

## ABSTRAK

Peningkatan kebutuhan global terhadap asam laktat sebagai bahan baku *polylactic acid* (PLA) mendorong pengembangan proses produksi asam laktat yang berkelanjutan dan ekonomis menggunakan substrat terbarukan. *Molasses* sebagai limbah industri gula yang kaya akan gula fermentabel memiliki potensi besar sebagai substrat alternatif terbarukan dalam produksi asam laktat. Penelitian ini bertujuan untuk mengoptimasi konsentrasi *molasses* dan waktu fermentasi pada biokonversi *molasses* menjadi asam laktat menggunakan *Lactobacillus delbrueckii*. Metode penelitian menggunakan *Response Surface Methodology* (RSM) dengan desain *Face Centered Central Composite Design* (FCCCD). Variabel bebas yang digunakan adalah konsentrasi *molasses* (10%, 15%, dan 20%) dan waktu fermentasi (24, 48, dan 72 jam), sedangkan respons yang diamati meliputi kadar asam laktat, pH akhir fermentasi, dan biomassa sel (OD600). Hasil penelitian menunjukkan bahwa konsentrasi *molasses* dan waktu fermentasi berpengaruh signifikan terhadap produksi asam laktat. Kondisi optimum produksi asam laktat diperoleh pada konsentrasi *molasses* 17,168% dan waktu fermentasi 72 jam, dengan kadar asam laktat 15,305 g/L, pH 4,096, biomassa sel 1,357, serta nilai *desirability* 0,884. Pemodelan kuadratik hasil analisis ANOVA menunjukkan kesesuaian yang baik terhadap data eksperimen dengan nilai signifikansi  $p < 0,05$  untuk respons kadar asam laktat dan pH. Sedangkan untuk respons biomassa sel dapat dimodelkan menggunakan persamaan regresi 2FI. Penelitian ini membuktikan bahwa *molasses* berpotensi digunakan sebagai substrat ekonomis terbarukan dan berkelanjutan untuk produksi asam laktat melalui fermentasi menggunakan bakteri asam laktat *Lactobacillus delbrueckii*.

**Kata kunci:** asam laktat, *molasses*, fermentasi, *Lactobacillus delbrueckii*, *Response Surface Methodology* (RSM).

## ABSTRACT

The increasing global demand for lactic acid as a raw material for polylactic acid (PLA) production has spurred the development of sustainable, cost-effective production processes using renewable substrates. Molasses, a by-product of the sugar industry rich in fermentable sugars, has considerable potential as an alternative renewable substrate for lactic acid production. This study aimed to optimize molasses concentration and fermentation time in the bioconversion of molasses into lactic acid using *Lactobacillus delbrueckii*. The research employed Response Surface Methodology (RSM) with a Face-Centered Central Composite Design (FCCCD). The independent variables were molasses concentration (10%, 15%, and 20%) and fermentation time (24, 48, and 72 hours), while the observed responses included lactic acid concentration, final fermentation pH, and cell biomass (OD600). The results showed that molasses concentration and fermentation time significantly affected lactic acid production. The optimum conditions for lactic acid production were obtained at a molasses concentration of 17.168% and a fermentation time of 72 hours, resulting in a lactic acid concentration of 15.305 g/L, a final pH of 4.096, a cell biomass value of 1.357, and a desirability value of 0.884. Quadratic models generated from ANOVA demonstrated a good fit to the experimental data, with significant effects ( $p < 0.05$ ) observed for lactic acid concentration and pH. Meanwhile, the cell biomass response was adequately described by a two-factor interaction (2FI) regression model. These findings indicate that molasses has strong potential as an economical, renewable, and sustainable substrate for lactic acid production through fermentation by the lactic acid bacterium *Lactobacillus delbrueckii*.

**Keywords:** lactic acid, molasses, fermentation, *Lactobacillus delbrueckii*, Response Surface Methodology (RSM).