

**Title** Controlled atmosphere (CA) treatment of broccoli after harvest delays senescence and induces the expression of novel *BoCAR* genes

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#### **Abstract**

The transcription of four genes (*BoCAR1A*, *BoCAR5*, *BoCAR6-4* and *BoCAR25*) is up-regulated in response to CA treatment in broccoli (*Brassica oleracea*). Physiological and biochemical changes and gene expression patterns were examined in broccoli tissues held in one of different atmospheres, namely air (< 1% CO<sub>2</sub>, 21% O<sub>2</sub>), high carbon dioxide and low oxygen (CA:10% CO<sub>2</sub>, 5% O<sub>2</sub>), low oxygen (0% CO<sub>2</sub>, 5% O<sub>2</sub>), and high carbon dioxide (10% CO<sub>2</sub>, 20% O<sub>2</sub>). Gene expression was also examined in tissues held for short periods in CA (< 24 h) followed by air. In addition, we examined whether CA treatment was effective in up-regulating these CA-responsive genes and delaying senescence after early senescence-associated gene changes had been initiated by exposing broccoli tissues to CA after 48 h in air. Molecular analysis showed that a combined high CO<sub>2</sub> and low O<sub>2</sub> atmosphere was more effective than high CO<sub>2</sub> or low O<sub>2</sub> alone for inducing maximum gene expression and delaying postharvest broccoli senescence. In addition, broccoli tissues responded to CA treatment after a 48 h period in air with increased CA-responsive gene expression. *BoCAR* transcription was not elevated in tissues exposed to stresses that promoted senescence (e.g. salt and water stress), or in tissues treated with cytokinin, a treatment known to delay the onset of postharvest senescence in broccoli. The expression of one gene (*BoCAR6-4*) appears to be specific to CA treatment in harvested broccoli tissues.