059-AGR

Effect of Ultraviolet Light (UV-C) Treatment on the Biochemical Composition and Cytotoxicity of Almond milk

Plant-based beverages like almond milk (AM) are popular for their nutritional benefits, compatibility with diverse dietary needs, and environmental sustainability, but traditional heat-based methods (pasteurization, sterilization) for microbial safety can compromise their nutritional quality. This research study examines the effect of UV-C treatment on the amino acids and vitamin micronutrient composition of almond milk. A secondary objective was to assess the cytotoxicity of UV-C treated almond milk.

Optical properties of AM were experimentally measured. The test fluid was treated with a custom-designed pilot-scale continuous flow UV-C system operating at a flow rate of 200 litres/hr, delivering a reduction equivalent fluence (REF) of 18 mJ/cm^2. Samples were analyzed for amino acids and vitamins using spectrometry (LC-MS/MS). Percentage retention was assessed. The cytotoxicity of UV-C treated AM was evaluated using HepG2 hepatoma cells treated with varying volumes (15 µL, 25 µL, 50 µL) of UV-treated and control samples, followed by cell viability assessment using an XTT assay. Data of triplicate treatments were statistically analyzed for each analyte using one-way ANOVA.

The analysis of amino acids and vitamins showed no significant changes in concentration, indicating that UV-C treatment did not substantially alter the biochemical composition of almond milk. The mean concentrations of amino acids remained stable, with treated and control values as follows: arginine [7.2 ± 0.56 µg/mL vs. 8.77 ± 1.75 µg/mL], tyrosine [5.05 ± 0.32 µg/mL vs. 4.6 ± 0.94 µg/mL], leucine [4.23 ± 0.18 µg/mL vs. 4.13 ± 0.46 µg/mL], phenylalanine [3.09 ± 0.17 µg/mL vs. 3.1 ± 0.31 µg/mL], and tryptophan (peak area) [12,175.67 ± 1,269.8 vs. 10,190 ± 1,109.21]. Similarly, vitamin levels were consistent between treated and control samples: biotin [0.13 ± 0 ppm for both], thiamine [12.57 ± 1.06 ppm vs. 12.86 ± 1.33 ppm], and vitamin C [27.81 ± 2.35 ppm vs. 25.8 ± 0.41 ppm].In addition, the cytotoxicity results revealed that cell viability remained consistently high across all tested volumes, with treated and control samples showing viability above 80%, confirming the safety of UV-C treatment.

This study demonstrates that UV-C is an effective non-thermal processing method for plant-based beverages, preserving their nutritional quality.