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A Novel Technique Using Advanced Oxidation Process (UV-C/H_2O_2) Combined with Micro-Nano Bubbles on Decontamination, Seed Viability, and Enhancing Phytonutrients of Roselle Microgreens

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Abstract: Microbial contamination commonly occurs in microgreens due to contaminated seeds. This study investigated the decontamination effects of water wash (control), 5% hydrogen peroxide (H_2O_2), UV-C (36 watts), advanced oxidation process (AOP; H_2O_2 + UV-C), and improved AOP by combination with microbubbles (MBs; H_2O_2 + MBs and H_2O_2 + UV-C + MBs) on microbial loads, seeds' viability, and physio-biochemical properties of microgreens from corresponding roselle seeds. Results showed that H_2O_2 and AOP, with and without MBs, significantly reduced total aerobic bacteria, coliforms, *Escherichia coli* (*E. coli*), and molds and yeast log count in seeds as compared to the control. Improved AOP treatment of H_2O_2 + UV-C + MBs significantly augmented antimicrobial activity against total bacteria and *E. coli* (not detected,) as compared to control and other treatments due to the formation of the highest hydroxy radicals (5.25×10^{-13} M). Additionally, H_2O_2 and combined treatments promoted seed germination, improved microbiological quality, total phenolic, flavonoids, and 2,2-diphenyl-1-picrylhydrazyl radical (DPPH$^{\bullet}$) activity of the grown microgreens. Ascorbic acid content was induced only in microgreens developed from H_2O_2-treated seeds. Single UV-C treatment was ineffective to inactivate the detected microorganism population in seeds. These findings demonstrated that improved AOP treatment (H_2O_2 + UV-C + MBs) could potentially be used as a new disinfection technology for seed treatment in microgreens production.

Keywords: advanced oxidative process; antioxidants; phytochemicals; hydrogen peroxide; hydroxyl radicals; microbubbles; microgreens

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1. Introduction

Over the past decade, the demand for plant-based diets has been on the rise, compelled by the growing awareness of physical and environmental health in society [1]. Therefore, the quest for wholesome nutrient-dense foods that support environment, health, and longevity, combined with gastronomic delight, is crucial. Microgreens, miniature tender leafy greens produced from seeds of vegetables, herbs, or grains, having two fully developed cotyledon leaves with or without the emergence of a rudimentary pair of first true leaves [2,3], has recently attracted many as novel culinary ingredients for both sweet and savory dishes. The popularity of microgreens is accelerated worldwide, and this has been ascribed to their high nutrient content with unique flavors, as compared to their seeds and mature plants, along with the fast and convenient production in space-efficient