10. Urine stabilization and treatment using lactic acid from fruit and vegetable peel fermentation: a potential source of nitrogen fertilizer

Tabitha Nekesa[1]

[1]Department of Agriculture, Meru University of Science and Technology

*Corresponding author email: tabinek@gmail.com

Subtheme: Agriculture - Sustainable Agro-ecological practices for climate resilience

Abstract

This study addressed the stabilization and treatment of human urine using lactic acid (LA) produced from the anaerobic fermentation of fruit and vegetable peels as a sustainable and effective nitrogen fertilizer. LA was produced after three-day fermentation of samples prepared at 1:1 and 1:2 waste-to-water ratios and incubated at 34°C, 37°C, and 40°C. Urine samples were then treated with the resulting LA for four, seven, and ten days. The pH of the samples was measured to determine LA's efficiency in inhibiting urea hydrolysis and stabilizing urine. The Kjeldahl method determined nitrogen concentration, and E. coli presence tested pathogen inactivation with MacConkey Agar. The maximum rate of iron (III) lactate absorption was seen at 410 nm, close to the ideal wavelength range of 380-405 nm for detecting lactic acid. The calibration curve was created using sequential lactic acid dilutions, and the equation was $y = 1.9051x + 0.0267$. The correlation coefficient (R^2) was 0.9804. Lactic acid treatment significantly reduced the pH of urine samples across all settings, with the greatest pH reduction at 37°C, corresponding to the highest lactic acid production. Nitrogen analysis revealed that samples treated at 37°C in a 1:1 ratio preserved the most nitrogen content, indicating successful urease inhibition and prevention of ammonia volatilization. Furthermore, lactic acid had strong antibacterial action, inhibiting E. coli growth, especially in samples obtained at higher temperatures. This study revealed the ability of lactic acid from organic waste to stabilize urine, preserve nitrogen content, and ensure pathogen safety, supporting sustainable sanitation practices and resource recovery in agriculture. The best conditions for urine stabilization were determined as a 1:1 LA to urine ratio at 37°C, treated for 10 days, demonstrating its potential in sustainable urine management and agricultural applications.

Keywords: *anaerobic fermentation, lactic acid, food waste, urine stabilization, pathogen inactivation, nitrogen preservation*