

CHAPTER 6 CONCLUSIONS

Hot water, vapor heat treatment, ozonated water, sodium chlorite solution and their combined treatments were applied to fresh-cut broccoli (*Brassica oleracea* L.) florets to investigate their sanitary effects on the survival of food-borne pathogens (total bacteria, coliform, *Salmonella-Shigella* spp., and yeast and mold) and on the physical properties of the broccoli florets during storage.

HW treatment at 55 and 60 °C for 3 min completely controlled coliform and *Salmonella-Shigella* spp., but these treatments resulted in tissue softening and scald-like symptoms on the fresh-cut broccoli florets. The HW treatment at 50 °C for 3 min resulted in a reduction of both food-borne pathogens of 1.0 to 1.2 log CFU·g⁻¹ FW maintained freshness and firmness, and delayed yellowing of fresh-cut broccoli florets for 4 days. These results suggest that a hot water treatment at 50 °C for 3 min has the potential to maintain the physical quality of broccoli florets, but may not be sufficient to control the growth of food-borne pathogens.

For initial day storage, VH for 15 sec could reduce coliform 0.51 log CFU·g⁻¹ FW, but it may not enough to reduce *Salmonella-Shigella* spp., total bacteria and yeast and mold populations of fresh-cut broccoli florets as compared with untreated as control. In addition, VH for 15 sec could be accepted by the consumer in terms of quality and freshness appearance including visual quality, visual color and odor. However, increasing exposure time of VH resulted in increasing microbial populations and significantly increased traits that are unacceptable for consumers in the fresh-cut broccoli florets during storage at 4 °C. VH for 15 sec may be a poor treatment to control microbial population but this treatment could be accepted by consumers after 3 days of storage.

The use of ozonated water for 15 min significantly reduced coliforms, total bacteria, and yeast and mold counts by 1.20, 2.50, and 1.80 log CFU·g⁻¹ FW, respectively, when compared with that of the control. However, ozonated water treatments impacted fresh-cut broccoli quality by decreasing the chlorophyll contents, L* value, and hue angle. Although these physio-chemical changes of fresh-cut broccoli could be detected after

treatments, these changes were not significant enough to be observed by consumers. The visual quality and visual color of fresh-cut broccoli evaluated by the consumers in both ozonated water and non-ozonated water treatments were not significantly different.

For sodium chlorite (SC) solutions, on the initial day of storage, SC regardless of concentration significantly reduced *Salmonella* spp. population by approximately 3.0 log CFU·g⁻¹ FW. During storage, 750 and 1,000 ppm SC decreased *Salmonella-Shigella* spp. load more effectively than 500 ppm SC; however, higher SC levels caused tissue damage and browning was evident after 9 days of storage. SC at 500 ppm was often more effective than higher SC levels in reducing total bacterial and yeast and mold counts. SC did not affect weight loss, floret color, sensory attributes and chlorophyll content. 500 ppm SC could be used to reduce microbial population and to maintain quality of fresh-cut broccoli florets.

The effects of combined treatments with hot water (HW) at 45 °C and 300 ppm of sodium chlorite (SC) solution on microbial reduction, quality and antioxidant properties of fresh-cut broccoli florets were determined during storage at low temperature. Results revealed that washing the fresh-cut broccoli with either HW combined SC solution or pre-washing with tap water was able to reduce microbial loads. The combined treatments were powerful in decreasing the total aerobic bacteria, coliforms, and yeast and molds during storage with the ranges of 1.31 to 1.97, 1.06 to 1.33 and 1.08 to 1.96 log CFU·g⁻¹ FW, respectively, compared with non-treated samples. Furthermore, the combined treatments had no negative effects on color quality (lightness and hue angle). In addition, the HW combined SC treatment maintained the antioxidant capacity (ascorbic acid and dehydroascorbic acid, the chlorophyll content (total chlorophyll, chlorophyll *a*, chlorophyll *b* and carotenoid), total phenolic, flavonoid and total glucosinolate contents and the antioxidant capacity (DPPH*)) throughout the storage period. These findings indicate that HW combined SC treatment may have potential to reduce microbial contamination and preserve the antioxidant capacity of fresh-cut broccoli.

The HW combined SC treatment also influenced the antioxidant enzymes activity. An increase in chlorophyllase (Chlase), catalase (CAT), peroxidase (POD), ascorbate peroxidase (APX) and glutathione reductase (GR) activities were detected during the

storage period. The H_2O_2 generated by superoxide dismutase (SOD) or other sources accumulated and thus CAT, POD and APX activities were higher towards the end of the storage. This suggests that HW at 45 °C combined with 300 ppm of SC treatment can delay or maintain the senescence of broccoli florets. The benefits of applying a combined treatment may not only generate higher protection against oxidative molecules in plant broccoli tissues during postharvest senescence, but also could contribute to better nutritional quality in fresh-cut broccoli florets.