CASE STUDIES: ACTIVE RESEARCH ON FOOD SAFETY

DR P J CULLEN

FRESH PRODUCE SAFETY CENTRE
AUSTRALIA & NEW ZEALAND

NSW GOVERNMENT Trade & Investment

HAL Horticulture Australia

PROUDLY HOSTED BY THE UNIVERSITY OF SYDNEY

PROGRAM PARTNER pma AUSTRALIA+NEW ZEALAND

Plasma Chlorine Replacement

PJ Cullen

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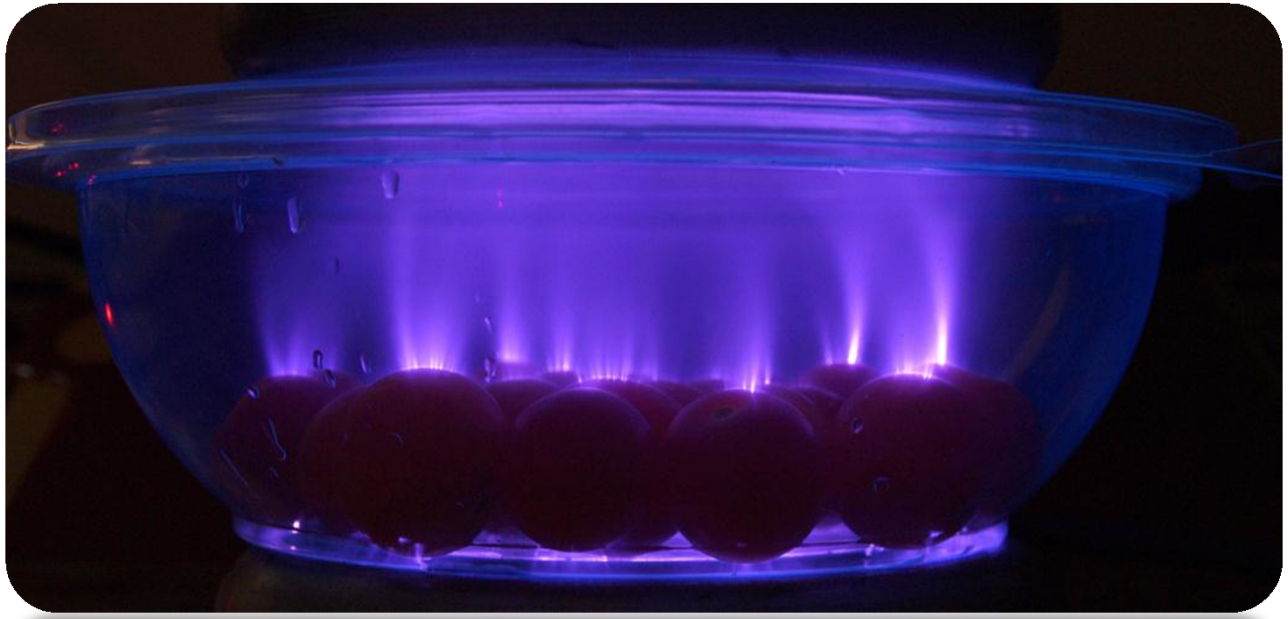


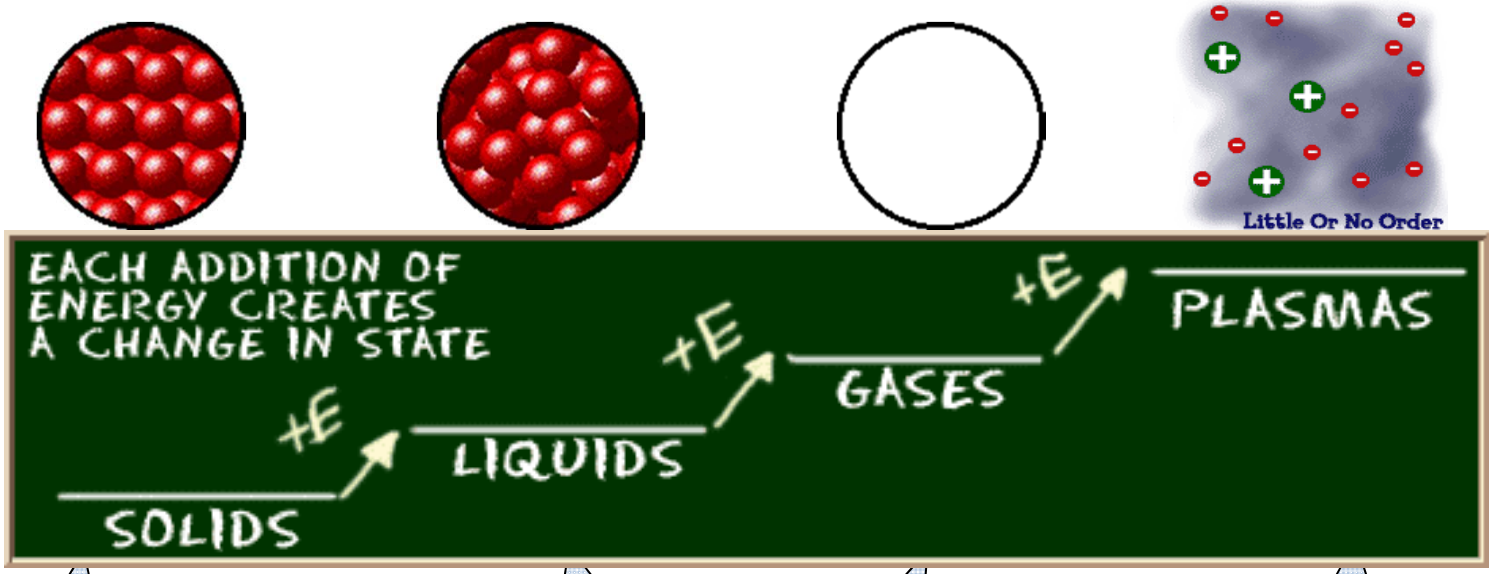
SEVENTH FRAMEWORK PROGRAMME
embarkinitiative Investing in People and Ideas
Department of Agriculture, Food and the Marine An Roinn Talmhaíochta, Bia agus Mara
sfi science foundation ireland fondúireacht eolaíochta éireann
DIT Dublin Institute of Technology Institiúid Teicneolaíochta Átha Cliath

Problem statement

- The fresh-cut industry is heavily dependent on chlorine as a sanitizers to assure the safety of their produce.

- However, in light of concerns about the environmental and health risks associated with the formation of carcinogenic disinfection by-products, there is increasing pressure on the industry to eliminate chlorine from the disinfection process.

STATES OF MATTER



SOLID	LIQUID	GAS	PLASMA
Tightly packed, in a regular pattern Vibrate, but do not move from place to place	Close together with no regular arrangement. Vibrate, move about, and slide past each other	Well separated with no regular arrangement. Vibrate and move freely at high speeds	Has no definite volume or shape and is composed of electrical charged particles

Cold Plasma

The term cold plasma has been recently used to distinguish the one-atmosphere, near room temperature plasma discharges from other plasmas, operating at hundreds or thousands of degrees

For food processing, a nonthermal plasma (NTP) is specifically an antimicrobial treatment being investigated for application to fruits, vegetables and other foods with fragile surfaces.

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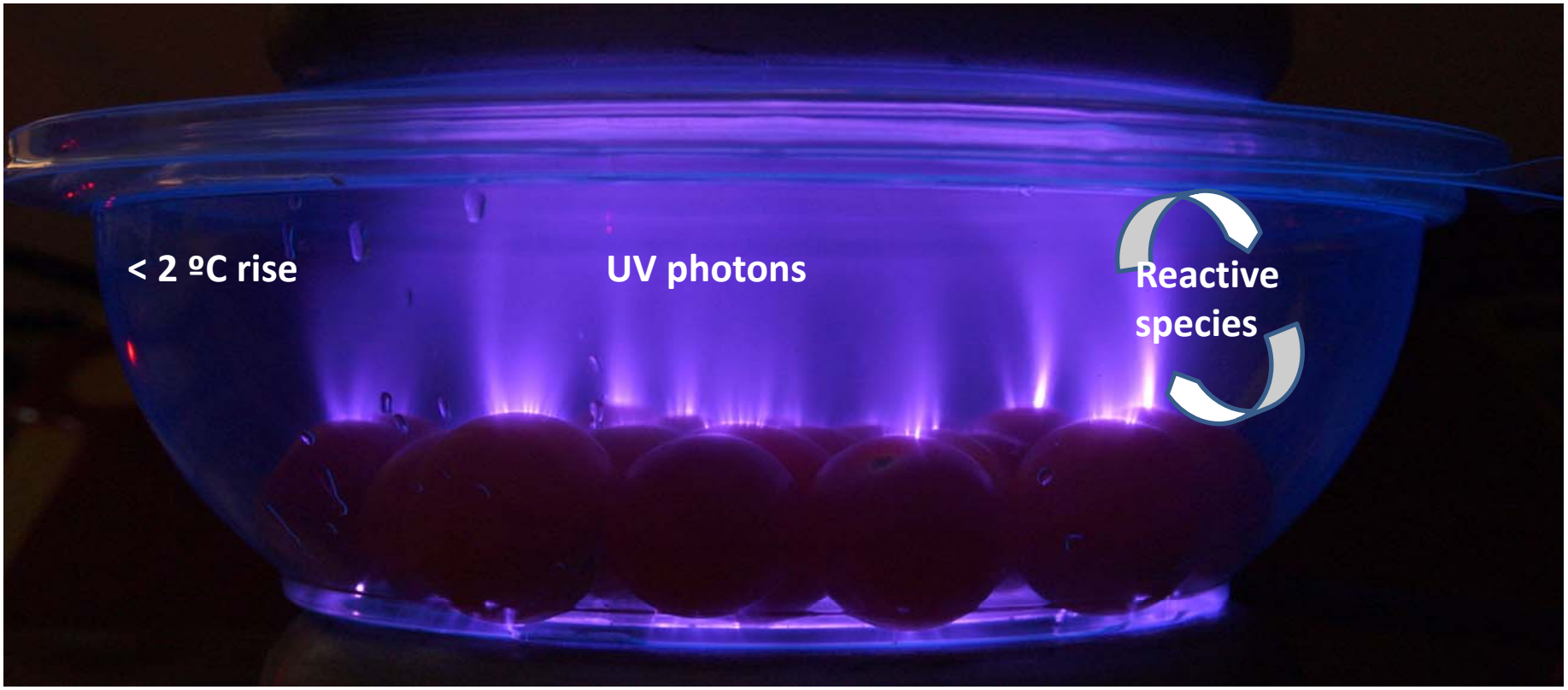
Generate Plasma in a Package



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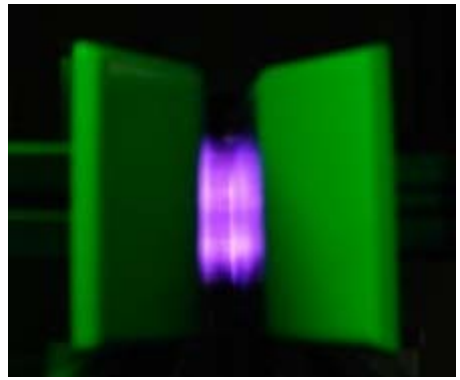
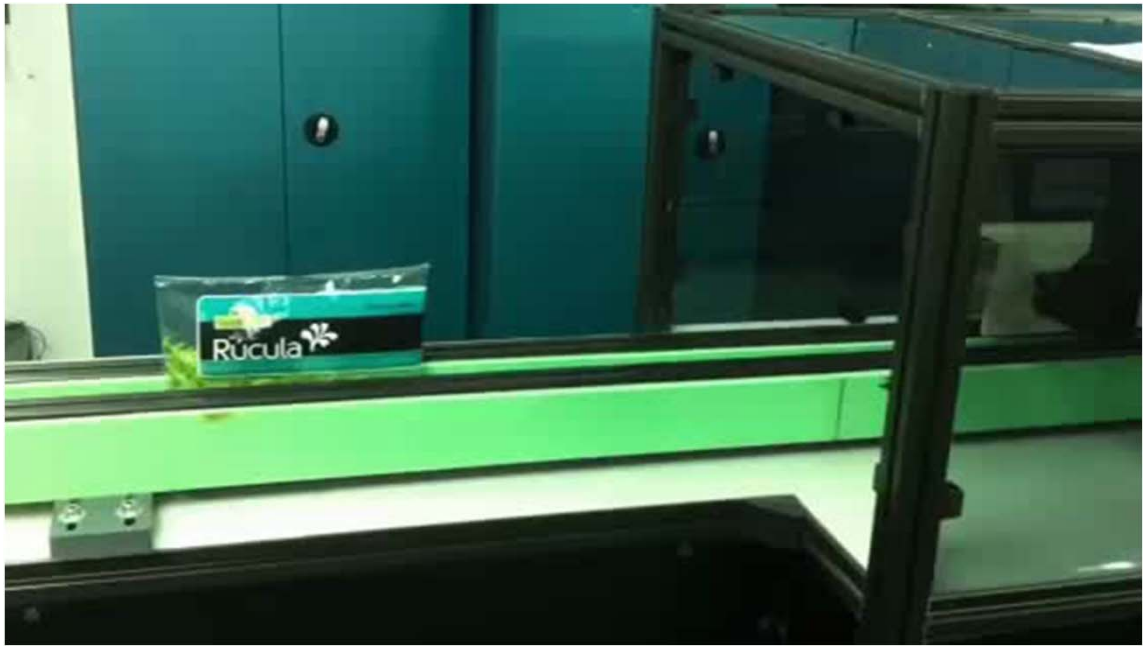
Continuous system





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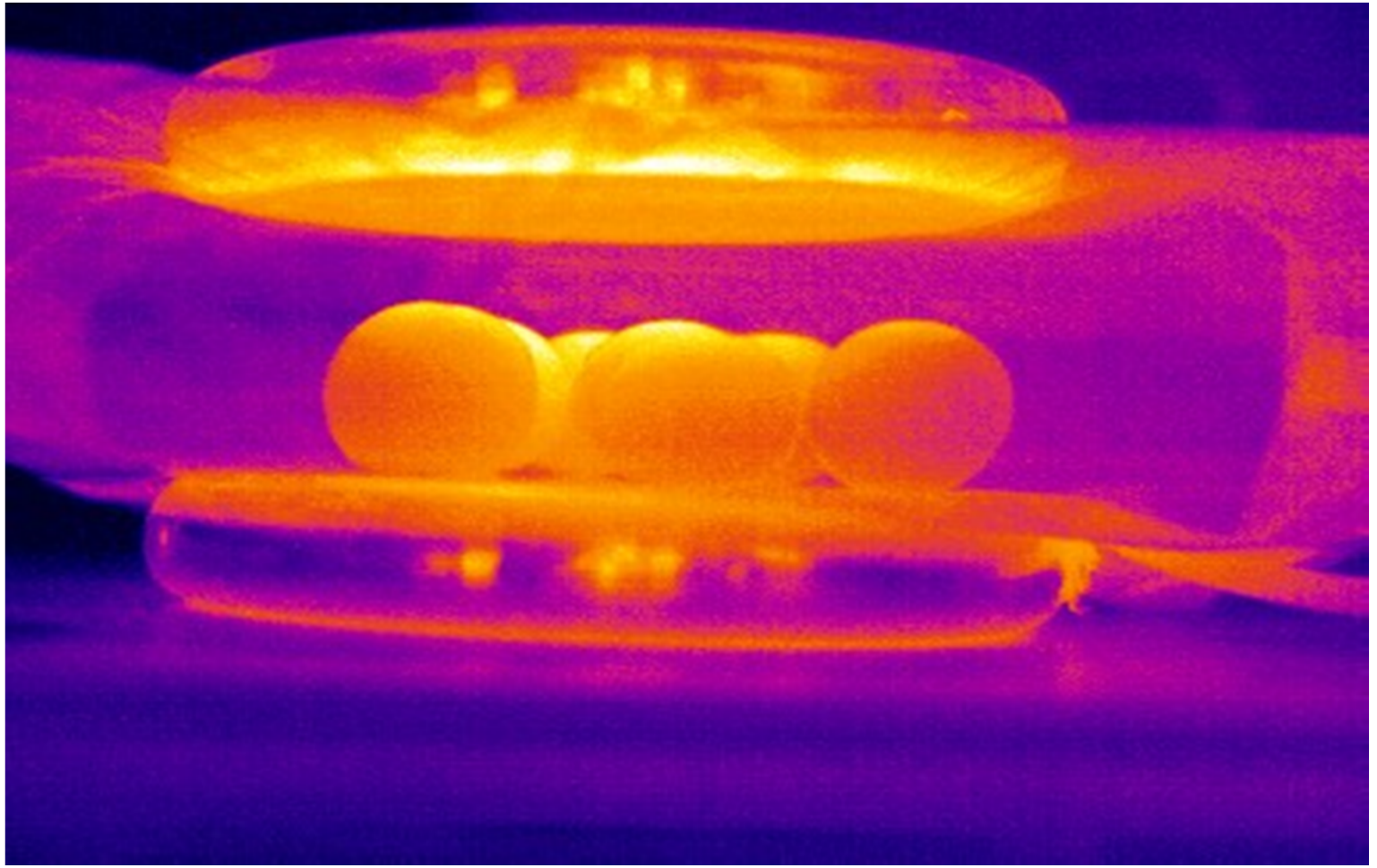
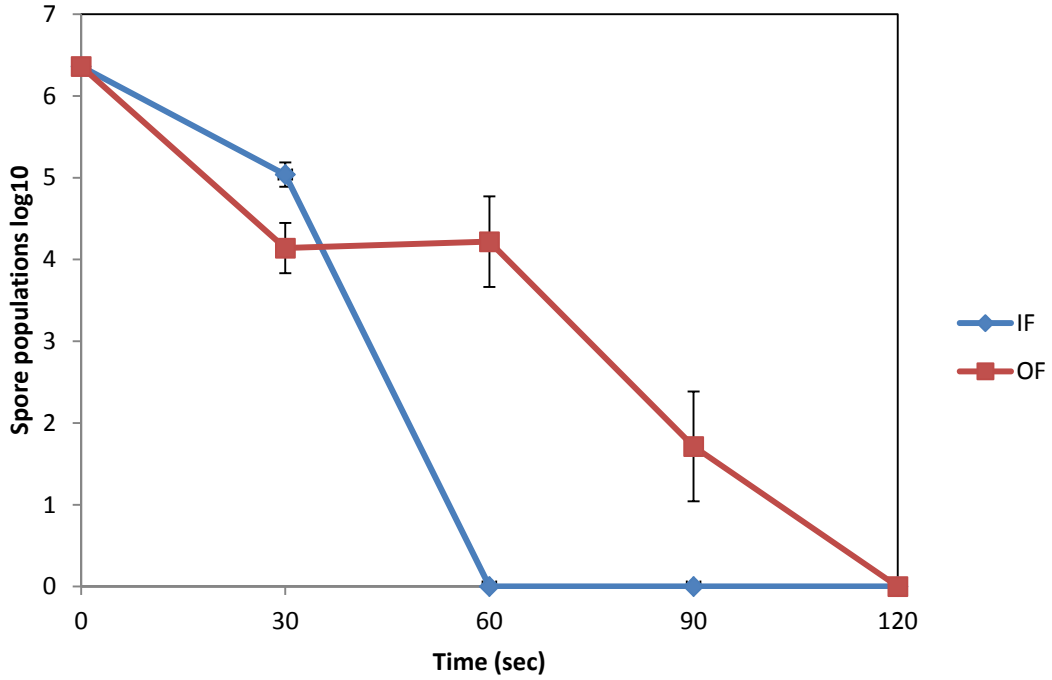
Non-thermal



Spore reductions

- Plasma efficiency for inactivation of *B. atrophaeus* spores
- Spore population 6.3 $\log_{10}$/strip
- Voltage : 50kV
- Gas: Atmospheric air
- Mode of exposure
- Direct (IF)
- Indirect (OF)



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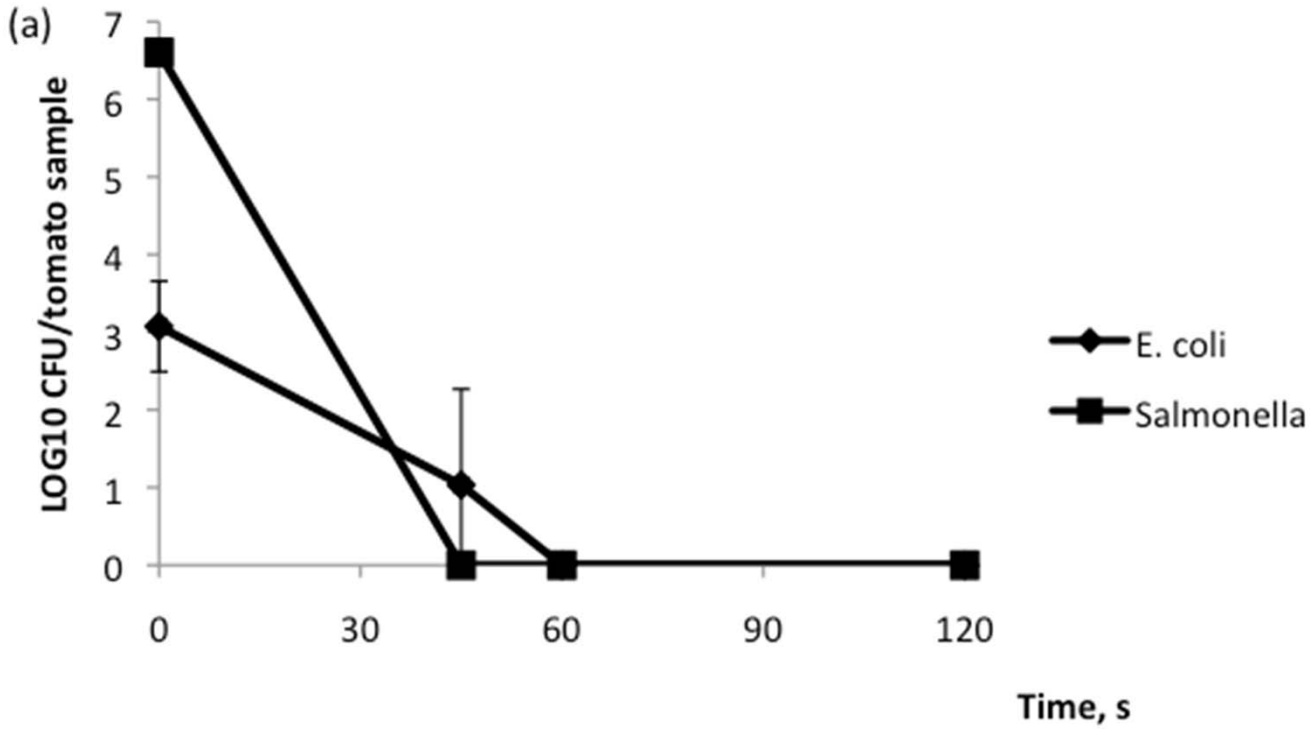
Tomato



Tomatoes

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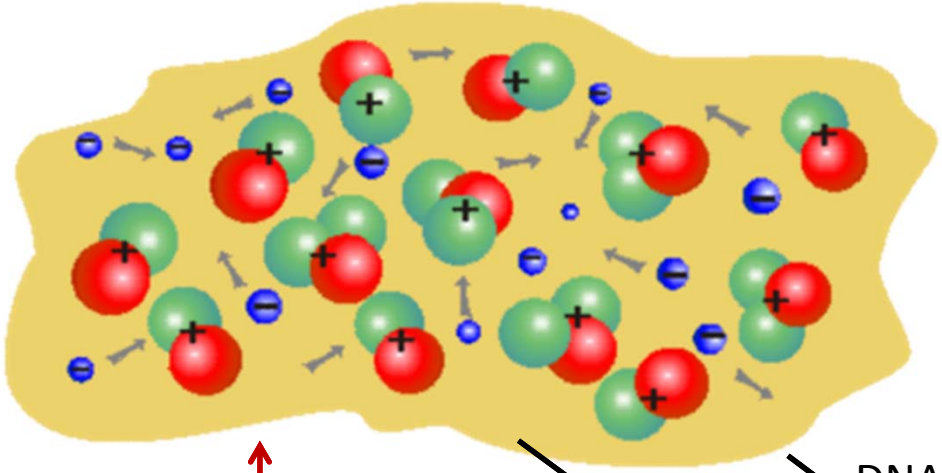
Plasma bacteria interaction



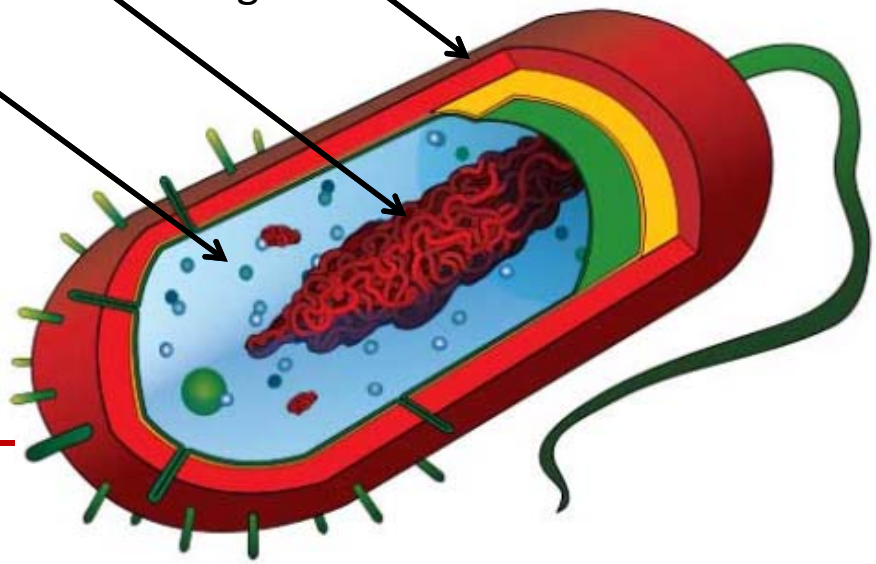
Polarization induced cell morphology changes

Cell envelope damage

DNA damage

Oxidation caused enzyme activity loss and intracellular pH changes

Anti-oxidative and repair system related genes upregulated



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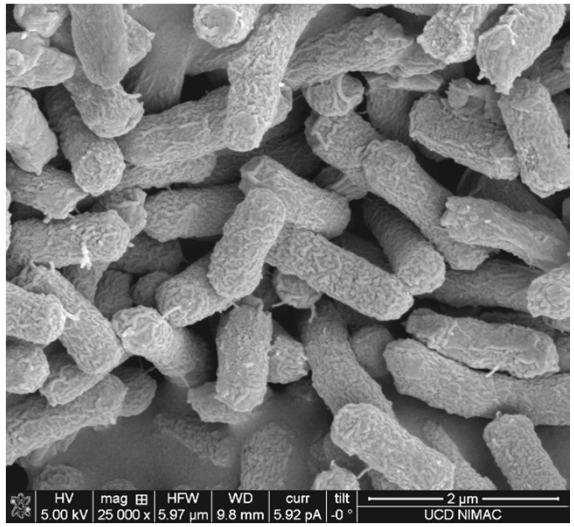
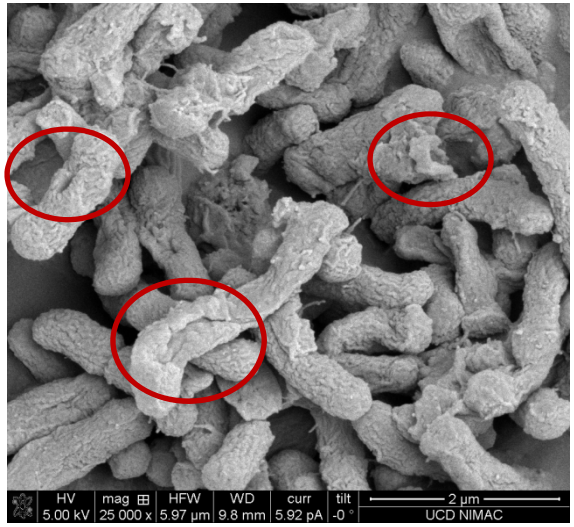
E.coli ATCC 25922

Gram Negative (G-)



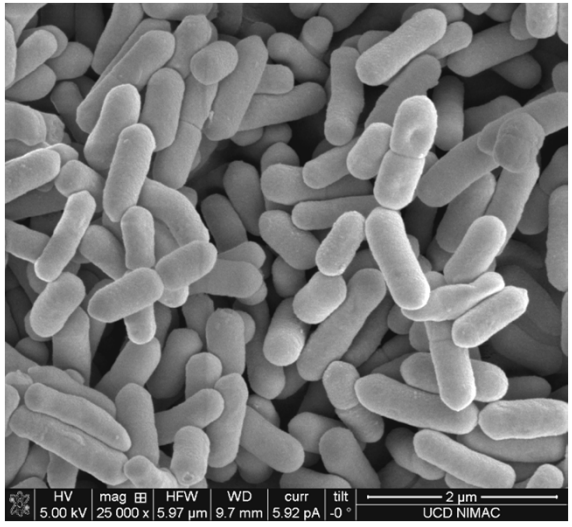
Control



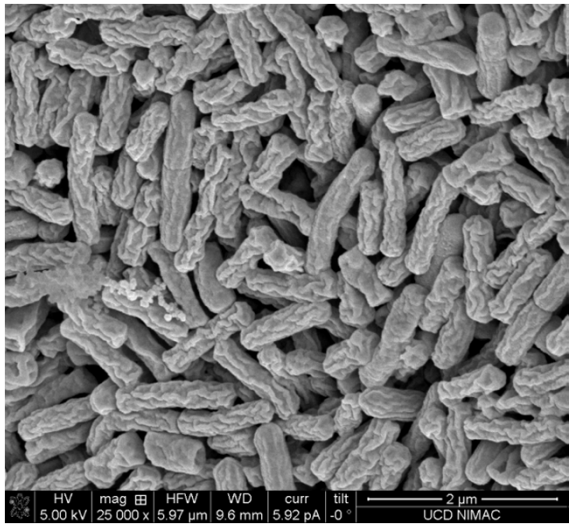
Treated

L. monocytogenes NCTC 11994

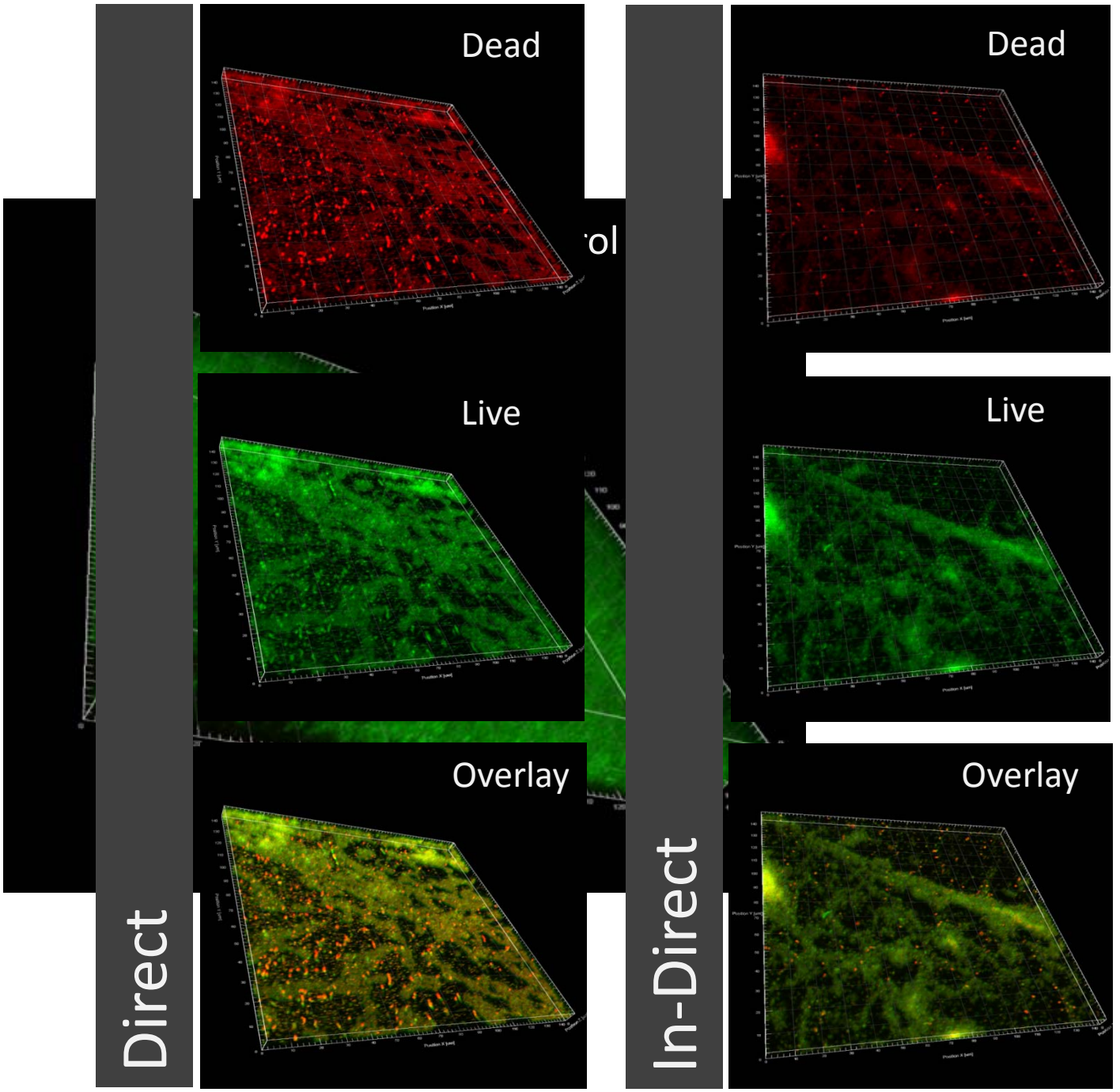
Gram Positive (G+)



Control

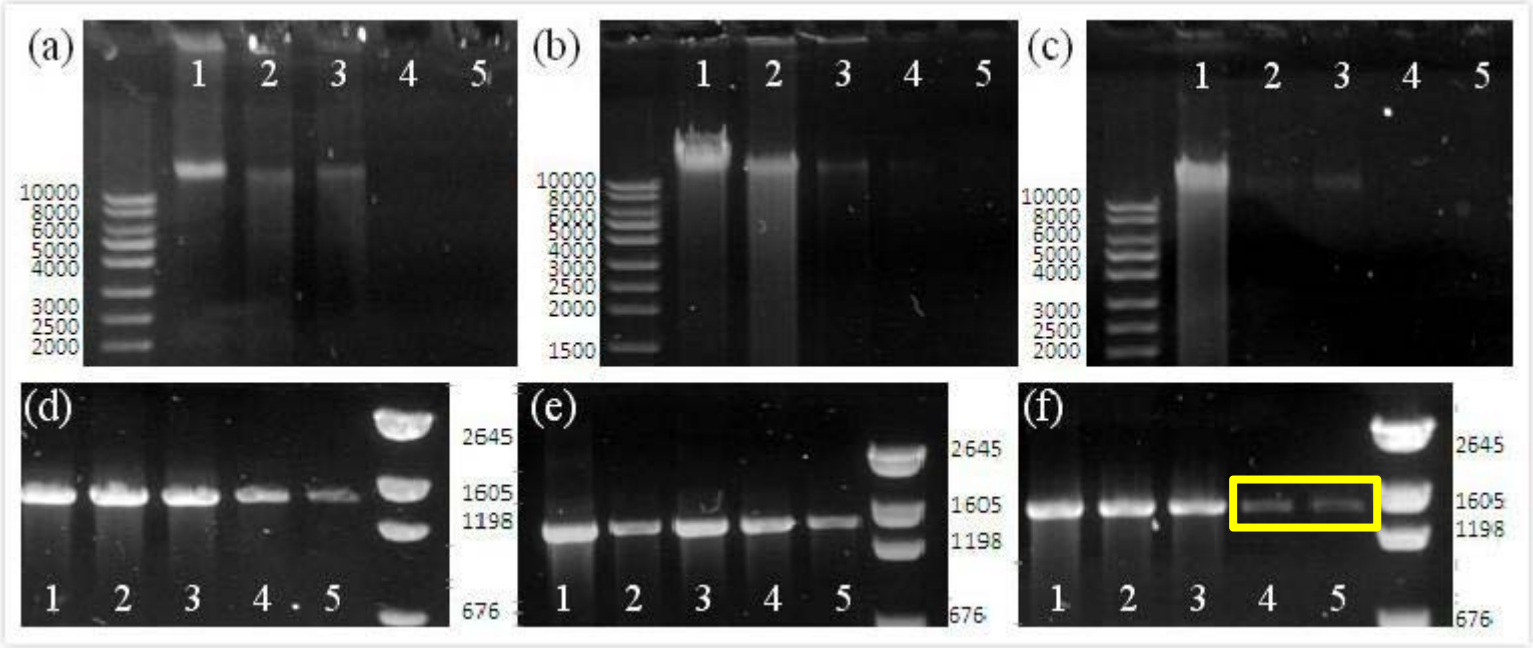


Treated



P. Aeruginosa
Biofilm 48 h
5 min treatment

DNA damage



DNA damage effect of plasma.
Genomic DNA damage of (a) *E. coli* ATCC 25922; (b) *E. coli* NCTC 12900; (c) *L. monocytogenes* NCTC 11994
16s RNA PCR results of (d) *E. coli* ATCC 25922; (e) *E. coli* NCTC 12900; (f) *L. monocytogenes* NCTC 11994
Lane 1: Non plasma treatment control; 2: 5s directly treated samples; 3: 5s indirectly treated samples; 4: 30s directly treated samples; 5: 30s indirectly treated samples

Quality Studies

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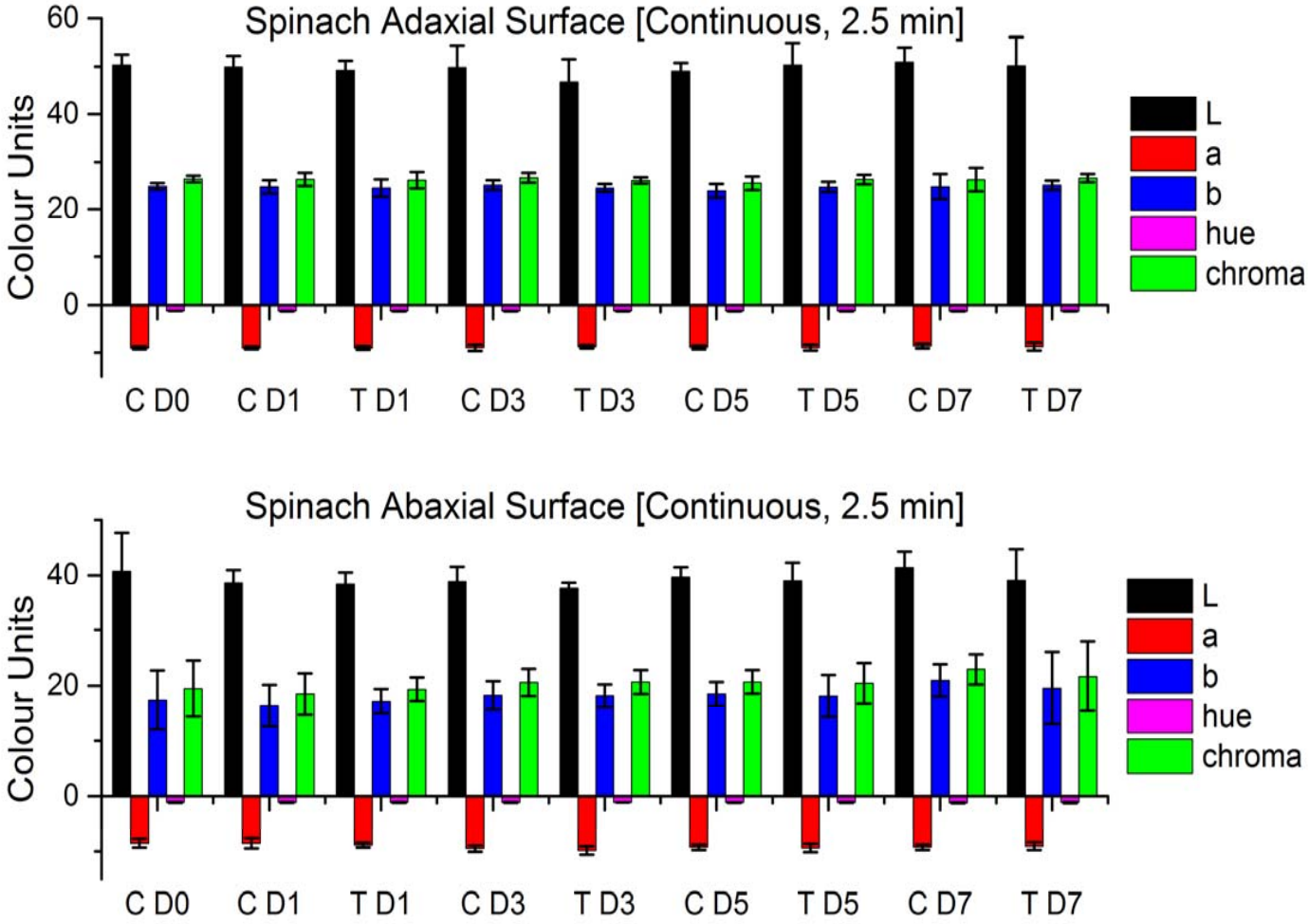
Spinach Adaxial Surface [Continuous, 2.5 min]
Colour Units
60
40
20
0
C D0
C D1
T D1
C D3
T D3
C D5
T D5
C D7
T D7
L
a
b
hue
chroma
Spinach Abaxial Surface [Continuous, 2.5 min]
Colour Units
40
20
0
C D0
C D1
T D1
C D3
T D3
C D5
T D5
C D7
T D7
L
a
b
hue
chroma

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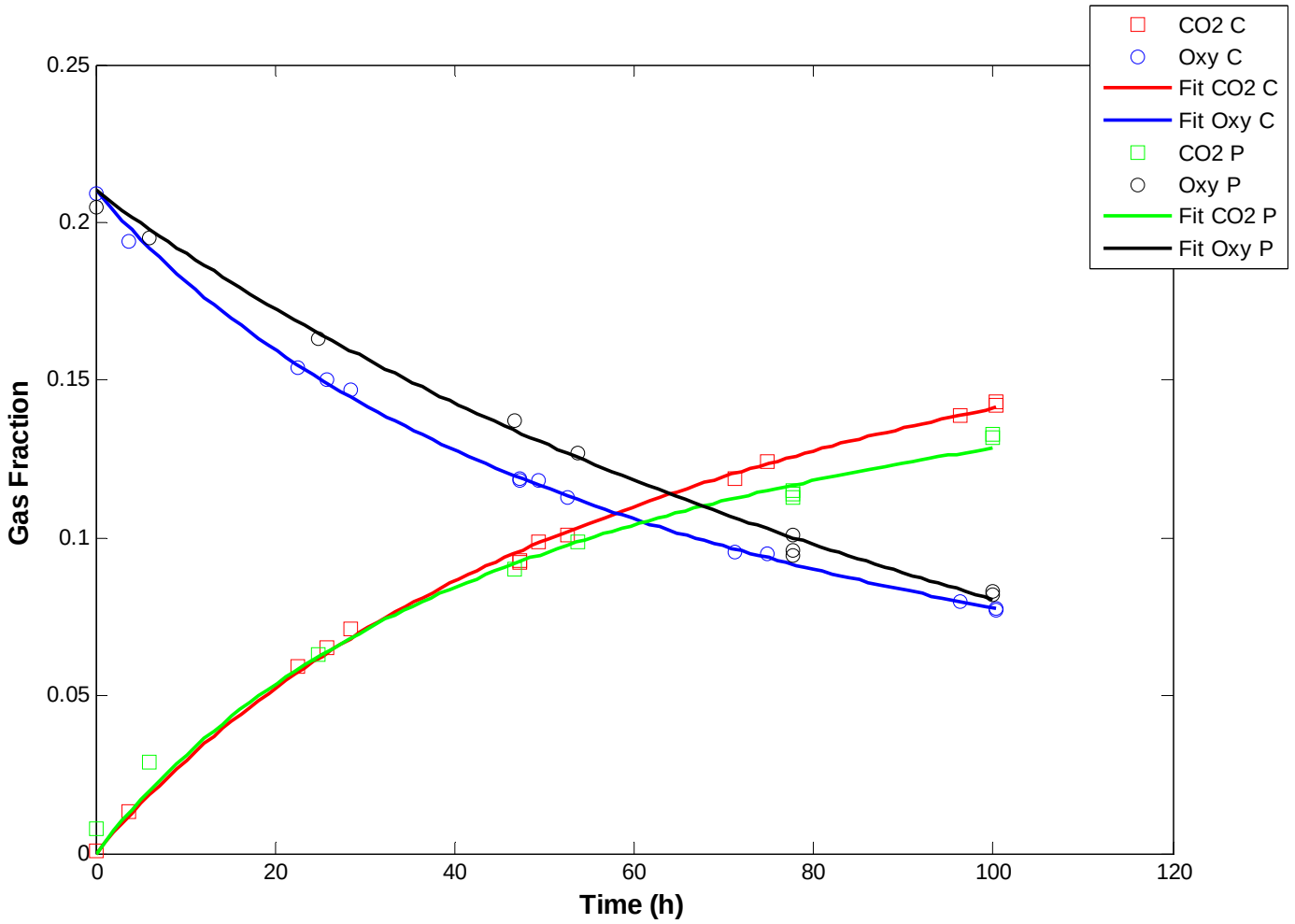
Respiration studies- Room Air (42 % RH, 21 % O_2)



Safebag

Post treatment

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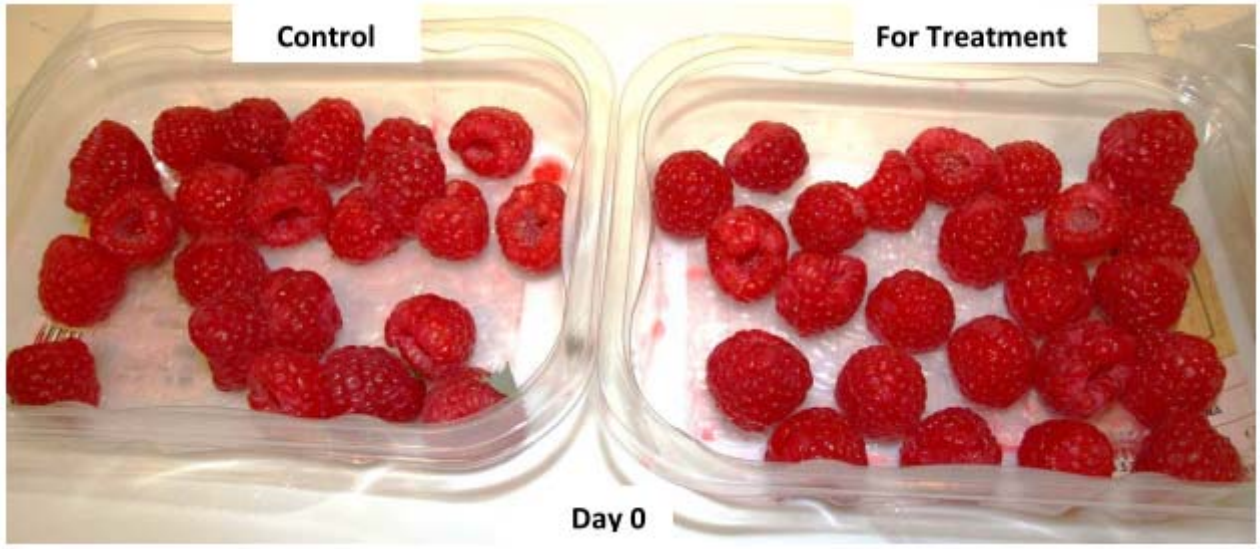
Post treatment- Raspberry

50kV for 2 min
Indirect treatment



Left under room
Conditions
(24°C/ ~50% RH)

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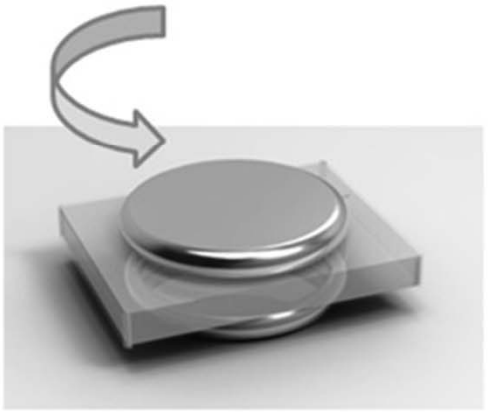
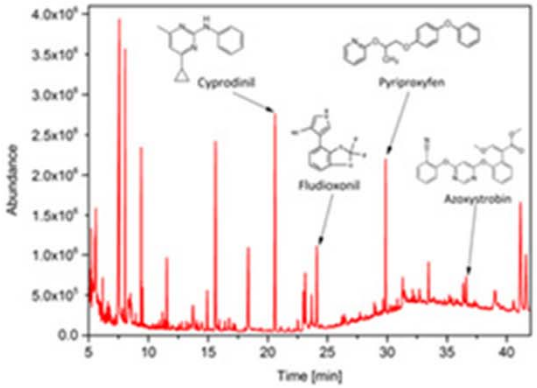
Pesticide degradation

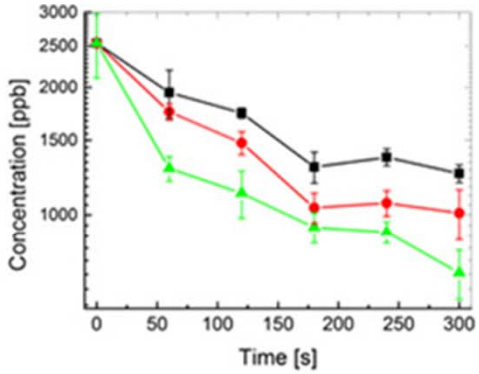
Azoxystrobin,
Cyprodinil,
Fludioxonil
Pyriproxyfen



In-Package
Nonthermal Plasma [DBD]



GC-MS/MS Analysis



Degradation Kinetics

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Dr Kevin Keener

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SEVENTH FRAMEWORK PROGRAMME

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http://www.safebag-fp7.eu/