ABSTRACT

The significance of DNA extraction grows in the fields of molecular biology, medicine, and environmental studies. Pursuits for novel methodologies to reduce the complexities and costs involved have been a crucial endeavour in recent times. This study is an evaluation of the Vortex Fluidic Device (VFD) for DNA extraction from *Escherichia coli* by comparing its performance with the conventional PowerSoil DNeasy extraction kit. It introduces VFD as a transformative alternative to traditional DNA extraction methods.

Quantifying bacterial populations using flow cytometry and measuring DNA concentrations at absorbance ratios of 260/280 nm using NanoDrop were employed to assess the efficacy and cost-effectiveness of the VFD. Results revealed a higher DNA concentration from the VFD extraction at 6000 rpm speed compared to the kit (average yield for VFD at 6000 rpm: 146 ng/µL, PowerSoil Kit: 123 ng/µL) for all three biological replicates with their three technical replicates (to check lab technique) each among varied VFD speeds (6000 rpm, 7500 rpm, 8000 rpm, 8500 rpm and 9000 rpm). Standard deviations and standard errors were minimal (SD: 2 and standard error ±0.7 for the kit, and SD: 2 and standard error ±0.6 for VFD 6000 rpm) indicating the reproducibility and reliability of the VFD method similar to that of the kit. Absorbance ratios at 260/280 nm indicated acceptable purity levels for both VFD and kit extraction sample triplicates however, kit extracted DNA had higher purity (absorbance ratio of 1.88 nm) compared to the VFD extracts. Statistical analysis of the Shapiro-Wilk test affirmed normal distribution among the datasets for all samples with $p > 0.05$ except for VFD at 8000 rpm. One-sample t-tests revealed a statistical significance of p-value 4.2×10^{-2} for kit-extracted DNA and further analysis of two-sample independent t-tests highlighted the effectiveness of VFD at 6000 rpm with a significant p-value of 3.62×10^{-11} underscoring the higher DNA yield from VFD comparable to that of the kit.

Along with enhanced DNA yield, the simplicity and cost-effectiveness analysis of the VFD method indicates reduced financial, environmental, and labour outlays suggesting a significant reduction in extraction time and resources. VFD thus holds the potential to be a novel tool in DNA extraction to accelerate sustainable and efficient laboratory practices.