ABSTRACT

Millets, a group of small-seeded grasses, are widely cultivated as staple food sources due to their nutritional richness. Finger millet (*Eleusine coracana*), a widely cultivated and nutritionally rich cereal, is gaining attention for its health benefits. However, its consumption is often limited due to the presence of antinutritional factors such as tannins and phytic acid, which impede nutrient bioavailability and protein digestibility. This study explored the application of atmospheric pressure cold plasma (CP) as a novel, green processing technology to mitigate these antinutritional factors and enhance the functional and nutritional properties of full grain, dehusked, and flour of finger millet. Using a Box-Behnken design, the CP process parameters—voltage (10–20 kV), treatment time (10–20 min), and electrode distance (8–10 cm)—were optimized with tannin and phytic acid reductions as target responses. The optimized conditions were determined for full-grain millet (20 kV, 18 min, 10 cm), dehusked millet (20 kV, 19 min, 10 cm), and flour (20 kV, 20 min, 9 cm), achieving tannin and phytic acid reductions of 24.4% and 30%, 15.37% and 19.39%, and 27% and 43%, respectively. Characterization of the CP-treated samples revealed significant improvements in functional properties, including enhanced water solubility, oil and water absorption capacities, emulsifying capacity, and foaming properties. FTIR analysis confirmed alterations in functional group concentrations, while SEM imaging demonstrated morphological changes, such as surface cracking, indicative of improved reactivity. Furthermore, CP treatment effectively reduced microbial loads, achieving over a 4-log reduction in bacterial count and a 3-log reduction in yeast and mold, enhancing the microbiological safety of the product. Storage studies conducted over 18 weeks at room temperature (28±3°C) showed that CP-treated samples stored in laminated pouches retained quality better than those stored in LDPE packets. These findings underscore the potential of CP technology to improve the nutritional and functional quality of finger millet while extending its shelf life. The study highlights CP as a sustainable and efficient alternative for processing finger millet, paving the way for its broader industrial and consumer applications.