

Effect of Fermentation pH on Ethanol Production from *Saccharomyces cerevisiae* Using Waste Bread

Ainin Sofia Othman, Muhammad Naziz Saat*

Structured Abstract

Background: The growing demand for sustainable energy and the global impact of fossil fuels have prompted interest in utilizing food waste as an alternative feedstock for biofuels production, like ethanol. Waste bread, a food waste that is rich in starch, provides an effective and inexpensive carbon source for ethanol production. This research proposes the effect of fermentation pH on ethanol production utilizing waste bread as a carbon source and uses the fermentation abilities of *Saccharomyces cerevisiae* (Mauripan yeast).

Methods: Batch fermentation was conducted with prepared waste bread in a glucose-yeast medium at three different initial pH levels (4.0, 5.0 and 6.0) for 72 hours at 25°C with stirring. Biomass increase was determined via dry weight methods and optical density calibration, glucose utilization was assessed through the DNS assay, and ethanol production was calculated stoichiometrically based on glucose consumption.

Results: The results showed that pH 5 facilitated the maximum biomass accumulation (~1.1 g/L), the most effective glucose utilization, and the highest ethanol concentration (~1.48 g/L). Ethanol yield per substrate (Y_{ps}) was highest at pH 5 (0.523 g/g), achieving a conversion efficiency of 52%. One-way ANOVA statistical analysis demonstrated a significant influence of pH on fermentation performance ($p < 0.05$). These results emphasized that pH 5 is the ideal condition for yeast metabolic function and enzyme effectiveness, leading to enhanced substrate conversion.

Conclusion: In conclusion, this study shows that a pH of 5 is the ideal fermentation condition for enhancing ethanol production and yeast development with waste bread as a carbon source. The effective transformation of discarded bread into bioethanol not only aids in the valorization of food waste but also aligns with principles of the circular economy and objectives of renewable energy. Thus, this research aids in the sustainable development of biofuels and presents an encouraging option for waste management via microbial bioconversion methods.

Keywords: Ethanol Production, *Saccharomyces cerevisiae*, Waste Bread, Fermentation pH, Biofuel

*Correspondence: naziz@uitm.edu.my

School of Biology, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia