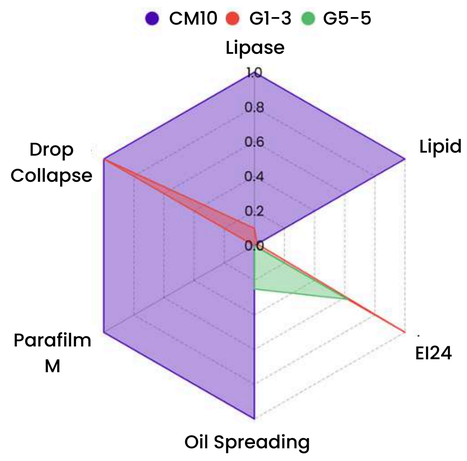


Figure 4. Radar chart of normalized functional traits in yeast isolates.

- CM10: Strong multi-trait performance (lipid, lipase, and biosurfactant assays).
- G1-3: Highest emulsification capacity (EI24).
- G5-5: Moderate overall performance.

Conclusion

- CM10 showed strong potential for lipid accumulation and lipase production.
- G1-3 demonstrated the highest emulsification ability, indicating promising biosurfactant-related activity.
- The isolates exhibited distinct functional traits, highlighting the importance of multi-trait evaluation for strain selection.