

Fermentation of washed rice water Increases beneficial plant bacterial population and nutrient concentrations

ABSTRACT

Washed rice water (WRW) is said to be a beneficial plant fertilizer because of its nutrient content. However, rigorous scientific studies to ascertain its efficiency are lacking. The purpose of this study was to determine the effect of fermenting WRW on the bacterial population and identification, and to measure how fermentation affects the nutrient composition of WRW. Rice grains were washed in a volumetric water-to-rice ratio of 3:1 and at a constant speed of 80 rpm for all treatments. The treatments were WRW fermented at 0 (unfermented), 3, 6, and 9 days. Bacterial N fixation and P and K solubilization abilities in the fermented WRW were assessed both qualitatively and quantitatively. The isolated bacterial strains and the WRW samples were also tested for catalase and indole acetic acid (IAA) production ability. Significantly greater N fixation, P and K solubilization, and IAA production were recorded after 3 days of fermentation compared with other fermentation periods, with increases of 46.9–83.3%, 48.2–84.1%, 73.7–83.6%, and 13.3–85.5%, respectively, in addition to the highest (2.12×10^8 CFU mL⁻¹) total bacterial population. Twelve bacteria strains were isolated from the fermented WRW, and the gene identification showed the presence of beneficial bacteria *Bacillus velezensis*, *Enterobacter* spp., *Pantoea agglomerans*, *Klebsiella pneumoniae* and *Stenotrophomonas maltophilia* at the different fermentation periods. All the identified microbes (except *Enterobacter* sp. Strain WRW-7) were positive for catalase production. Similarly, all the microbes could produce IAA, with *Enterobacter* spp. strain WRW-10 recording the highest IAA of up to 73.7% higher than other strains. Generally, with increasing fermentation periods, the nutrients N, S, P, K, Mg, NH₄⁺, and NO₃⁻ increased, while pH, C, and Cu decreased. Therefore, fermentation of WRW can potentially increase plant growth and enhance soil health because of WRW's nutrients and microbial promotional effect, particularly after 3 days of fermentation.

Keyword: Bacteria; Catalase; Fermentation; Indole acetic acid; Nutrients; Wastewater