



biofresh
fresh thinking in crop storage

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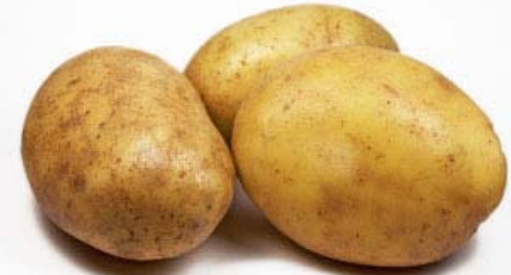
biofresh

biofresh aims to become a globally recognised brand in novel, residue-free, post-harvest solutions for fresh produce.

biofresh technologies

- ozone (O_3) : reducing microbial decay in a wide range of produce.
- ethylene (C_2H_4) : inhibiting sprouting in potatoes.

biofresh technologies



- ethylene for sprout suppression in potatoes



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biofresh technologies



- ozone for reduction of post harvest microbial decay



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why ozone?



- 1) **reduces fruit spoilage:**
inhibits sporulation
protecting against a
broad spectrum of
bacterial and fungal
diseases



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why ozone?



- 2) **enhances shelf Life:**
(inhibits ripening and reduces odours) by reacting with volatile compounds including ethylene.



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why ozone?



- 3) maintains firmness/quality:
prevents break down of
wall-cells and therefore
softening of fruit.



why ozone?



- 4) cleanses warehouse environment: continual cleansing of both spores and ethylene from air.



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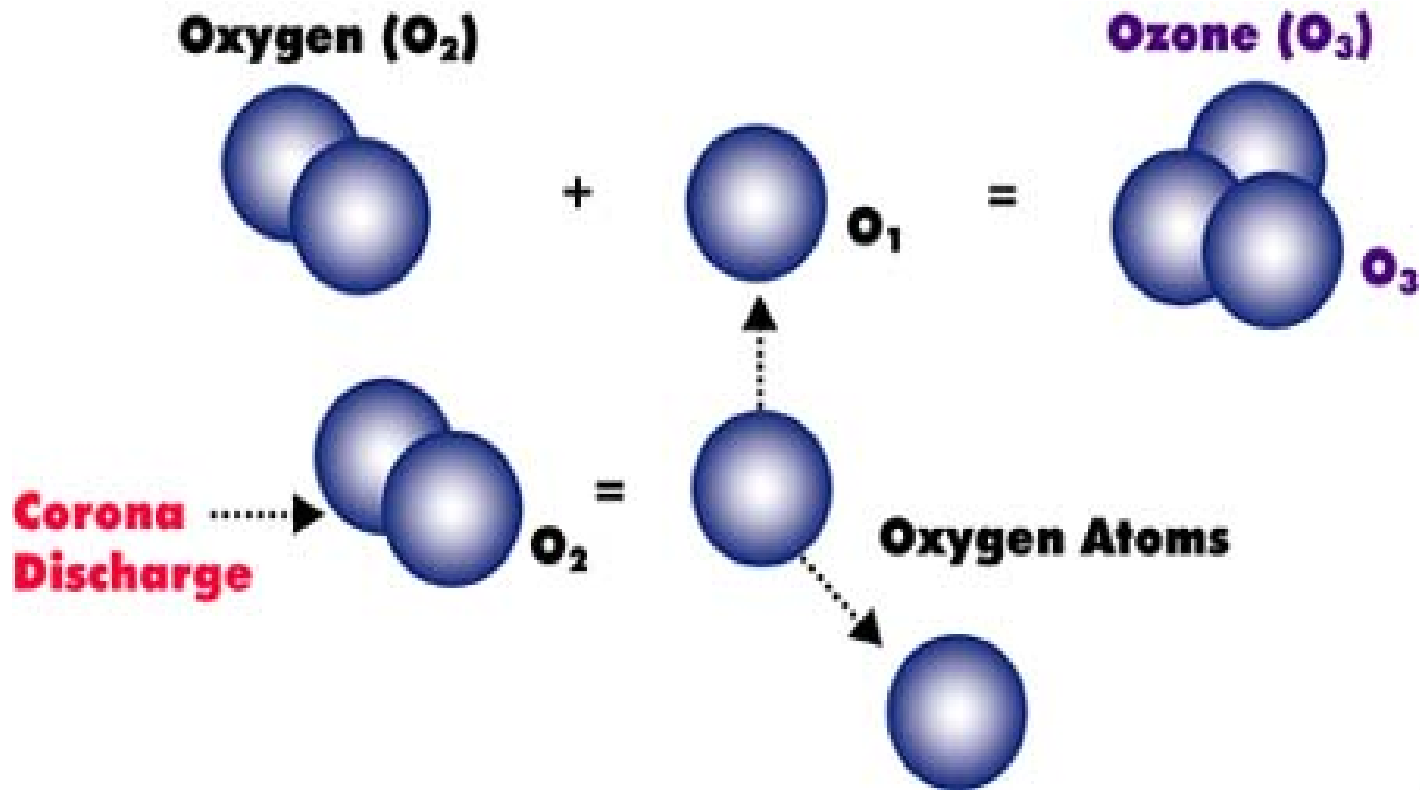
why ozone?



⇒ **easy & effective delivery** -
simple generator/monitor system with
no requirements for bottled gas.

⇒ **safe** -
no residues, breaks down to
yield oxygen

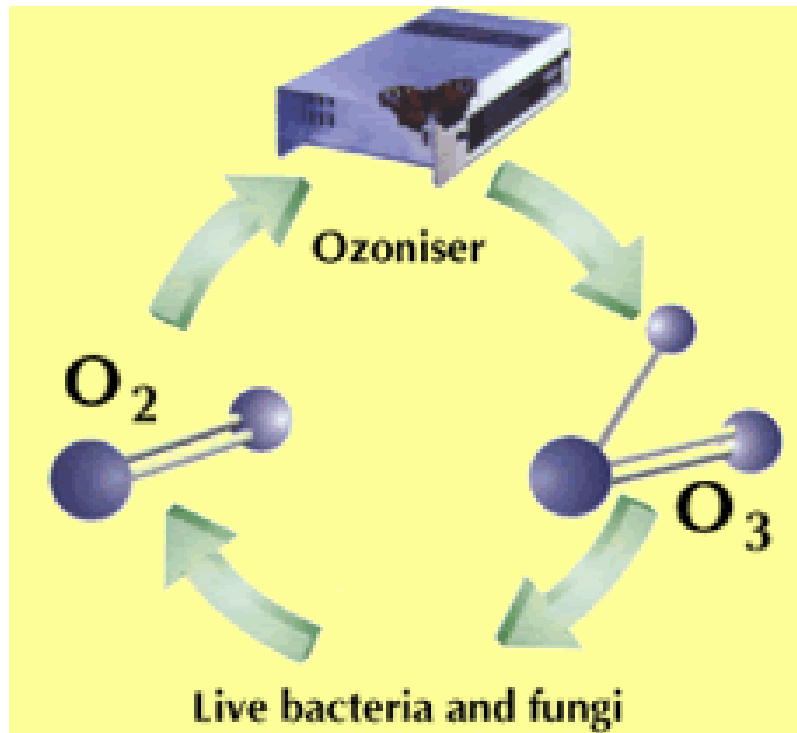
generation of ozone



ozone in nature



how ozone works



- O₃ has a weak bond that will split leaving O₂ as by-product
- Oxidation reaction occurs when O₃ collides with a molecule of an oxidable substance
- Organic molecules are destroyed

ozone - worker safety



[ozone] (ppm)	Effect
0.01 - 0.10	odor can be detected
0.1	permitted concentration (8hr/day)*
0.3	short-term exposure permitted (15 min)
0.01 - 1.0	throat pain, respiratory irritation, eye irritation
1.0 - 10.0	nausea, chest pain, coughing, fatigue, blurred vision
10.0	immediate risk to life
>20.0	fatal within one hour

biofresh results



strawberries

oranges

grapes

tomatoes

strawberry results



STAGE 1:

Strawberries firm, bright fresh appearance no signs of any deterioration.



STAGE 2:

Strawberries firm to touch, appearance satisfactory, one or two soft spots evident.



STAGE 3:

Strawberries give slightly when handled, more than two soft spots apparent.



STAGE 4:

Strawberries soft when handled, numerous soft spots evident, no signs of mould.



STAGE 5:

Strawberries of poor appearance, disintegrate when handled, mould apparent.

strawberry results



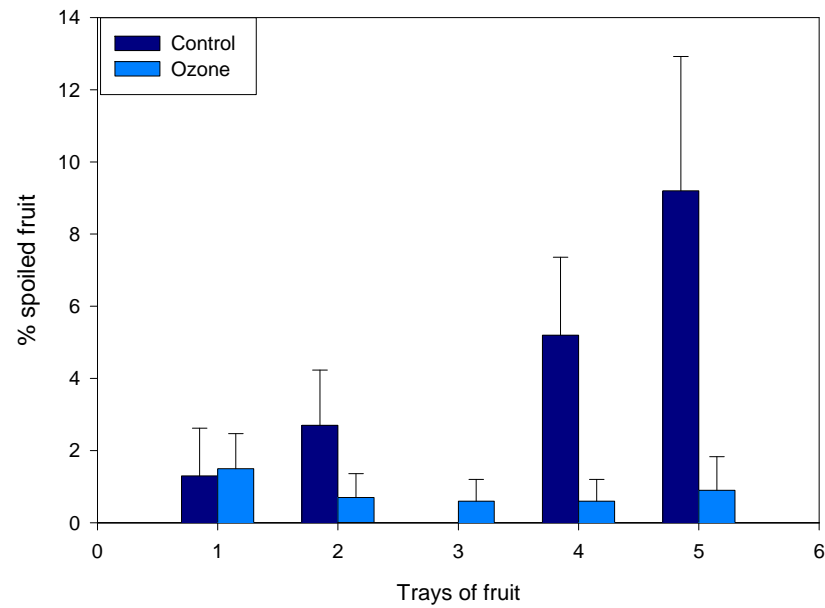
day 7 control



day 7 ozone

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strawberry results



strawberry results



day 10 control



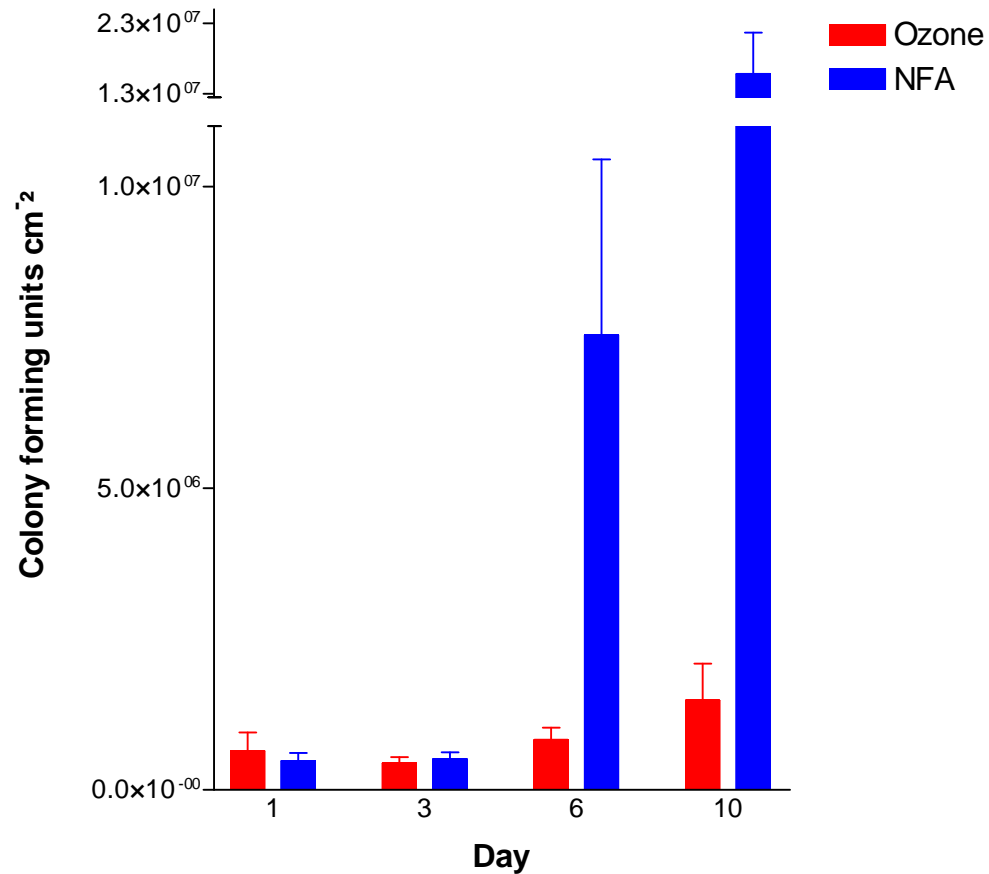
day 10 ozone

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bacteria in strawberries



**Bacterial Counts of Infected Strawberries
Treated with Ozone (200ppb) and Control
(NFA)**



strawberry results



treated for 36 hours @ 180ppb

photograph 9 days after harvest, 7 days after treatment

strawberry results



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citrus results



oranges - non-fungicide treated : stored 4 weeks (2 weeks O3)



no fungicide + ozone

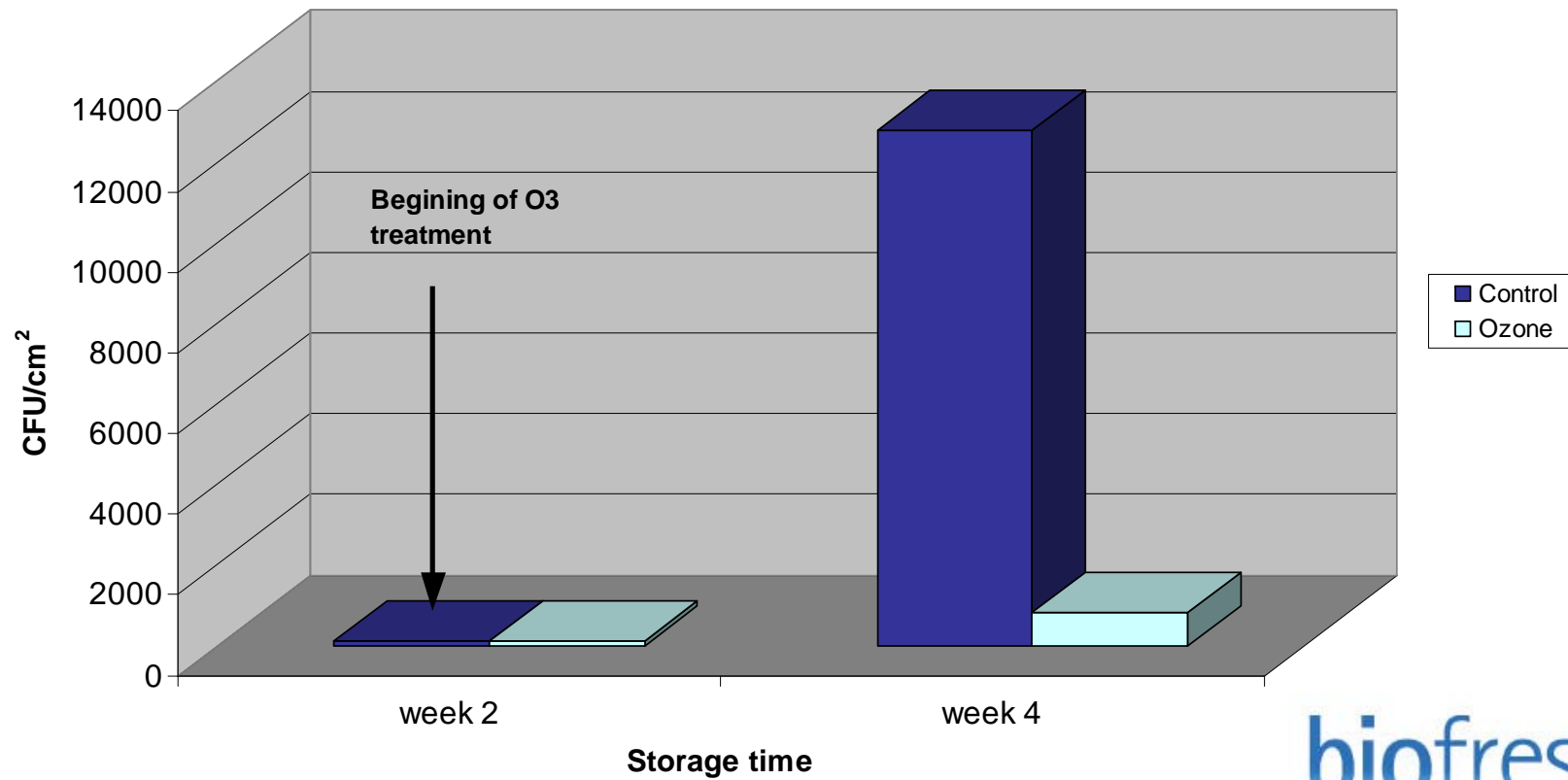


no fungicide :control

mould in oranges



mould counts in oranges treated without wax or fungicide



citrus results



oranges - drenched : stored 4 weeks (2 weeks O₃)



drench + ozone

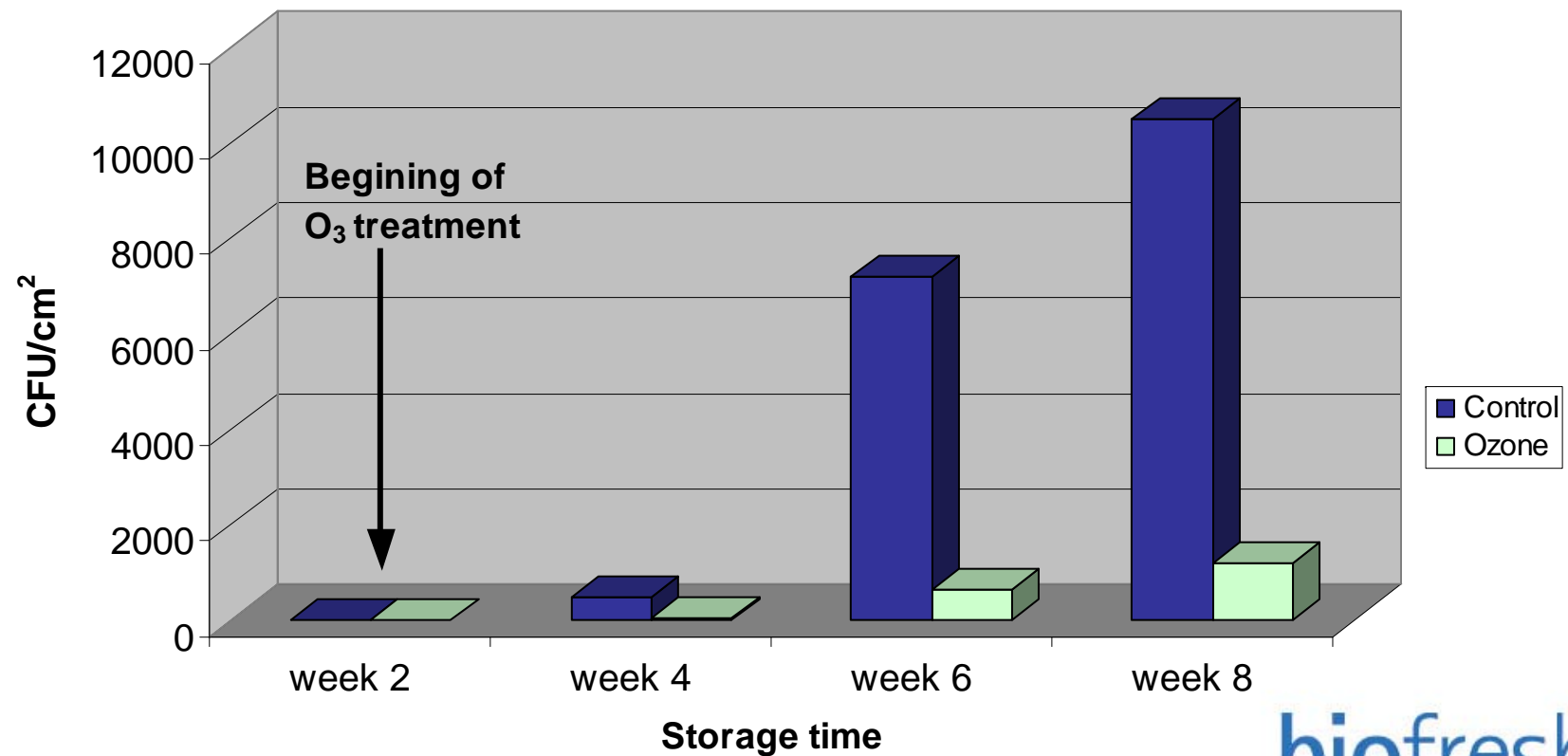


drench : control

mould in oranges



mould counts in oranges treated with wax & fungicide



mould in oranges



prevention of spread of disease



grape results



Storage in ozone at low concentrations (below H and S limits):

- clear quality maintenance in ozone enriched atmosphere
- improves turgidity
- less development of mould

grape results



O₃ improves turgidity of grapes



control
after 12 days storage



180ppb ozone

grape results



O₃ prevents deterioration of the stem



control



180ppb ozone

grape results



Improved colour when compared with sulphur treatment



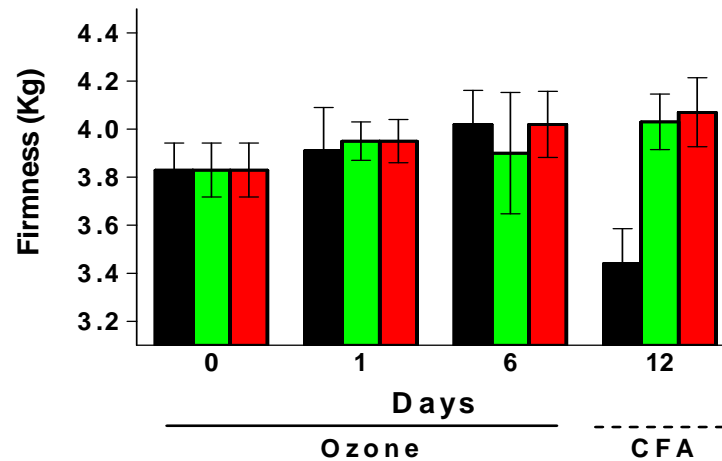
tomato results



note the reduction in
spore production :
leads to reduction in
disease spread during
storage

tomato maintained in ozone and
inoculated with botrytis cinerea

tomato results



charcoal-filtered 'clean air' (CFA: ■)
or ozone; 0.05 ppm (■) or 1.0 ppm (■)

biofresh results

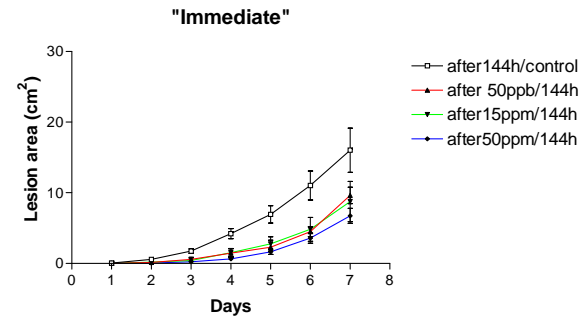
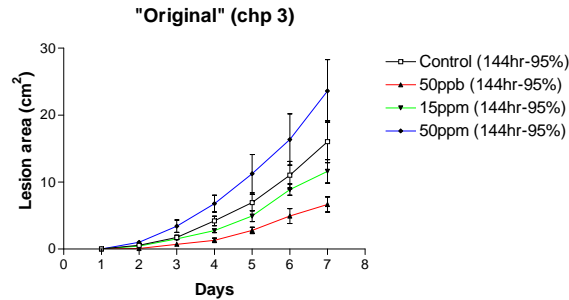


**vaccination
effect**

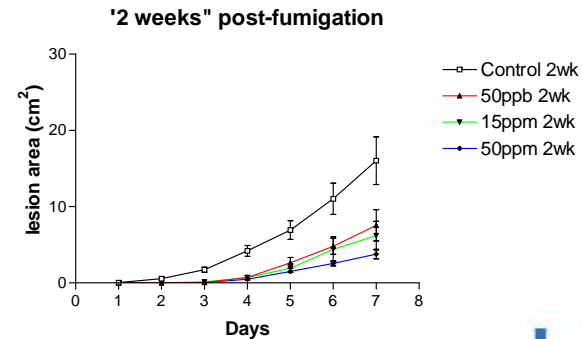
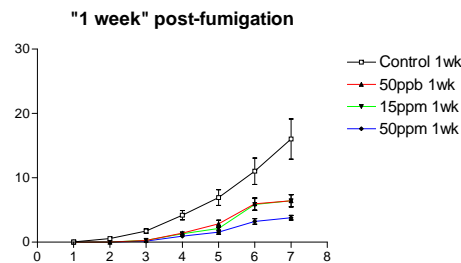
vaccination effect



infection reduction continues after end of ozone treatment



inoculated following ozone enrichment (13oC and 95% RH)



scanning electron micrograph showing fungal development after exposure to low levels (150ppb) of ozone for 10 days

biofresh results

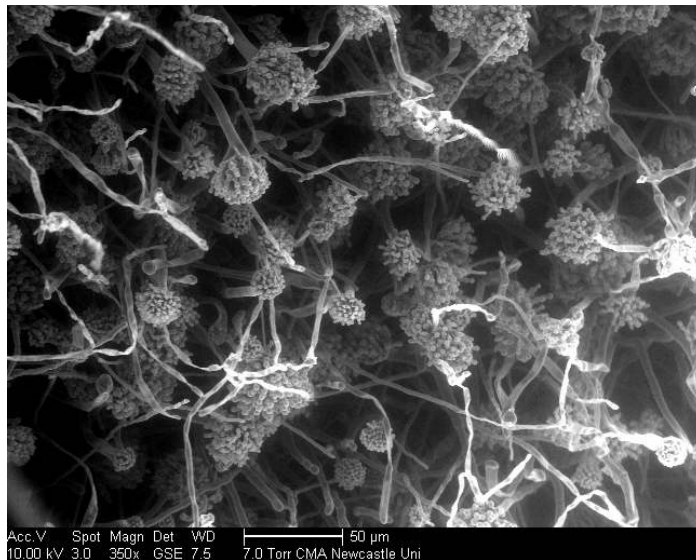


**ozone
conclusions**

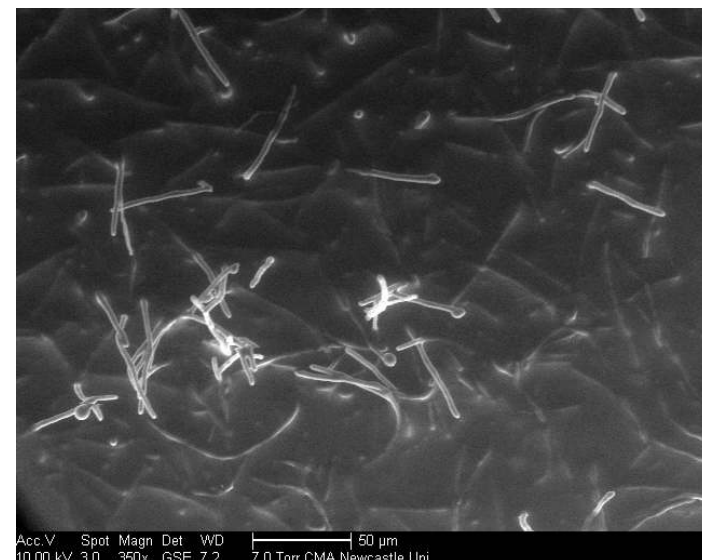
1) reduces spoilage



inhibits sporulation, protecting against a broad spectrum of bacterial and fungal diseases



control



ozone

scanning electron micrograph showing fungal development after exposure to low levels (150ppb) of ozone for 10 days

2) enhances shelf life



inhibits ripening & odours by reacting with volatile compounds inc. ethylene



generator



control

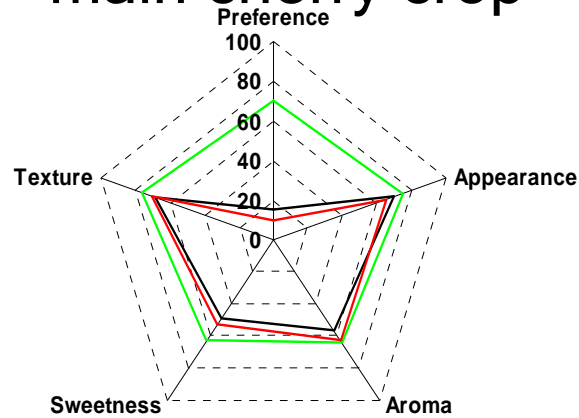


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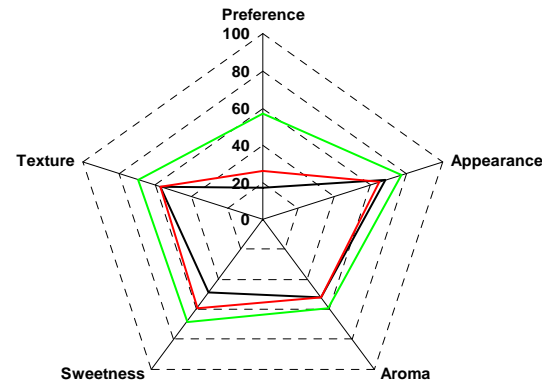
3) maintains quality



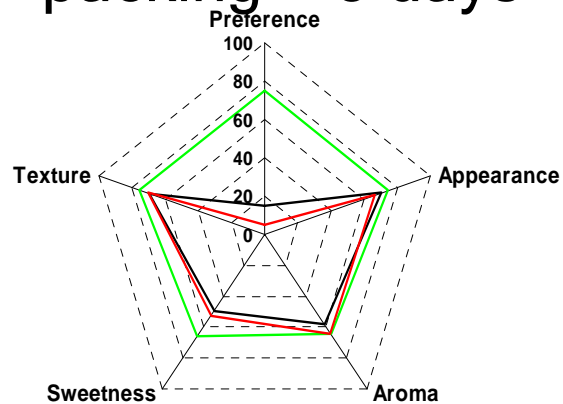
main cherry crop



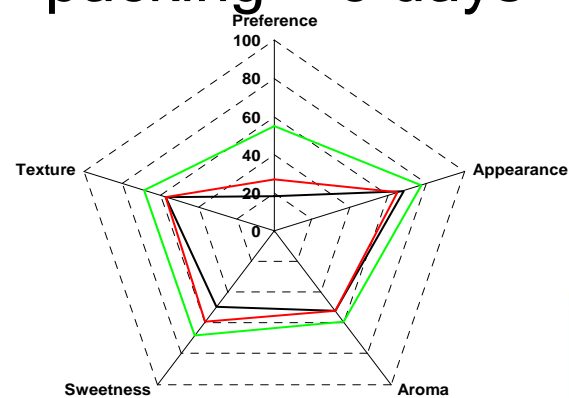
cherry tomatoes



packing + 5 days



packing + 5 days



— CFA — 0.15 ppm — 1.0 ppm

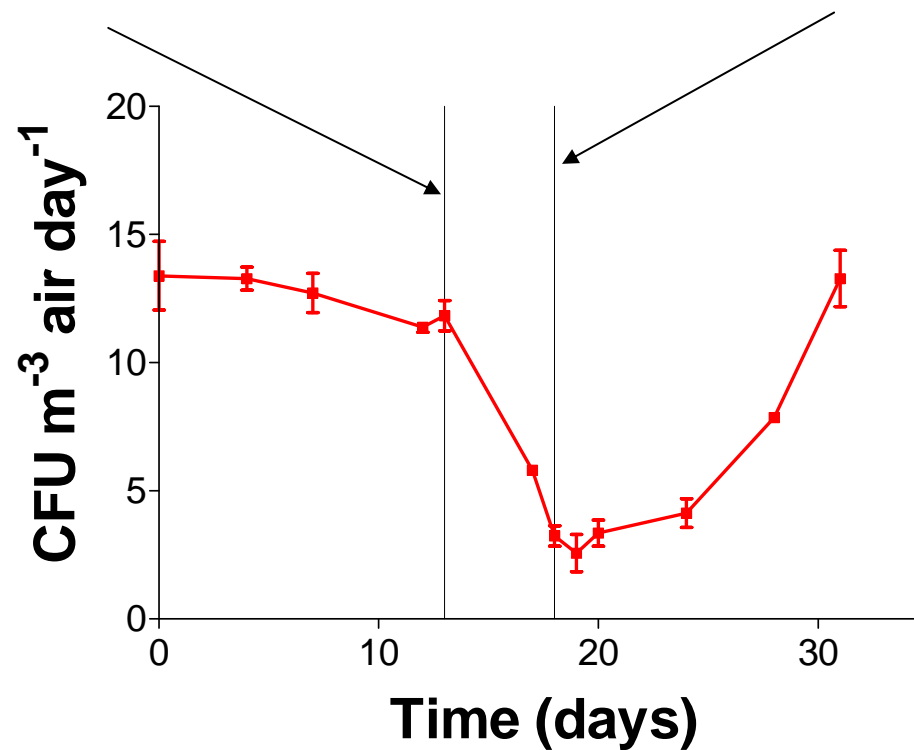
— CFA — 0.15 ppm — 1.0 ppm

4) cleanses warehouse



ozone switched on

ozone switched off



reduction in fungal spores in air due to ozone (200 ppb)

ozone conclusions



no effects with ozone-treatment:

- respiration
- ethylene emissions (post-treatment)
- organic acid composition
- water loss
- antioxidant content
- phenol composition
- pH components
- transient increase in pigment composition (incl. lycopene)

biofresh equipment



OZ1000 : 1000m³, 4000m³

OZ80 : 80m³



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biofresh equipment



smart pallet



biofresh equipment



decontamination unit



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