**Title** Inhibition of anaerobic respiration in fresh-cut apple slices

**Author** Joris Amissah and Joseph H. Hotchkiss

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**Abstract**

Modified atmosphere packaging (MAP) extends the shelf life of fresh-cut fruits and vegetables. However, low oxygen ($O_2$) atmospheres associated with MAP can result in anaerobic fermentation and the accumulation of undesirable levels of acetaldehyde, ethanol and ethyl acetate. Alcohol dehydrogenase (ADH) catalyzes the conversion of ethanol to acetaldehyde. Inhibition of this reaction by nitric oxide (NO) has been demonstrated in rat and equine liver but inhibition of the reverse reaction has not been shown in yeast or plant tissue. This study investigated the effects of NO and sodium nitrite ($NaNO_2$) treatment on ADH activity in yeast and on ADH activity and shelf life of fresh-cut apples.

Yeast ADH activity was determined after pre-incubating the enzyme over time with or without 0.5-2 mM solutions of NO or $NaNO_2$. Fresh-cut apple slices were stored in 0.25 to 1% (v/v) NO (balance $N_2$) or 100% $N_2$ atmospheres in anaerobic vessels or high $O_2$ barrier pouches for 2 or 3 days at 6.1 °C. Slices were also treated with 1% NO or 2 mM $NaNO_2$, (with 100% $N_2$ or deionized water as control) packaged in 100% $N_2$ in pouches and stored for 6 weeks. Accumulation of ethanol, acetaldehyde and ethyl acetate were determined. Slice firmness and color were also measured.

Yeast ADH activity decreased in a dose and time-dependent manner with NO but was unaffected by $NaNO_2$ . Ethanol accumulation in sliced apples was inhibited by 1% NO treatment whilst acetaldehyde increased, in both anaerobic vessels and pouches. Ethyl acetate accumulation was inhibited only in anaerobic vessels. In the six-week study, slices treated with 1% NO or 2 mM $NaNO_2$ accumulated lower ethanol and higher acetaldehyde concentrations than the controls. Ethyl acetate accumulation was lower in NO-treated slices but unaffected by 2 mM $NaNO_2$. Treatment with NO or $NaNO_2$ resulted in darker slices (lower L* Values) than the controls, but did not affect slice firmness.

Our results suggest that NO and nitrite may be used to inhibit anaerobic respiration and extend the shelf life of fresh-cut apple slices and produce with low concentrations of phenolic compounds in which browning is not a major factor.