Title Effects of CA treatment and temperature on broccoli colour development

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Abstract

Broccoli combines high contents of vitamins, fibres and glucosinolates with a low calorie count and is sometimes referred to as the 'crown jewel of nutrition'. Colour is one of the most important quality attributes of broccoli, and yellowing due to senescence of broccoli florets is the main external quality problem in the broccoli supply chain. Controlled Atmosphere (CA) is a very effective method to maintain broccoli quality but the effects of CA on colour retention have not been studied extensively. The aim of this paper is to characterise the colour behaviour (measured by RGB colour image analysis) of broccoli as affected by CA and temperature. Data on colour behaviour and gas exchange were gathered for broccoli heads that were stored in containers at three temperatures and subjected to four levels of O_2 and three levels of CO_2. Gas conditions and temperature have a clear effect on the colour change of broccoli especially at low O_2 in combination with high CO_2. An integrated colour model is proposed that combines a colour model with a standard gas exchange model. The colour model is based on three differential equations describing the formation of (blue/green) chlorophyllide from the colourless precursor, the bidirectional conversion of chlorophyllide into (blue/green) chlorophyll, and the decay of chlorophyllide. During the first step of building the integrated model, gas exchange data were analysed simultaneously using multi response regression analysis. No fermentation was encountered for this batch of broccoli. During the second step it was found that only one of the reactions of the colour model, the decay of chlorophyllide, is affected by the gas conditions. In the final step, a multi-response approach was applied where gas exchange parameters were estimated using the gas exchange model, the colour parameters were estimated using the colour model with both models linked via the reaction rate constant affected by the gas conditions. Such a calibrated, integrated, model could be used as a tool for predicting colour change in the postharvest chain.