

# Exploring oxygen diffusion and respiration in pome fruit using non-destructive gas in scattering media absorption spectroscopy

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## Abstract

Pome fruit stored under a controlled atmosphere (CA) often suffers hypoxia due to the mismatch of O<sub>2</sub> level in the storage rooms and the fruit's O<sub>2</sub> consumption. Fruit response-based O<sub>2</sub> sensing and control could be an efficient approach to reduce the hypoxia-related physiological disorders and therefore increase the shelf life of stored fruit. This research aims to validate and evaluate the application of nondestructive gas in scattering media absorption spectroscopy (GASMAS) O<sub>2</sub> sensing in fruit post-harvest. In the first stage, the GASMAS O<sub>2</sub> sensor was validated on a fruit mimicking multilayer model system where a high correlation was observed between the measured and reference O<sub>2</sub> partial pressures ( $r^2 \geq 0.9$ ). Later, the GASMAS sensor was evaluated on two apple cultivars (*Malus x domestica* 'Golden delicious', *Malus x domestica* 'Nicoter') and one pear cultivar (*Pyrus communis* 'Conference'). The observed GASMAS signal from the 'Golden delicious' apples were nearly 2 times higher than the signal from 'Nicoter' apples and 5 times higher than from the 'Conference' pears. In the next stage, GASMAS measurements were taken on water submerged 'Golden delicious' apple and 'Conference' pear to investigate the difference in O<sub>2</sub> consumption in those fruit. The calculated relative O<sub>2</sub> changes during respiration and evolution of the O<sub>2</sub> partial pressure after nitrogen treatment for both the fruit were found different. It was hypothesized that these findings may be attributed to variations in fruit porosity. And finally, the influence of skin and additional surface coating on the gas exchange was studied by immersing unpeeled, peeled and coated samples in the gaseous nitrogen for 2 h before measurement. The coating was found to reduce the gas exchange compared to the unpeeled samples which already exhibited a lower exchange rate than the peeled samples.