Ozone as an alternative method to control postharvest diseases on strawberries

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Introduction

Strawberries are popular fruit mainly appreciated for their red color, sweet taste and fruity flavor. However, they suffer from a short shelf life principally due to the development of fungal diseases and sensitivity to mechanical damages. Strawberries are therefore generally commercialized rapidly after harvest to limit high fruit losses, although retailers and consumers are nevertheless regularly confronted with rotten fruit. As the application of fungicides is more and more restrictive, alternative methods are needed to prolong storage life of strawberries after harvest while maintaining fruit quality.

Objective of the study

To evaluate the effect of a treatment with gaseous ozone on the development of decay and the quality of strawberries during cold storage and shelf life.

Material and methods

Strawberries from 4 cultivars ('Murano', 'Clery', 'Irma' and 'Laetitia') grown in Valais (Switzerland) and issued from organic and conventional crops were harvested in 2016 and 2017 at different dates and stored at 8 °C. When applied, ozone treatment was performed daily at a concentration of 2 to 3 ppm during 3 hours. Influence of ozone was evaluated on percentage of decayed fruit and fruit quality (firmness, skin color, total soluble solids (TSS) and acidity) after cold storage and after shelf life.

Results

Fungal decay was on average delayed with ozone treatment applied during storage at a concentration of 2 to 3 ppm, but not inhibited (Fig. 1 and 2). The repetition of the same experiment on fruit from the same crop but harvested at different dates showed that ozone influence varied according to harvest date (Fig. 1). Efficacy of ozone was particularly visible after 1 week of storage at 8 °C and an application of the treatment during 2 days showed no impact during shelf life (Fig. 2).

Fruit Quality was on average not affected by ozone treatment (Tab. 1). Firmness was slightly higher with ozone, although the difference was significant only for fruit of the cultivar 'Murano' harvested in 2016. Skin color, TSS and acidity were not influenced by the treatment.

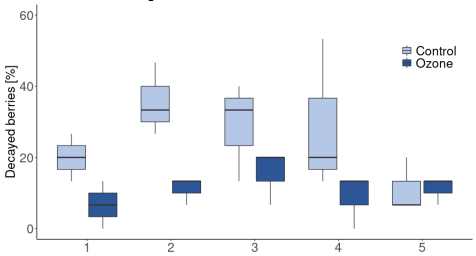

Fig. 1 Influence of ozone treatment on percentage of strawberries affected by decay after 8 days of storage at 8 °C (2016).

Tab. 1. Firmness, skin color [L*, a* and b*], TSS and acidity of strawberries treated or not with ozone. Values are means of n experiments. Means with the same letters are not significantly different at p≤0.05 according to the Student-test. nd: not determined.

Year	Days of storage 8°C/20°C	Treatment	Firmness [ID50]	Skin color [L*]	[a*]	[b*]	TSS [°Brix]	Acidity [g/kg citr. ac.]
2016 (n=4)	8/0	Control	63.2^{b}	35.6^{a}	34.5^{a}	21.9^{a}	8.6^{a}	8.1^{a}
		Ozone	65.5^{a}	35.7^{a}	34.2^{a}	21.7^{a}	8.7^{a}	8.0^{a}
2017 (n=7)	2/2	Control	70.9^{a}	31.3^{a}	27.3^{a}	18.1^{a}	nd	nd
		Ozone	72.2^{a}	31.2^{a}	27.8^{a}	17.8^{a}	nd	nd
2017 (n=7)	7/2	Control	58.3^{a}	31.6^{a}	29.0^{a}	19.6^{a}	nd	nd
		Ozone	59.6^{a}	31.5^{a}	28.9^{a}	19.5^{a}	nd	nd

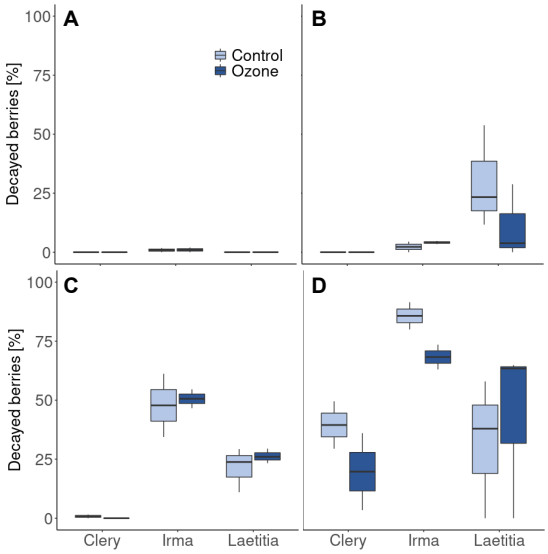

Fig. 2. Influence of ozone on the percentage of decayed strawberries stored during **A**: 2 and **B**: 7 days at 8 °C and 2 days of shelf life after **C**: 2 days at 8 °C and **D**: 7 days at 8 °C. 'Clery' and 'Irma' : means of 2 experiments, 'Laetitia': means of 3 experiments.

Conclusions

- Fungal growth was on average delayed but not entirely inhibited with ozone treatment applied at 2 to 3 ppm for 3 hours per day during storage of strawberries at 8 °C.
- Efficacy of ozone treatment was strongly influenced by the cultivar and / or harvest date.
- Fruit skin color, TSS and acidity were not affected by ozone treatment, while firmness was slightly higher in treated fruit.
- These results bring evidences that ozone is a suitable alternative method to limit fruit losses after harvest by acting efficiently on a major cause of fruit loss, i.e. microbiological growth.