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Report

Study to evaluate the effects of DCA-CF (Fruit Observer) on storability and fruit quality of 'Elstar' Apples

September 2017- June 2018

Date : 04 June 2019

final report

1. Detection of the lowest oxygen limit with Fruit Observer

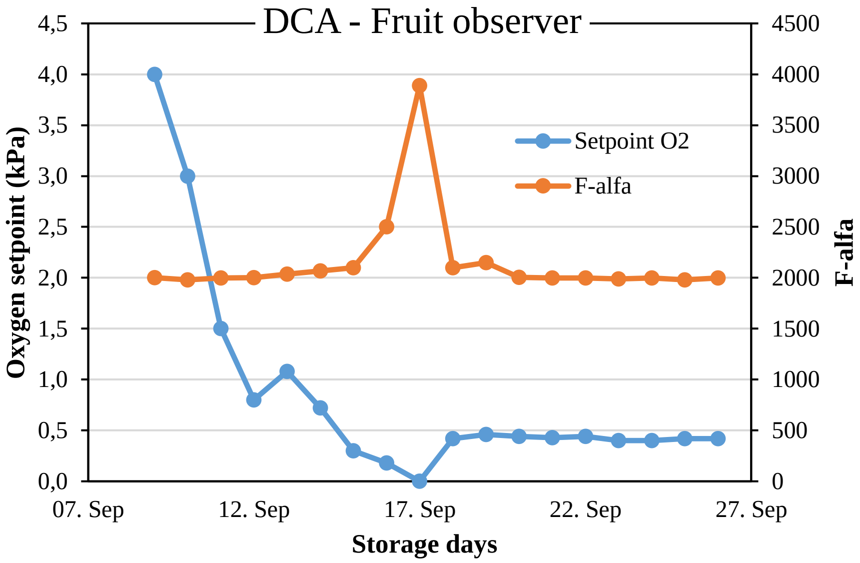

Figure 1. Oxygen setpoint lowering until a chlorophyll fluorescence peak was detected by Fruit observer in 'Elstar' apples at 1°C.

One of the main challenge during the storage of apples under extremely low oxygen partial pressures is the detection of the lowest oxygen limit over the storage period. Figure 1 shows how the oxygen was lowered in a storage room equipped with a chlorophyll fluorescence sensor (Fruit Observer) until the chlorophyll spikes. According to the results, it could be observed that the sensor was able to detect the lowest oxygen limit of 'Elstar' apples. For this cultivar, at this year, the lowest oxygen limit was between 0.5 and 0.3 kPa according to Fruit observer, as showed in figure 1.

2. The effect of storage under DCA based on Fruit observer and Respiratory Quotient on ethylene production and respiration rate of 'Elstar' apples

The storage under DCA results in reduced production of ethylene, regardless the DCA method (Figure 2). When the fruit were treated with 1-MCP there was no ethylene production regardless the storage condition (Figure 2). Storage under DCA - Fruit observer resulted in lower ethylene production as compared to CA, for fruit without 1-MCP treatment. The lower ethylene production by fruit stored under DCA is extremely important in order to reduce firmness loss, as will be discussed later.

The lower ethylene production by fruit stored under DCA resulted in lower respiration rate (Figure 2). The lower respiration of fruit stored under DCA is very important in order to extend the shelf life of fruit, reducing the sugars and acids degradation and consequently maintaining higher overall quality.

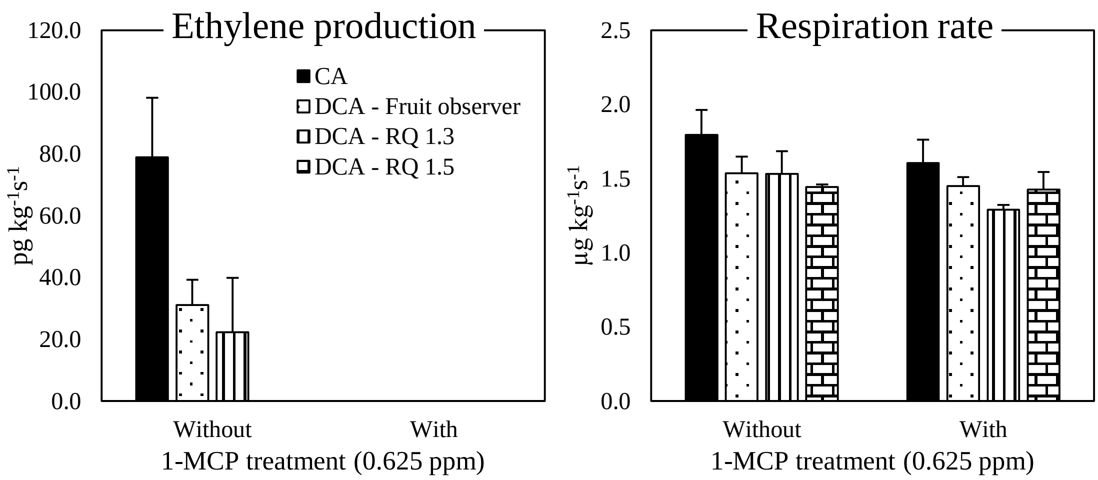

Figure 2. Ethylene production rate and respiration rate of ‘Elstar’ apples after 9 months of storage in controlled atmosphere (CA), dynamic controlled atmosphere based on chlorophyll fluorescence (DCA - CF - Fruit Observer) and dynamic controlled atmosphere based on respiratory quotient (DCA RQ) either without or with 1-MCP treatment (0.650 µL L^{-1}), plus 7 d of shelf life at 20°C.

3. Fruit quality after 9 months of storage in DCA - Fruit observer

Fruit storage under DCA, regardless the method, had lower decay incidence as compared to CA in fruit without 1-MCP (Figure 3). However, when fruit were treated with 1-MCP this positive effect of DCA was not observed, and there was a similar decay incidence for all storage conditions. These results showed that the storage under DCA combined to 1-MCP resulted in higher decay incidence as compared to fruit stored under DCA without 1-MCP.

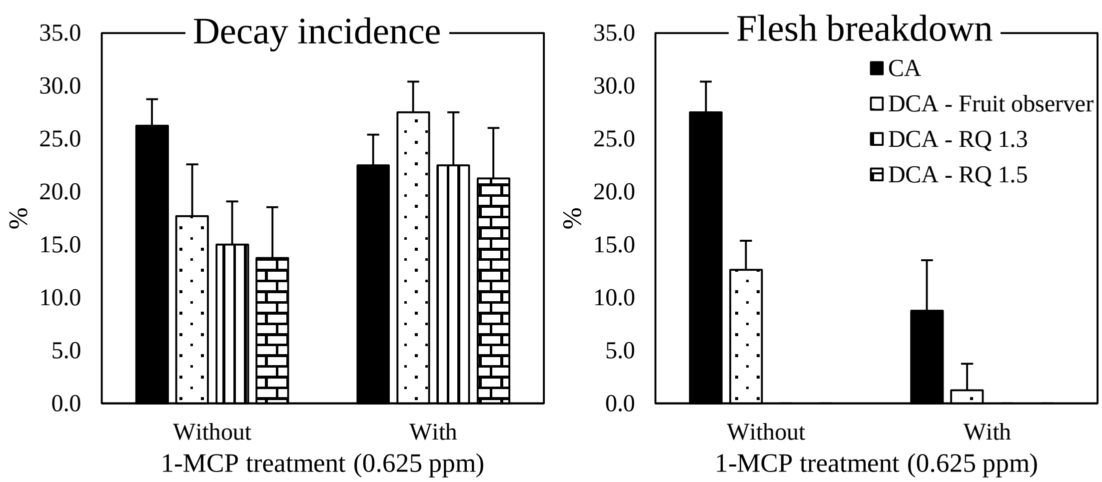

Figure 3. Decay incidence and flesh breakdown of ‘Elstar’ apples after 9 months of storage in controlled atmosphere (CA), dynamic controlled atmosphere based on chlorophyll fluorescence (DCA – CF – Fruit Observer) and dynamic controlled atmosphere based on respiratory quotient (DCA – RQ) either without or with 1-MCP treatment (0.650 µL L^{-1}), plus 7 d of shelf life at 20°C.

The storage under DCA, regardless the method resulted in lower flesh breakdown incidence as compared to CA after 9 months of storage plus 7 days of shelf life (Figure 3). However, the storage under DCA - Fruit observer resulted in fruit with higher flesh breakdown incidence as compared to DCA - RQ, for fruit without and with 1-MCP treatment (Figure 3). For fruit stored under CA and DCA - Fruit observer, the 1-MCP application reduced the incidence of flesh breakdown.

Reduced incidence of decay and flesh breakdown in fruit stored under DCA, regardless the DCA method, resulted in higher sound fruit amount as compared to CA (Figure 4). The positive effect of DCA on sound fruit amount is only observed in fruit without 1-MCP. The higher amount of sound fruit by storage under DCA means in practical terms, more income for the storage company.

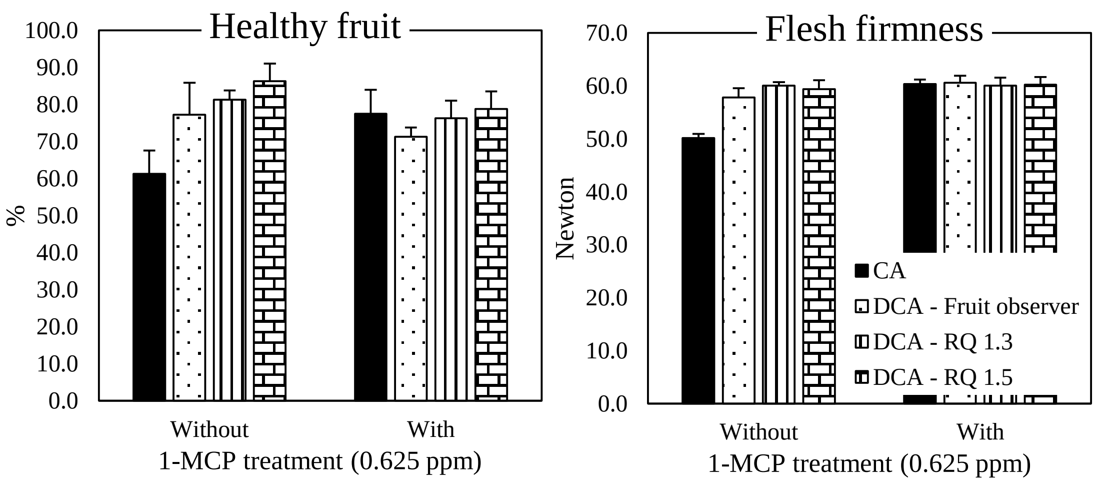

Figure 4. Sound fruit amount and flesh firmness of 'Elstar' apples after 9 months of storage in controlled atmosphere (CA), dynamic controlled atmosphere based on chlorophyll fluorescence (DCA – CF – Fruit Observer) and dynamic controlled atmosphere based on respiratory quotient (DCA – RQ) either without or with 1-MCP treatment (0.650 $\mu L\ L^{-1}$), plus 7 d of shelf life at 20°C.

Fruit firmness is one of the main quality attribute of apples. At the present experiment, the storage under DCA - Fruit observer resulted in higher flesh firmness as compared to CA, in fruit without 1-MCP (Figure 4). Probably, the higher flesh firmness retention by DCA is a result of reduced ethylene production, maintaining the integrity of cell wall. When fruit were treated with 1-MCP, the DCA had no positive effect on firmness maintenance (Figure 4).

The storage under DCA - Fruit observer and DCA - RQ had no effect on soluble solid accumulation and titratable acidity concentration, either in fruit without or with 1-MCP treatment (Figure 5).

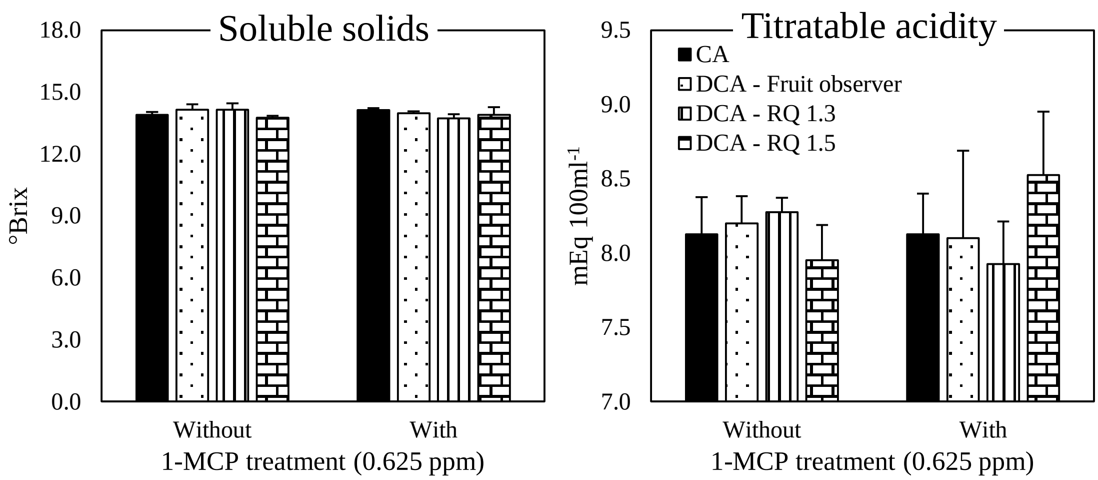

Figure 5. Soluble solids and titratable acidity of 'Elstar' apples after 9 months of storage in controlled atmosphere (CA), dynamic controlled atmosphere based on chlorophyll fluorescence (DCA – CF – Fruit Observer) and dynamic controlled atmosphere based on respiratory quotient (DCA – RQ) either without or with 1-MCP treatment (0.650 µL L^{-1}), plus 7 d of shelf life at 20°C.

4. Conclusion about DCA – Fruit observer on 'Elstar' apples

The method of chlorophyll fluorescence based on Fruit observer is able to detect the lowest oxygen limit during the storage of 'Elstar' apples, avoiding low oxygen damage.

'Elstar' apples monitored by Fruit observer had higher quality as compared to fruit in CA, due to lower decay incidence, higher healthy fruit amount and flesh firmness. This is a result of lower ethylene production and respiration rate of fruit in DCA – Fruit observer.

A noteworthy fact is that fruit stored under DCA, regardless the method, had lower flesh breakdown as compared to CA.