

ABSTRACT

Pomegranate (*Punica granatum*) is a highly valued crop with a huge economic potential. It is very nutritious with numerous bioactive compounds with the potential to prevent a certain type of cancers and other health conditions. The fruit can also be processed into various industrial products. In South Africa, the pomegranate industry is growing rapidly due to the rising demand from local and international markets. However, owing to its high perishability, the shelf life is limited to less than eight weeks under cold storage conditions. In light of this, a study of 'CA' storage as a supplementary postharvest treatment was investigated. The 'CA' storage is a system that involves altering and maintaining an atmospheric gas composition different from that of room air (79% N₂, 20% O₂, and 0.03% CO₂) to levels generally, with O₂ below 8% and CO₂ above 1% supplemented with low temperature and relative humidity above 90%. The primary objective of this study was to investigate the physiological and quality response of pomegranate (weight loss, shrivel, decay, colour, texture, incidences of disorders and decay) to different 'CA' treatments and storage temperatures. In addition, to assess the overall quality (total soluble solids, pH, acidity, antioxidant properties, aroma volatility compounds and sensory analysis) including respiration and development of a model for predicting the transpiration rate with the view to optimise the 'CA' storage requirements for 'Wonderful' and 'Bhagwa' pomegranates. The results showed that the selected pomegranate cultivars responded differently to 'CA' storage conditions. More importantly, it was observed that by increasing CO₂ and/or decreasing O₂ concentrations under 'CA' resulted in opposite effects on quality attributes. Despite the variation in response, the shelf life of the whole pomegranate fruit was extended by five months more after harvest with a minimal loss of physiological properties (weight loss, physiological disorders, colour, and texture) and quality. Furthermore, the notable fluctuation of quality attributes (TSS, aroma volatility compounds and antioxidants) under 'CA' conditions depended highly on cultivar, storage temperature, gas composition and storage duration. In addition, a mathematical model developed based on respiratory heat energy reliably predicted the transpiration rate, with an accuracy of $R^2 = 0.97$. In conclusion, the study proposes a goal-oriented optimisation strategy focussing on the market driven quality expectation with a negligible compromise on some attributes. The concept was validated using a general linear model (statistical tool) which showed that atmosphere under CAs minimised the weight loss with minimal physiological and quality loss of attributes in addition to extending the shelf life for than two-fold compared to room air. These findings highlight both importance and challenges in finding optimal 'CA' for the storage of fresh horticultural produce