

## Article

# Yeast-Based Pickering Emulsions: Is Yeast Truly the Stabilizing Agent?

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## Abstract

The increasing demand for sustainable and affordable surfactants requires the exploration of novel bio-based alternatives. In this context, this work investigates the potential of baker's yeast (*Saccharomyces cerevisiae*) as a surface-active agent. To this purpose, the performance of commercial dry, commercial fresh, and cultivated yeast was evaluated by characterizing their wetting behavior and formulating emulsions with a fixed oil-to-water ratio. Microscopic and macroscopic stability was monitored over 24 h and quantified via the creaming index (CI). The experimental results demonstrate that both the yeast source and concentration significantly dictate the surface properties and emulsion stability. Notably, commercial dry yeast exhibited the highest degree of hydrophobicity, likely attributed to the presence of sorbitan monostearate (SMS) in the formulation. Consequently, this was the main variant capable of producing stable emulsions, with microscopic evidence suggesting a Pickering-like stabilization mechanism driven by the irreversible adsorption of yeast cells at the oil–water interface. Conversely, commercial fresh and cultivated yeast failed to exert significant stabilizing activity. These results demonstrate that *S. cerevisiae* biomass can be effectively repurposed as a functional constituent in green emulsion technology, offering a scalable pathway for the development of biocompatible, particle-stabilized industrial formulations.

**Keywords:** Pickering emulsions; *Saccharomyces cerevisiae*; surfactants; emulsion stability; optical microscopy



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## 1. Introduction

Pickering emulsions are a class of emulsions stabilized by solid particles instead of traditional surfactants. These particles accumulate at the oil–water interface, anchoring firmly and irreversibly to it and creating a steric barrier against droplet coalescence [1]. This

approach offers a “surfactant-free” alternative that is highly valued in the cosmetic, pharmaceutical and food industries due to its low irritancy, lack of hemolytic side effects, and lower toxicity [1,2]. A wide variety of solid particles can be employed as Pickering stabilizers, and they are commonly classified as safe inorganic or food-grade organic particles [3]. Safe inorganic particles include silica ( $\text{SiO}_2$ ), calcium carbonate ( $\text{CaCO}_3$ ), and metal oxides [3,4]. Despite their effectiveness, the use of such inorganic particles has raised significant concerns regarding their long-term accumulation and potential deleterious effects on both human health and the environment [5]. These limitations, coupled with the high environmental footprint of their synthesis [5–7], have shifted research interest toward biodegradable and biocompatible alternatives. Organic particles (e.g., biopolymers, polysaccharides, proteins, microorganisms) offer important qualities such as biocompatibility, cost-efficiency, renewability, and biodegradability, thus meeting the growing demand for more sustainable and eco-friendly systems [8]. In this context, *Saccharomyces cerevisiae* has been frequently reported to act as an effective stabilizer for oil-in-water emulsions [9–11] through the Pickering stabilization mechanism [12]. In particular, several studies attribute the stabilizing activity of *Saccharomyces cerevisiae* to its negative zeta potential and surface hydrophobicity [11,13]. These characteristics facilitate strong electrostatic repulsion between coated oil droplets, creating a physical and electrical barrier that prevents coalescence [11,13]. However, the experimental approaches reported in the literature vary considerably, particularly regarding the source and preparation of yeast cells. Some studies employed freshly cultivated *S. cerevisiae* [10], while others have tested the emulsifying ability of commercial dry yeast with promising results observed (treated and untreated) [9–12]. Despite extensive studies on yeast-stabilized emulsions, the production process of dry yeast biomass is often overlooked. In particular, the dehydration procedure involves the addition of emulsifiers, stabilizers, or processing aids (e.g., trehalose or sorbitan monostearate) to improve yeast survival rates, resistance to stresses, and shelf stability [14–16]. The presence of such surface-active compounds raises an important but often neglected question: whether the observed emulsion stability is genuinely due to a Pickering mechanism mediated by yeast cells or instead driven by low-molecular-weight surfactants included in commercial yeast formulations. Despite the growing interest in yeast-based Pickering emulsions, a significant knowledge gap persists due to the lack of systematic comparative studies between freshly cultivated and commercial dry yeast. The absence of direct comparison leaves the specific role of *S. cerevisiae* cells in stabilizing these systems ambiguous, as the potential influence of additives in commercial formulations remains largely unexplored. To address this, the present study critically examines the stabilizing capacity of *S. cerevisiae* within a simple oil-in-water (O/W) system, employing soybean oil and yeast-in-water dispersions. By evaluating and comparing three distinct sources (e.g., commercial dry yeast, fresh yeast, cultivated yeast), we aim to isolate the stabilizing effect of the yeast cells themselves from that of surfactants typically found in commercial products. Emulsion stability was monitored through visual inspection and bright-field optical microscopy, while the wetting properties of the yeast dispersions were assessed to corroborate the observed interfacial behavior. Ultimately, this comparative approach provides new insights into the interpretation of yeast-based Pickering emulsions currently reported in the literature, clarifying whether stability is a result of cellular architecture or added compounds. The results show that despite the potential of yeast as a cost-effective, bio-based Pickering stabilizer, its emulsifying efficiency is highly dependent on industrial processing. The experimental results indicate that stable emulsions are achieved only with dry yeast formulations containing sorbitan monostearate. In contrast, analyses of pure variants (e.g., fresh and cultivated yeast) reveal that yeast cells alone are unable to spontaneously stabilize the oil–water interface.

## 2. Materials and Methods

### 2.1. Production of Yeast Biomass and Culture Conditions

Three distinct types of yeast biomass were evaluated as Pickering agents. The first source consisted of commercial dry yeast and was purchased at the local market, and it was dispersed in distilled water at different concentrations (10% *w/w*, 1% *w/w*, and 0.5% *w/w*).

Fresh baker's yeast, purchased at the local market, served as the second yeast biomass source, and it was prepared as aqueous dispersions at identical concentrations (10% *w/w*, 1% *w/w*, and 0.5% *w/w*).

Finally, a third biomass type was obtained by subculturing the commercial dry yeast. Briefly, dry yeast was first resuspended in distilled water and streaked onto Sabouraud Dextrose Agar plates (40 g/L dextrose (Sigma Aldrich, St. Louis, MO, USA), 10 g/L peptone (Sigma Aldrich, St. Louis, MO, USA), 15 g/L agar (Sigma Aldrich, St. Louis, MO, USA)), followed by incubation at 30 °C for 24 h. A single isolated colony was then selected and inoculated into 35 mL of fresh Sabouraud Dextrose Broth (SBD) [17] (40 g/L dextrose, 10 g/L peptone) and incubated overnight at 30 °C under constant agitation (170 rpm).

The resulting liquid culture was centrifuged at 1200 rpm for 5 min, and the collected biomass was washed and resuspended in distilled water to obtain final dispersions at three different concentrations (10% *w/w*, 1% *w/w*, and 0.5% *w/w*).

This third biomass was included to enable a direct comparison between industrially processed yeast and its biologically equivalent cultivated counterpart. The commercial dry yeast formulation revealed the presence of sorbitan monostearate (E491) as an added stabilizing agent. This non-ionic, lipophilic surfactant is commonly incorporated into industrial yeast preparations to preserve membrane integrity and enhance cell viability during dehydration processes [14]. The presence of such surface-active compounds may influence the apparent emulsifying behavior of the formulation. Therefore, subculturing the dry yeast allowed us to distinguish between stabilization arising from cellular properties and that potentially driven by residual surfactants.

### 2.2. Emulsification Process

Oil-in-water (O/W) emulsions were prepared at a fixed oil-to-water ratio of 30:70 (*v/v*) to systematically evaluate the stabilizing capacity of the different biomass treatments. Each biomass was dispersed in water at fixed concentrations *w/w*: 10%, 1%, and 0.5%. Three distinct systems were formulated:

- (1) A dispersion of dry yeast and distilled water as the continuous phase and soybean oil (Sigma Aldrich, St. Louis, MO, USA) as the dispersed phase;
- (2) A dispersion of fresh yeast and distilled water as the continuous phase and soybean oil as the dispersed phase;
- (3) A dispersion of cultivated *S. cerevisiae* isolated from dry yeast cultures as the continuous phase and soybean oil as the dispersed phase.

All samples were homogenized using an Ultra-Turrax T25 high-shear mixer (IKA, Staufen im Breisgau, Germany). Homogenization was performed at 6000 rpm for 5 min at room temperature. Following preparation, the resulting emulsions were immediately transferred to glass tubes for macroscopic observation of creaming stability and further microscopic characterization.

### 2.3. Emulsions Characterization

#### 2.3.1. Macroscopic Stability Assessment

The stability of the emulsions was evaluated by monitoring phase separation [18] over a 24 h period. To capture the kinetics of initial destabilization, images were taken at fixed time intervals (e.g.,  $t = 0$ ,  $t = 1$  h,  $t = 3$  h, and  $t = 24$  h). The images allowed for

the calculation of the creaming index (Equation (1)) and a quantitative comparison of the stabilization efficiency across the four experimental systems [19]:

$$CI (\%) = \frac{H_C}{H_T} \cdot 100 \quad (1)$$

where  $H_C$  is the height of the cream layer, and  $H_T$  is the total height of the emulsion sample. A representative image showing the identification of the cream layer height ( $H_C$ ) and the total emulsion height ( $H_T$ ) is reported in the Supplementary Materials (Figure S1). Measurements were repeated in triplicate and averaged.

### 2.3.2. Microscopy Acquisition

Microscopic analyses were performed to characterize both yeast cell morphology and emulsion stability. Phase-contrast images of the yeast cells were acquired using an automated time-lapse microscopy workstation. The system comprised a Zeiss Axiovert 200 inverted microscope (Carl Zeiss, Jena, Germany) equipped with a 32× objective (Zeiss LD A-Plan) and a motorized stage (Märzhäuser Wetzlar, Wetzlar, Germany). Grayscale images were captured using a CCD camera (Orca AG, Hamamatsu, Japan) [20].

Acquired images were processed using Image-Pro Plus 6 software (Media Cybernetics, Rockville, MD, USA). Morphological parameters of yeast cells (commercial dry yeast, commercial fresh yeast, and cultivated yeast) were quantified. Specifically, the mean cell diameter (averaged across multiple orthogonal measurements per cell) and projected cell area were determined.

Measurements were performed on three independent biological replicates for each yeast type. Prior to segmentation, images were pre-processed using a flatten filter to correct for background inhomogeneity, followed by a Sobel edge-detection filter to enhance cell contours. The processed images were subsequently thresholded to enable accurate cell boundary identification.

Emulsion morphology and evolution were characterized by acquiring bright-field microscopy images at fixed time intervals ( $t = 0, 1$ , and 24 h) and employing the previously described setup equipped with a 10× objective (Zeiss, EC Plan-NEOFLUAR). To enhance the visualization of yeast cell localization at the oil–water interface, the emulsions were imaged using the same setup equipped with a 63× objective (Zeiss, Plan APOCHROMAT OIL), providing the necessary resolution to characterize the interfacial assembly (Figure S2).

To ensure a representative qualitative assessment of the phase behavior and droplet distribution, multiple micrographs were captured across various fields of view for each sample.

### 2.4. Wetting Investigation

Wettability tests of the yeast dispersions were performed by dispensing a 20 µL drop of each sample on a cleaned glass slide (Eppredia Inc., Portsmouth, NH, USA) placed on a homemade device composed of an adjustable plane (leveled to the ground), and an independent video camera, Canon EOS 60D equipped with Canon EF-S-60 mm and 55 mm Macro Lens, was used to acquire images of the drop side view. Eight solutions at different concentrations of dry and fresh yeast were prepared: 0.01%, 0.05%, 0.1%, 0.5%, 1%, 3%, 5%, 7%  $w/w$ , and 10%  $w/w$ . As for the cultivated yeast, the grown cells were harvested, resuspended in fresh SDB, and incubated overnight at 30 °C under constant agitation at 170 rpm. The liquid culture was then centrifuged at 1200 rpm for 5 min. Upon collection, the pellet was resuspended in distilled water at the same  $w/w$  concentrations. The analysis was performed following previously described protocols [21], and the measurement was carried out using the open-source image processing software ImageJ (64-bit Java 8). Images were pre-processed employing the commercial software Image Pro Plus (64-bit Java 8).

First, images were converted to greyscale, and then, contrast was enhanced to facilitate the subsequent measurements. The drop contact angle on the surface was measured following the sessile drop method [22], according to which the contact angle is measured by fitting a tangent to the point where the liquid surface touches the solid surface [23]. The angle was manually determined from side-view images, as shown in Figure 1. Measurements were repeated in triplicate, and left and right contact angles were averaged.

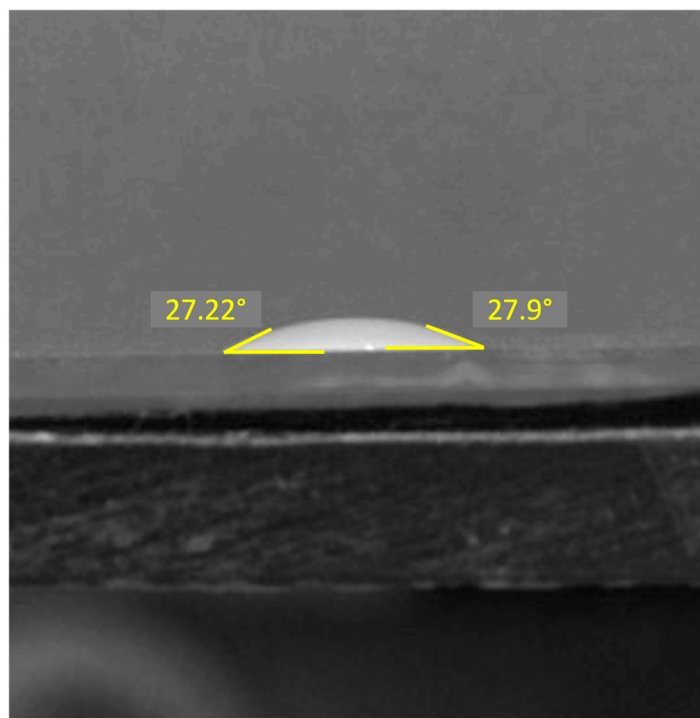


**Figure 1.** Contact angle measurement. Greyscale image illustrates a drop of yeast dispersions on glass slides. Left and right contact angles are determined according to the sessile drop method.

### 3. Results

#### 3.1. Yeast Morphology and Interfacial Integrity

As a preliminary step, we verified whether the different yeast biomasses exhibited comparable cell dimensions. Quantitative image analysis revealed no significant differences in mean cell diameter or projected area among commercial dry yeast, commercial fresh yeast, and cultivated yeast (Figure 2). The average cell diameter across all preparations ranged within the typical micrometric scale characteristic of *Saccharomyces cerevisiae* ( $\approx 4.5 \mu\text{m}$ ), and the measured projected areas were statistically comparable across the three groups [24].

From a purely geometrical perspective, particle size is a key parameter governing the theoretical adsorption energy at oil–water interfaces in Pickering systems [25]. Since the adsorption energy scales with the square of the particle radius, the comparable dimensions observed among the three yeast preparations suggest that, based solely on size considerations, their potential for interfacial anchoring is in the same order of magnitude [25]. Importantly, the cultivated yeast strain was isolated directly from the commercial dry formulation and subsequently regrown under controlled laboratory conditions. This approach was specifically adopted to enable a direct comparison between the industrially processed dry yeast and its biologically equivalent cultivated counterpart. The absence of measurable size differences confirms that any variation in emulsifying performance cannot be attributed to geometric factors alone. The same analytical framework was applied to yeast dispersions following high-shear homogenization. This step was critical to determine

if the intense mechanical stress altered the cellular structure or morphology, which would directly influence the resulting emulsification mechanisms and long-term kinetic stability (Figure S3).

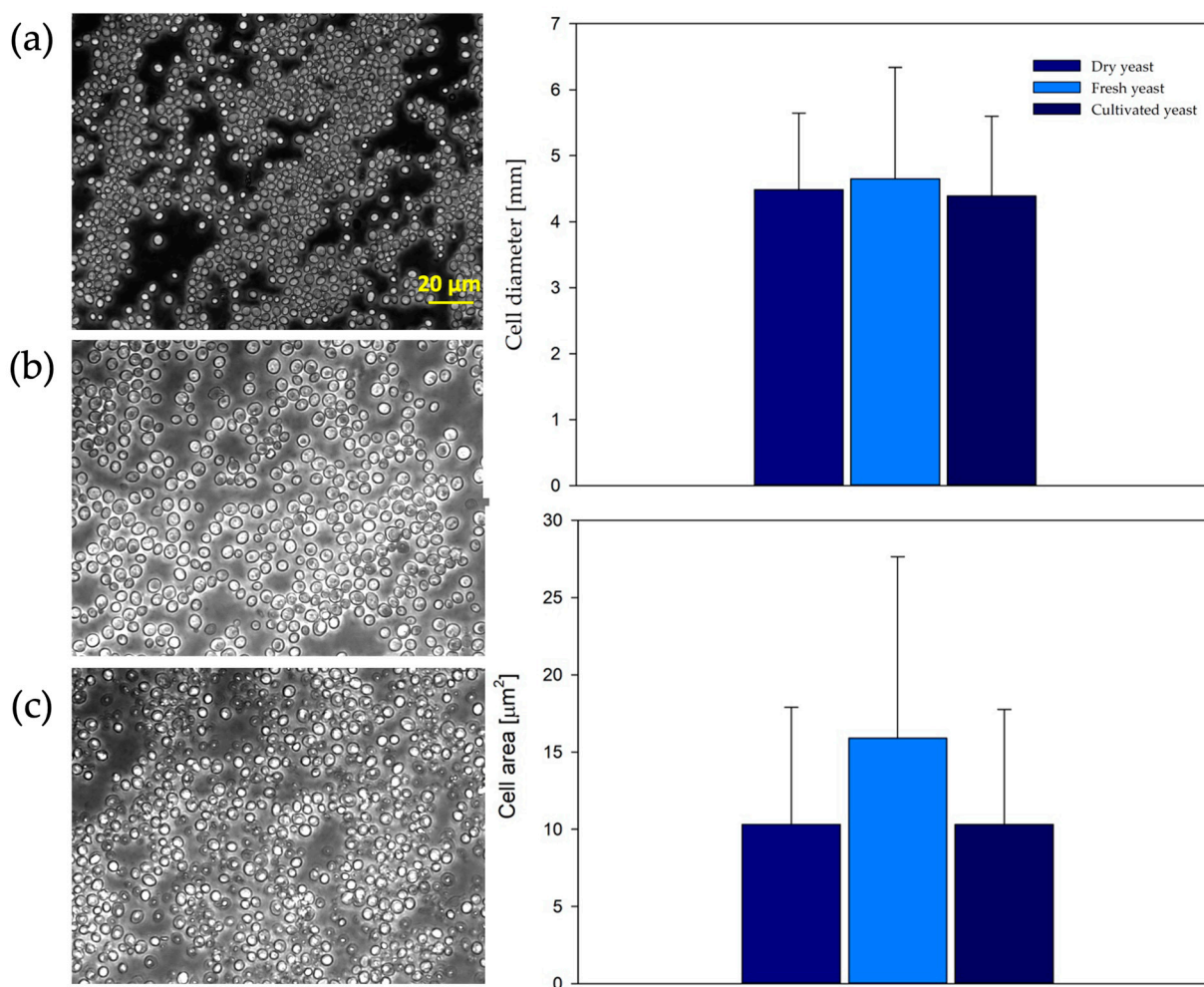


**Figure 2.** Yeast morphological analysis. Representative phase-contrast micrographs of (a) commercial dry yeast, (b) commercial fresh yeast, and (c) cultivated *Saccharomyces cerevisiae*. Quantitative analysis of mean cell diameter and projected area is reported alongside the corresponding images. Measurements were performed on three independent biological replicates for each yeast type. No statistically significant differences were observed among the different yeast preparations, indicating comparable cell dimensions regardless of processing method or cultivation history. Statistical analysis was performed using one-way ANOVA, yielding  $p = 0.80$  for mean cell diameter and  $p = 0.76$  for projected area.

### 3.2. Wettability and Surface Behavior

Pure water was used as a reference, yielding a baseline contact angle of approximately  $28^\circ$ , similarly to values available in the literature [26]. Contact angle measurements of yeast dispersions are reported in Figure 3. For the dry yeast solutions (**magenta dots**), a slight increase in the contact angle is visible at lower concentrations (e.g., 0.01% and 0.5%), peaking at  $\sim 35^\circ$  for the 0.5% concentration and suggesting a modification of surface energy or the formation of a yeast cell coating that initially increases hydrophobicity compared to pure water. However, as yeast concentrations increase beyond 0.5%, a gradual downward trend is observed, with the contact angle reaching its minimum at  $\sim 28^\circ$  at 10%  $w/w$ . On the other hand, the addition of fresh yeast to water (**dark pink dots**) in concentrations up to 10%  $w/w$  has a negligible impact on surface wettability. The contact

angle values remained stable within a narrow range of about 28–29°, regardless of the yeast content. This behavior suggests that the presence of yeast cells at these concentrations does not significantly alter the surface tension of the liquid phase nor the interfacial energy. The consistency between the pure water and the yeast suspensions indicates that the wetting regime is dominated by the aqueous medium. At last, cultivated yeast (**light blue dots**) exhibits a highly stable wetting profile across the investigated concentration range, with the contact angle remaining nearly constant between 27° and 29° regardless of the increase in yeast concentration, indicating that the interface reaches a saturation point or maintains consistent surface tension early in the dilution process likely due to a rapid formation of a stable layer of yeast cells at the liquid–air interface. Although these macroscopic contact angle measurements on a glass substrate do not directly resolve fluid–fluid interfacial thermodynamics, they provide a valuable qualitative basis for correlating global formulation wettability with the observed emulsification performance.

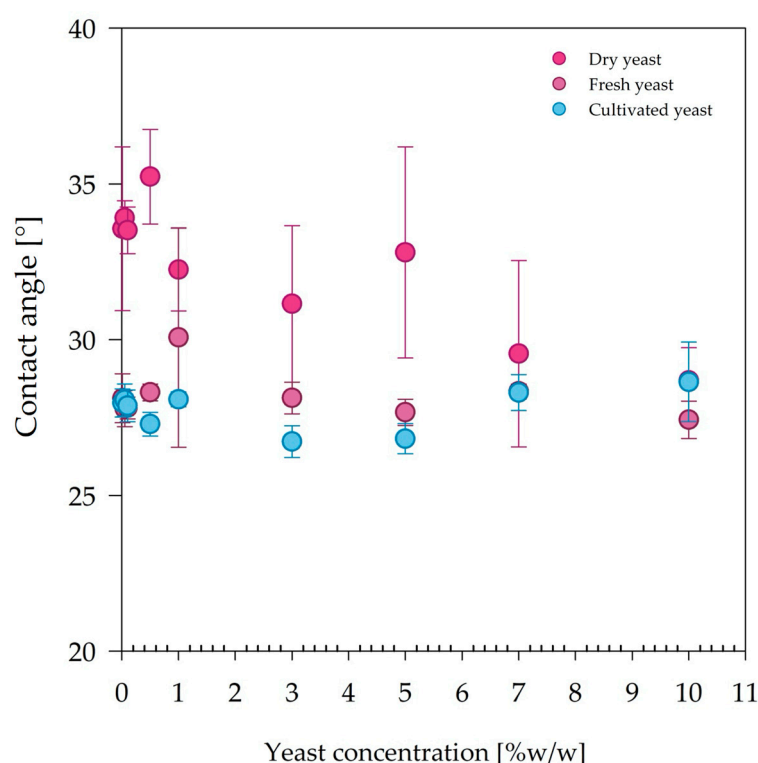


**Figure 3.** Contact angle vs. yeast concentration. Contact angle measurement with the sessile drop method for different yeast sources at three concentrations: 10% *w/w*, 1% *w/w*, and 0.5% *w/w*. Data points indicate mean values; error bars denote standard deviation ( $n = 3$ ).

### 3.3. Evaluation of Macroscopic Stability

Macroscopic stability was evaluated for emulsions prepared with three different yeast biomasses (e.g., commercial dry yeast, commercial fresh yeast, and cultivated yeast) at three concentrations (10% *w/w*, 1% *w/w*, and 0.5% *w/w*) over a 24 h period. A clear overview of all samples and their macroscopic evolution is provided in Figure 4. Notably, the image set used for visual inspection was later employed to measure phase-layer heights, allowing for the precise determination of the creaming index over time. Creaming index data are displayed in Figure 5.

Immediately after homogenization ( $t = 0$ ), all formulations appeared as homogeneous, light-yellow dispersions. However, significant phase separation occurred within the first hour of storage, as evidenced by the formation of a three-layer system: a distinct cream

layer at the top, a clarified serum layer in the middle, and a yeast precipitate at the bottom driven by the sedimentation of non-absorbed yeast cells.

Emulsions prepared using dry yeast (Figure 4a) demonstrate concentration-dependent stability, where higher yeast content promotes interfacial stabilization and foaming, while the 1% and 0.5% *w/w* samples undergo rapid phase separation and sedimentation after three hours. According to dry yeast creaming index data, the 0.5% (Figure 5c, **magenta dots**) *w/w* sample exhibited the highest initial instability with a CI of about 62% at  $t = 1$  h, whereas the 10% *w/w* (Figure 5a, **magenta dots**) sample showed greater resistance to migration with a CI of ~52%. By  $t = 24$  h, the 10% *w/w* emulsion maintained a relatively stable CI around 52%, while the 1% *w/w* sample (Figure 5b, **magenta dots**) showed a decrease to 43%. In contrast, the 0.5% *w/w* sample concluded with a CI of about 56% at  $t = 24$  h; although this value decreased from its initial peak, the persisting high index and the high transparency of the lower serum phase suggest that low yeast concentrations were insufficient for building a stable network [11], leading to the nearly complete migration of the dispersed phase [27].

Regarding the fresh yeast, all samples exhibited rapid phase separation within the first hour (Figure 4b, **dark pink dots**), characteristic of buoyant droplets migrating toward the top of the vials. Quantitatively, the 10% *w/w* yeast emulsion reached the highest initial CI of ~38%, indicating that a higher solid content initially facilitates a more voluminous cream layer. The analysis revealed a gradual decrease in CI across all samples over the 24 h period, falling to 33% for the 10% yeast concentration samples and from 31% to 28% for the 0.5% yeast concentration sample. Furthermore, the 0.5% *w/w* sample displayed the highest degree of translucency in the serum phase, aligning with its lower CI values. In terms of overall physical stability, these systems can be characterized as macroscopically unstable but kinetically hindered. The rapid rise in creaming index within the first hour confirms that the yeast particles and oil droplets lack sufficient steric or electrostatic repulsion to overcome gravitational separation [27]. However, the observed compaction of the cream layer rather than a complete coalescence of droplets suggests that the yeast may be acting as a physical barrier at the interface [11]. The 10% *w/w* emulsion, despite having a higher CI, appears more stable in its creamed state due to the higher solid volume fraction, which creates a more viscous network that resists further rearrangement [27]. In contrast, the 0.5% *w/w* system demonstrates the highest degree of instability regarding phase separation probably because the lower particle density fails to create a sufficient network, leading to a more rapid clarification of the serum.

The emulsions prepared with cultivated yeast demonstrate significant macroscopic instability characterized by rapid phase separation (Figure 4c, **light blue dots**). At  $t = 0$ , all samples appear as homogeneous, opaque dispersions. However, within just one hour, a distinct clarification layer becomes visible, indicating that either the dispersed phase is migrating downward or the system is rapidly flocculating. The CI values jump from 0% to a range between 26% and 30% within the first hour, suggesting that the yeast concentrations provide insufficient steric or electrostatic stabilization for preventing droplet aggregation. Interestingly, the 0.5% *w/w* sample exhibits the highest eventual CI (~35%), implying that lower concentrations of the stabilizing agent led to more pronounced separation. Furthermore, the system reaches a state of sedimentation equilibrium relatively quickly, as evidenced by the CI values remaining constant between  $t = 3$  h and  $t = 24$  h across all formulations, indicating that the emulsions remain kinetically unstable over time. To further investigate the impact of dry yeast concentrations, additional analyses were conducted using a broader range of concentrations and extended observation periods. These experiments were performed to ensure the robustness of the observed stability trends

and to explore the long-term behavior of the systems. The results are provided in the Supplementary Materials (Figures S4 and S5).

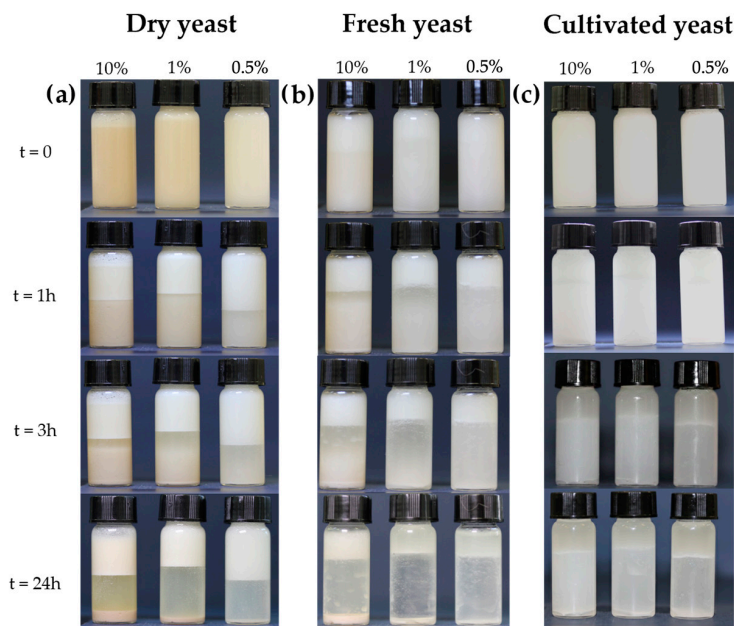


**Figure 4.** Macroscopic stability assessment. Emulsion monitoring over 24 h to evaluate stability and to measure the creaming index for (a) emulsions prepared using dry yeast, (b) emulsions prepared using fresh yeast, and (c) emulsions prepared using cultivated yeast. Images were taken at fixed time intervals (e.g.,  $t = 0$ ,  $t = 1$  h,  $t = 3$  h, and  $t = 24$  h).

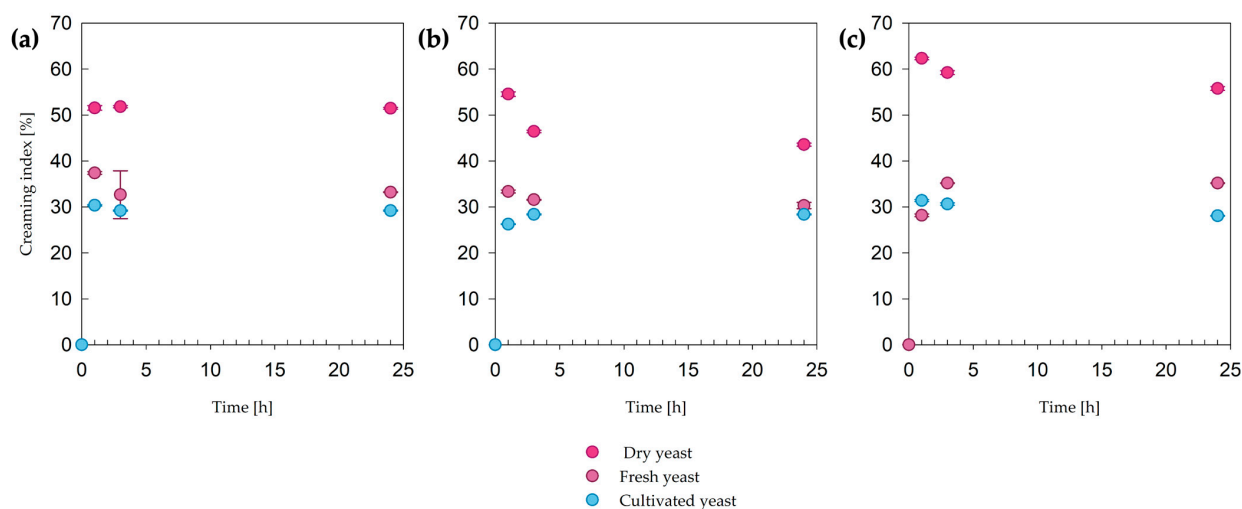


**Figure 5.** Creaming index evolution for emulsions stabilized by dry, fresh, and cultivated yeast at varying concentrations: (a) 10%  $w/w$ , (b) 1%  $w/w$ , and (c) 0.5%  $w/w$  over 24 h. Data points indicate mean values; error bars denote standard deviation ( $n = 3$ ).

### 3.4. Microscopic Stability Assessment

The microscopic evolution of the emulsions prepared using dry yeast is shown in Figure 6. The images provide compelling evidence of a Pickering stabilization mechanism. For emulsions prepared using dry yeast (Figure 6a), at  $t = 0$ , the droplets are characterized by a well-defined “grainy” boundary, indicating that the yeast cells may have adsorbed at the interface to form a physical barrier. This mechanical shell appears more robust in the 10%  $w/w$  formulation, which maintains a relatively uniform droplet size distribution and prevents the faster coalescence seen at lower concentrations. As time progresses, the

influence of the yeast concentration on the Pickering effect becomes critical. In the 0.5%  $w/w$  and 1%  $w/w$  samples, the lower particle density leads to droplets approaching each other and subsequent coalescence, as evidenced by the appearance of large, irregular oil domains. Conversely, the higher particle concentration in the 10%  $w/w$  sample effectively suppresses these destabilization phenomena. While buoyancy-driven forces lead to macroscopic phase separation, the microscopic integrity of the droplets remains intact due to the steric hindrance provided by the adsorbed yeast layer (Figure S2) [28]. The microscopic analysis of emulsions stabilized with fresh yeast (Figure 6b), on the other hand, reveals a high degree of polydispersity, with droplet diameters significantly influenced by the yeast concentration. At the highest concentration, the presence of distorted, non-spherical oil domains suggests that the yeast cells are unable to form a sufficiently rigid interfacial layer to resist droplet merging. Conversely, at 1% and 0.5%  $w/w$ , the droplets appear more spherical and discrete, yet their lower number density suggests a limited capacity for the fresh yeast to saturate the oil–water interface. At last, the microscopic characterization of emulsions prepared with cultivated yeast proved very challenging. These formulations exhibited extreme kinetic instability, undergoing phase separation almost immediately upon preparation. This rapid separation precluded the acquisition of representative images.

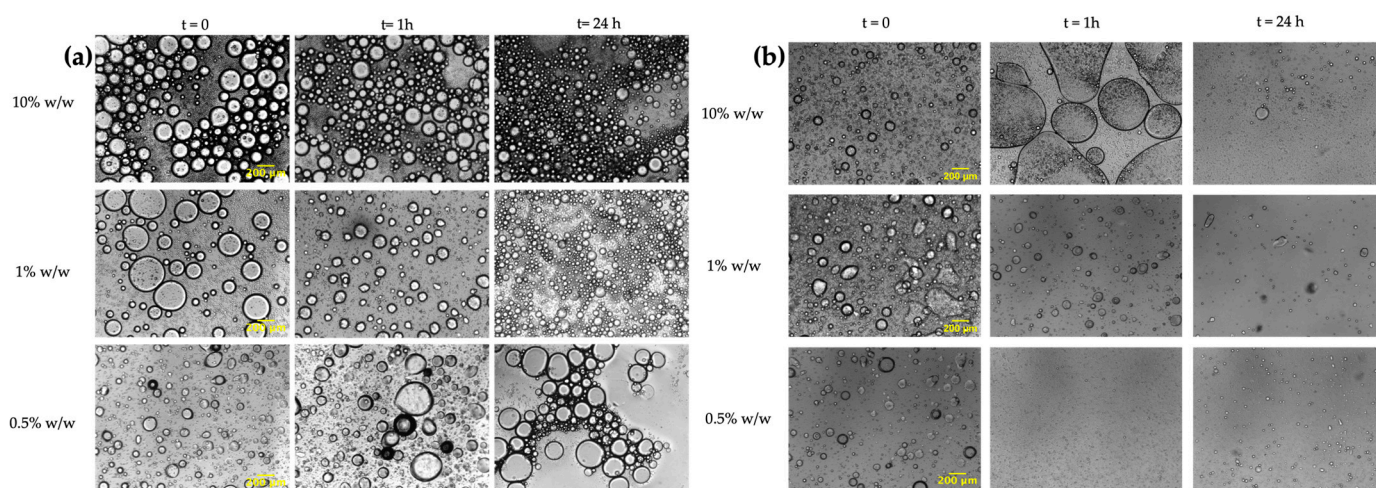


**Figure 6.** Emulsions' microstructure and evolution. Comparison of the physical stability and microscopic morphology of emulsions formulated with different yeast types: (a) microscopy images of dry yeast emulsions and (b) microscopy images of fresh yeast emulsions, each at concentrations of 10%, 1%, and 0.5%  $w/w$  over a 24 h period.

#### 4. Discussion

In this work, we investigated the stabilizing activity of *Saccharomyces cerevisiae*. To this purpose, we tested three different yeast sources (e.g., commercial dry baker yeast, commercial fresh baker yeast, and cultivated yeast). The comparative analysis of the three yeast sources revealed fundamental differences in their interfacial behavior and emulsifying capacity. Notably, while all three systems consist of yeast cells, only the commercial dry yeast successfully facilitated the formation of more stable emulsions, raising a critical question regarding the underlying stabilization mechanism. Commercial dry yeast typically incorporates surfactants (e.g., sorbitan monostearate, SMS) to preserve cell viability during dehydration. The inability to produce stable emulsions in the case of fresh yeast and the complete absence of emulsification in the case of cultivated yeast, both of which lack these additives, strongly suggest that the primary driver for initial droplet formation is either the surfactant itself or a synergistic effect between the surfactant and the yeast particles positioned at the oil–water interface.

Macroscopically, emulsions underwent rapid phase separation within the first hour regardless of the yeast source or the concentration. However, dry yeast systems exhibited prolonged stability and persistence. The quantitative analysis of the stability via computation of the creaming index appeared to be independent of the yeast concentration, while the microscopy analysis revealed significant changes in the microstructure as the yeast content increased. Furthermore, contact angle measurements revealed no drastic alterations in global wetting behavior upon the addition of any yeast source; however, dry yeast exhibited higher relative hydrophobicity compared to fresh and cultivated yeast, likely mediated by the presence of SMS. To fully elucidate the precise microstructural stabilization mechanisms, future investigations should focus on direct oil–water interfacial tension measurements and interfacial rheology. Yet, these efforts should take into consideration the Pickering effect of the dispersed cells and the difficulties arising from the complex interactions among adsorbed particles at the employed different cells coverage (surface concentration) which permit only estimation of apparent interfacial properties rather than their rigorous thermodynamic counterparts. Nevertheless, under certain assumptions such studies might allow, at least on a comparative basis, a better quantitative characterization of single-cell adsorption kinetics and competitive displacement at the actual liquid–liquid interface. Overall, the findings presented in this work provide a preliminary characterization of *Saccharomyces cerevisiae* as a stabilizing agent in emulsified systems. While our results also take into account the concomitant activity of auxiliary surfactants in initiating droplet formation, they also underscore the significant potential of yeast cells to influence long-term microstructural persistence. Given the current scarcity of the literature regarding the interfacial behavior of whole-cell microorganisms in complex fluids, this study serves as a necessary baseline for more advanced investigations.

*S. cerevisiae* remains a highly complex biological entity with interfacial properties that are still largely unexplored. However, its status as a sustainable, readily available, and low-cost microorganism positions it as a promising candidate for the development of bio-based surfactants and Pickering stabilizers. Future research should focus on isolating the specific contributions of cell wall components and investigating the effects of high-shear processing on cellular morphology to fully unlock the potential of yeast-based stabilization.

**Supplementary Materials:** The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/colloids10030043/s1>. Figure S1: Measurement of the Creaming Index (CI); Figure S2: Microscopic visualization of Pickering emulsion stabilization by dry yeast cells; Figure S3: Yeast morphological analysis after high shear homogenization; Figure S4: Macroscopic stability assessment; Figure S5: Effects of NaCl addition on emulsions.

**Author Contributions:** Conceptualization, S.C. and T.D.K.; methodology, C.C., D.M., A.P.C. and O.O.; software, I.P. and D.M.; validation, M.P., O.O. and I.P.; formal analysis, C.C.; investigation, C.C.; data curation, C.C., D.M. and I.P.; writing—original draft preparation, C.C.; writing—review and editing, D.M., O.O., S.C. and T.D.K.; visualization, S.C., T.D.K. and M.P.; supervision, A.P.C., D.M., T.D.K. and S.C.; project administration, S.C. and T.D.K.; funding acquisition, S.C. All authors have read and agreed to the published version of the manuscript.

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