Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

Banana is a major fruit crop in India, ranking second in area and production after mango. The banana stem, known as the pseudostem, is a juicy, fiber-rich material that is commonly consumed in certain regions of India. It also holds significant medicinal value. Widely available in markets across India, banana stem juice is recognized for its effectiveness in treating urinary disorders. It enhances kidney and liver function, helping to alleviate discomfort and improve health. However, its consumption is somewhat restricted due to its high content of phenolics and tannins. The storage of BPS juice presents a challenge for its commercialization. This study aims to compare the effectiveness of retort pouch packaging and PL technology in preserving BPS juice.

Retort processing is a thermal preservation method where BPS juice is filled into retort pouches, evacuated to remove air, sealed, and then subjected to heat treatment in a retort chamber at specific temperatures (70–90°C) and times (15–25 min). An innovative non-thermal method, PL technology, involves exposing the juice to high-intensity light pulses, rich in antimicrobial UV-C, over a short period. For PL processing, key parameters include the number of pulses (100–200), sample depth (5–15 mm), and the distance between sample and light source (4–10 cm). Experimental designs using Central Composite Design (CCD) and Box-Behnken Design in Response Surface Methodology were applied to optimize retort and PL parameters, respectively. The optimization considered physicochemical properties pH, TSS, titrable acidity, total carbohydrate, vitamin C, colour, turbidity, enzyme activity, and microbial count to ensure quality and safety.

In retort processing, variations in process parameters led to minimal changes in the TSS, titratable acidity, turbidity, and total carbohydrate levels of BPS juice. However, parameters such as pH, vitamin C, colour, enzyme inactivation, and microbial activity were significantly influenced by the retort conditions. In contrast, PL technology relies on three primary mechanisms photochemical, photothermal, and photophysical for food preservation. As a non-thermal method, PL technology minimizes nutrient and quality loss. Physicochemical assessments of PL-treated BPS juice under different parameter settings indicated that pH, TSS, titratable acidity, turbidity, and carbohydrate content experienced minimal changes, while vitamin C levels, colour, enzyme inactivation, and microbial growth showed significant variation with adjustments in processing conditions.

Optimization of the retort processing parameters, temperature (70–90°C) and time (15–25 min), was performed using Central Composite Design (CCD), while three parameters in PL treatment the number of pulses (100–200), sample depth (5–15 mm), and sample-source distance (4–10 cm) were optimized using the Box-Behnken design in Response Surface Methodology (RSM). The optimum retort conditions identified through CCD were 75°C for 17 min. For PL processing, the ideal settings were determined to be 200 pulses, a sample depth of 11 mm, and a sample-source distance of 10 cm. Experimental results using these optimized conditions revealed less than 10% variation across all responses for both retort and PL processing, indicating that the selected models were appropriate for the study.

Sensory evaluation was conducted on the optimally processed samples, revealing that PL processed samples received higher scores for all organoleptic qualities compared to those processed by retort. Retort pouch samples exhibited a slight colour change and off-odor, which decreased their overall acceptability. Shelf life analysis of BPS juice processed under optimized conditions for both retort and PL methods showed notable differences in physicochemical and microbiological stability during storage. Fresh juice samples spoiled by the 5th day, showing significant changes in physicochemical and microbial properties. In contrast, PL-treated samples maintained quality with only slight changes in initial physicochemical and microbial properties throughout storage. However, retort-processed samples showed greater variations over the storage period. By the 60th day, retort samples exhibited spoilage, along with a sour taste and foul odor. After 70 days, PL-processed samples remained relatively stable, while retort-processed samples showed higher variations in physicochemical and microbiological qualities. The rheological analysis of fresh, retort-processed, and PL processed BPS juice indicated a non-linear increase in shear stress with rising shear rate, demonstrating the juice’s non-

Newtonian behaviour. In the viscosity versus shear rate graph, all samples fresh, retort-processed, and PL-processed showed an increase in viscosity with increasing shear rate, confirming non-Newtonian shear-thickening properties. Additionally, viscosity in each type of juice sample decreased as temperature increased.

Microbial and enzyme activities in both PL and retort-processed BPS juice follow first-order reaction kinetics. This means that their reduction rate is directly proportional to the remaining concentration of microbes and enzymes, leading to exponential decay. In retort processing, microbial reduction occurs gradually with heat, while PL treatment rapidly inactivates microbes and enzymes through high-intensity light. First-order kinetics thus helps optimize processing conditions for improved juice safety and shelf life.

The PL processing, a non-thermal preservation method, is effective for preserving BPS juice. Compared to thermal processing, PL processing better retains vitamin C and the juice's natural colour, with minimal degradation. Additionally, it helps maintain the juice’s overall physicochemical properties.