Zaharan Hussein

Perforation-Mediated Modified Atmosphere Packaging (PM-MAP) and Shelf-Life of Pomegranate Fruit Arils (cv. ACCO)

Abstract

Perforation-mediated modified atmosphere packaging (PM-MAP) offers the possibility of optimizing polymeric films in order to compensate for barrier limitations of conventional modified atmosphere packaging (MAP). The aim of this study was to investigate the effects of PM-MAP and storage duration on the physico-chemical quality attributes, microbial quality, phytochemicals (anthocyanins, phenolics and ascorbic acid) and antioxidant activities of arils from fresh minimally processed pomegranate (cv. Acco). The effects of number of perforations (0, 3, 6 and 9; Ø = 0.8 mm) and storage temperature (5, 10 and 15 ºC) on water vapor transmission rate (WVTR, g/m2.day) of synthetic 'Polylid' and biodegradable (Nature flexTM) polymeric films were investigated. The results showed that non-perforated biodegradable film had higher WVTR at all storage temperatures, and irrespective of film type, increasing the number of perforations (from P-3 to P-9) had a higher impact on WVTR than increasing storage temperature (from 5 to 15 ºC).

Furthermore, this study investigated the effects of PM-MAP on the physico-chemical properties, phytochemicals components and antioxidant activities of fresh minimally processed arils. Arils (100 g) were packaged in polypropylene trays (10.6 x 15.1 cm2) and heat-sealed with a polymeric film POLYLID®. Perforations (0, 3, 6 and 9; Ø = 0.8 mm) were made on the top of the film and all samples were stored at 5 ± 1 ºC and 95 ± 2% relative humidity for 14 days. Samples were analyzed at intervals of 3, 6, 9, 12 and 15 days. Microbial analysis included tests for *Escherichia coli*, aerobic mesophilic bacteria, yeast and molds at days 0, 6, 10 and 14.

The results showed that headspace gas composition was significantly influenced by the number of perforations, which helped balance the decrease in O2 with corresponding increase in CO2 levels, thus preventing anoxic conditions. Total soluble solids, titratable acidity and firmness of arils were slightly reduced by PM-MAP compared to clamshell trays. Color attributes were generally maintained across all treatments and throughout the storage duration. The highest counts of aerobic mesophilic bacteria (5.5 log CFU/g), yeast and molds (5.3 log CFU/g) were observed in P-0 and P-9 packages, respectively. Overall, P-3 and P-6 better maintained the physico-chemical properties and microbial quality of arils. Total phenolics and anthocyanin contents were higher in arils packaged in PM-MAP while ascorbic acid was slightly reduced. Antioxidant activities that were tested against FRAP and DPPH radical-scavenging activity increased across all types of MAP over storage duration. However, antioxidant activities were significantly higher in pomegranate arils packaged in PM-MAP due to O2-promoted biosynthesis of phenolics and anthocyanins which constitute the antioxidant properties.

Overall, the results reported in this study showed that the use of PM-MAP in cold chain could be suitable for the preservation of physico-chemical quality, phytochemical contents and antioxidant properties of arils packaged in passive PM-MAP compared to clamshell and non-perforated packages during postharvest handling and storage. Perforating MAP films showed potential regarding the prevention of the incidence of in-package moisture condensation which is a common problem during postharvest handling and storage of fresh produce packaged inside non-perforated MAP. The results

also showed the importance of keeping PM-MAP packs in closed refrigerated shelves to avoid cross contamination or ingress of foodborne pathogens.