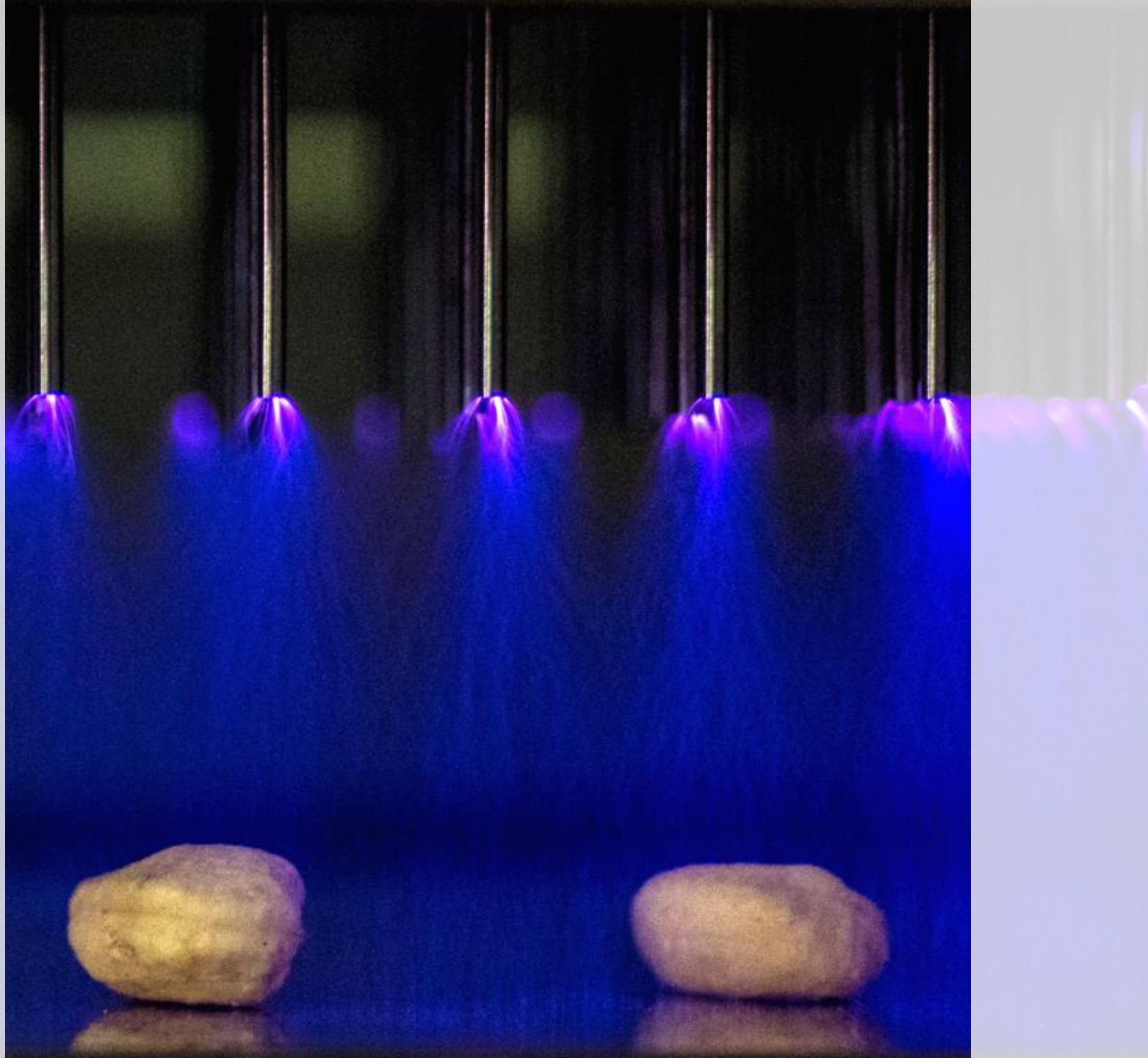


Cold Plasma:

Pink physics for a
greener tomorrow



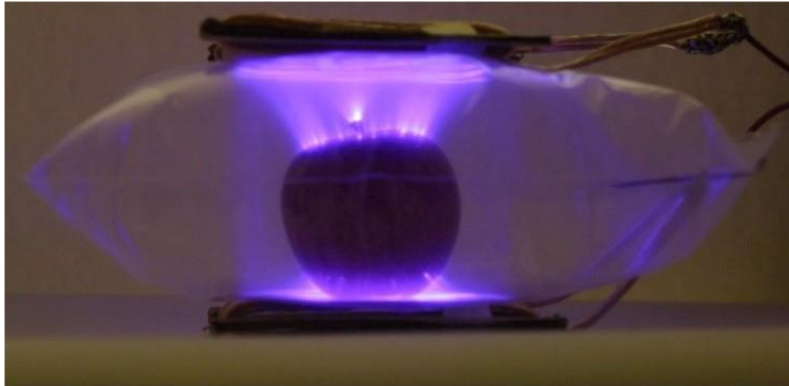
THE UNIVERSITY OF
SYDNEY



10 Years of technology development

2009

Helium



Basic
transformers



2019

Air



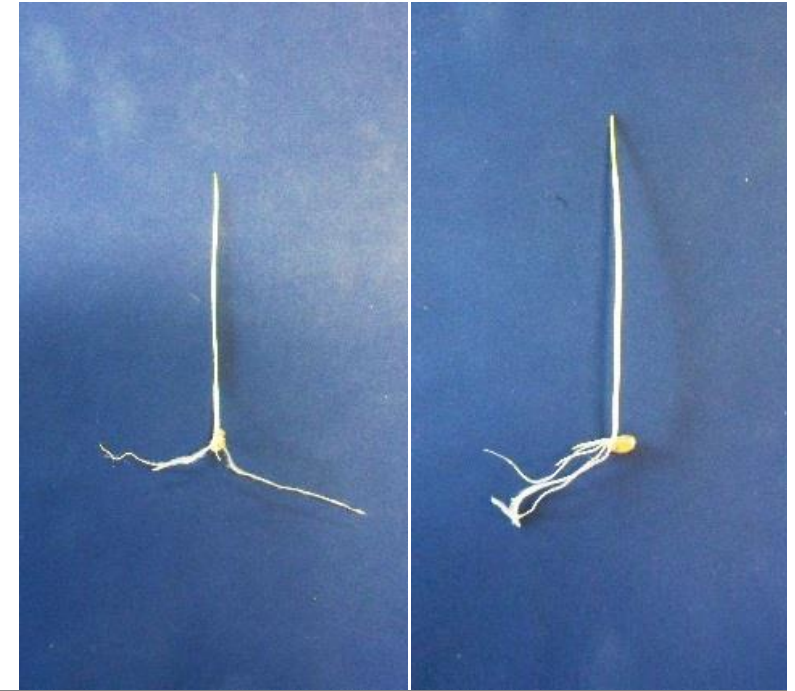
Programmable
plasma



Plasma Agriculture

- Seed treatment
- Green fertilizer
- Mycotoxin degradation
- Green pesticide
- Food preservation
- Food washing
- Biomass conversion

Increased
rates of
germination

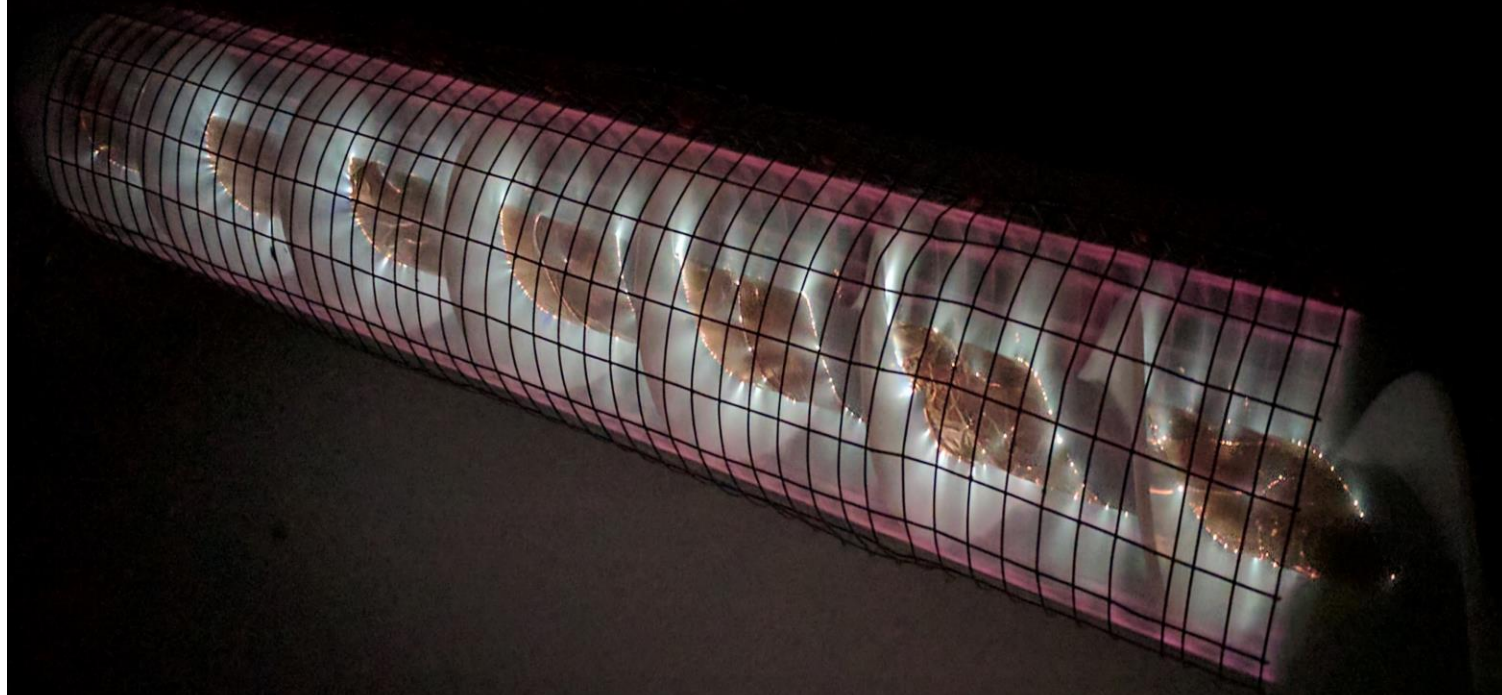


| | | |
|-------------------------------|------------------|----------------------|
| Shoots length [mm] | 67.3 ± 4.2^a | $79.9 \pm 3.1^{b,c}$ |
| Roots length [mm] | 57.3 ± 2.6^a | 65.4 ± 1.9^b |

TRL
5

Seed treatment

The biological seed treatment market projected to grow from \$739.3 million in 2017 to \$1.25 billion by 2022





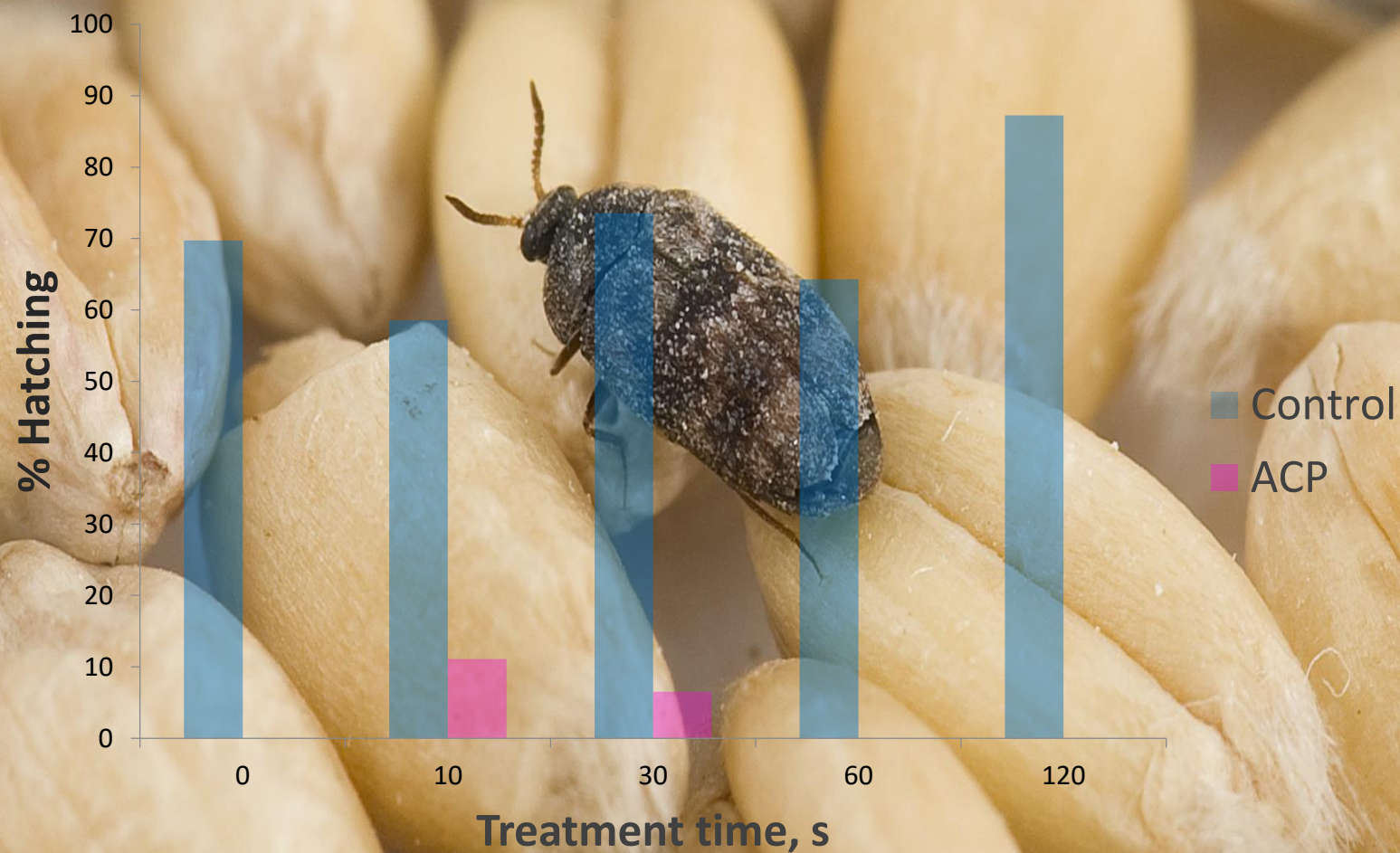
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Plasma can increase **drought tolerance** by improving antioxidant enzyme activities, increasing osmotic-adjustment products, and reducing lipid peroxidation

Grain preservation

T. castaneum eggs
hatching





Mycotoxins

Costs for the agricultural industry in the United States due to mycotoxin contamination (according to the food and agricultural regulations) can reach 1,500,000,000 USD per year.

In-package cold plasma technology



TRL
6

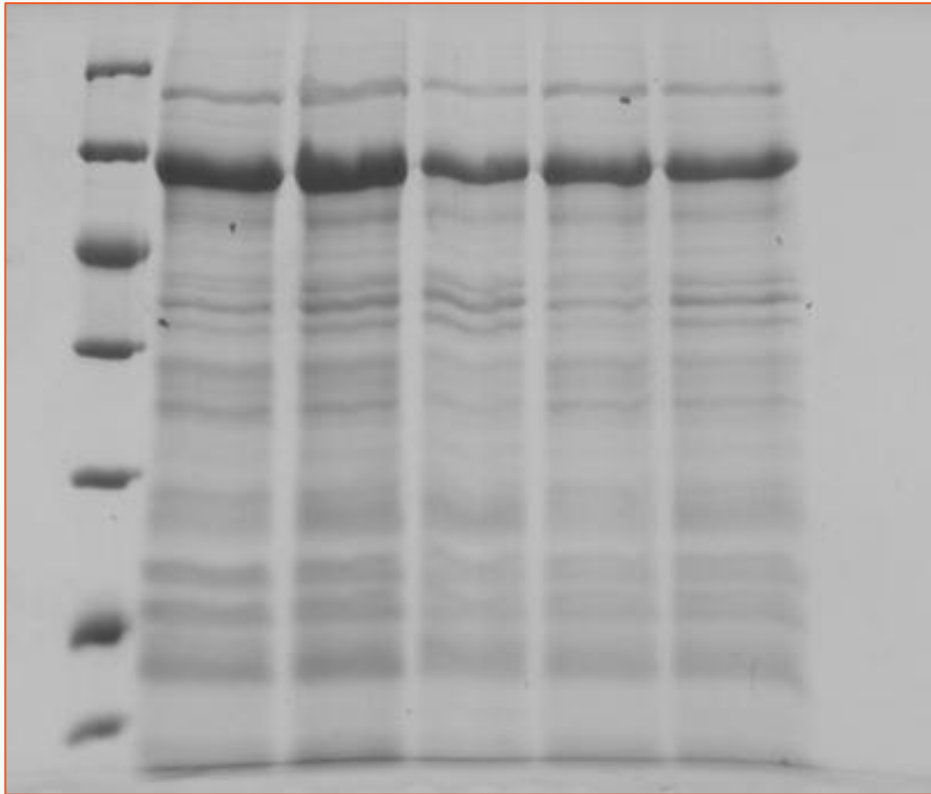


UNTREATED CONTROL TOMATOES SHOW SIGNS OF SPOILAGE AT THE END OF THEIR SHELF-LIFE, WHILE THOSE THAT WERE PLASMA-TREATED SHOW NO SIGNS OF SPOILAGE YET.

Allergenic reduction

TRL
2

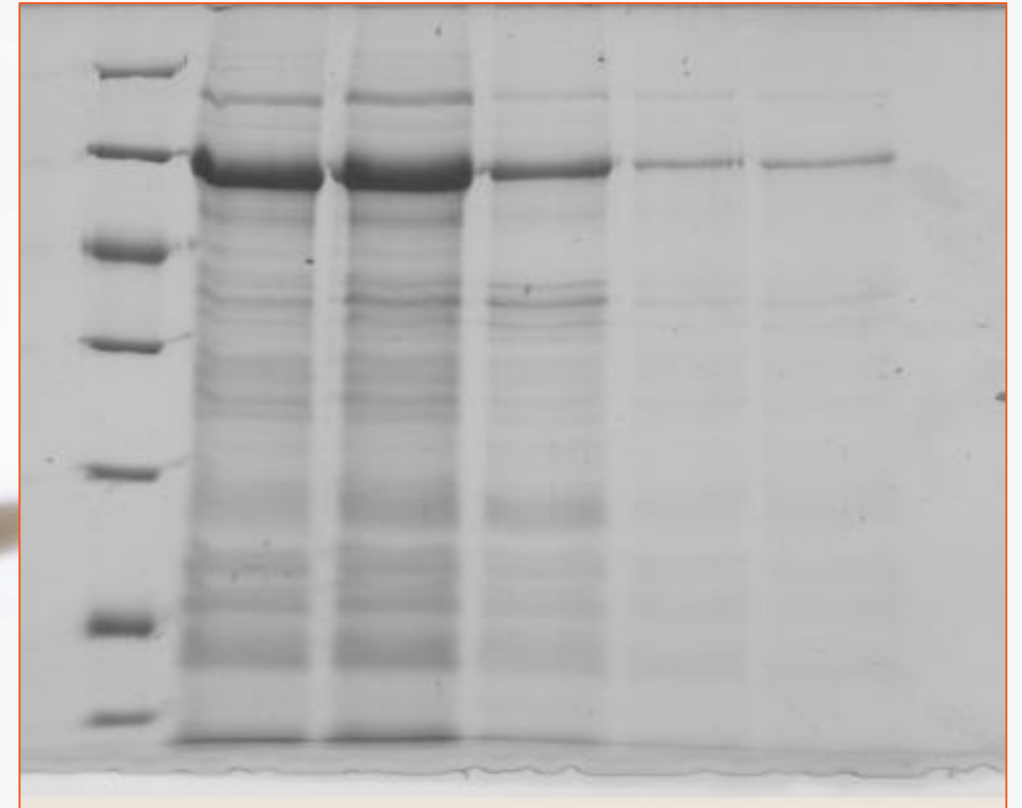
Whole Peanut



Lane 1: Control; Lane 2- 15min; Lane 3: 30 min;
Lane 4: 45min Lane 5: 1hr



Defatted Peanut flour

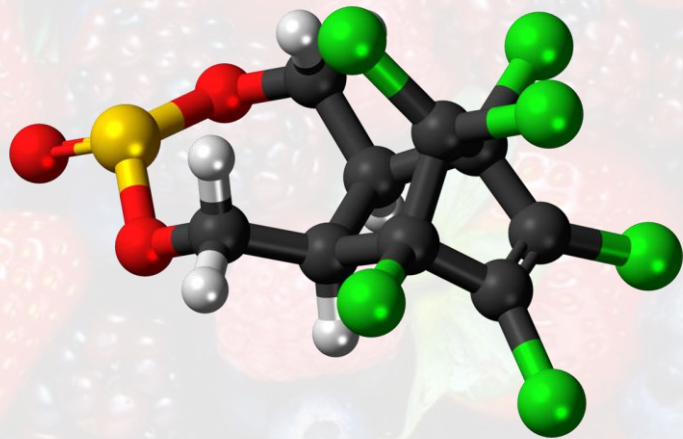


Lane 1: Control; Lane 2- 15min; Lane 3: 30 min;
Lane 4: 45min Lane 5: 1hr



Pesticide removal

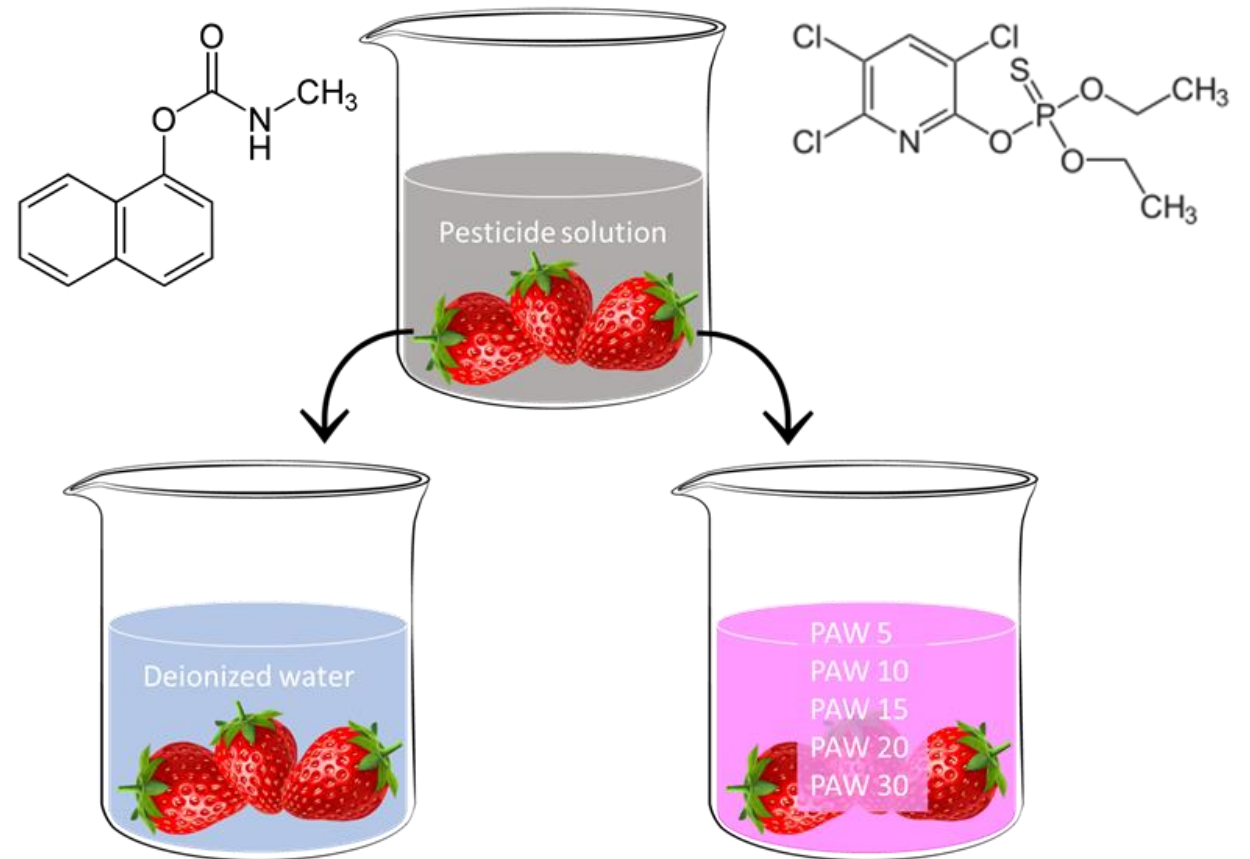
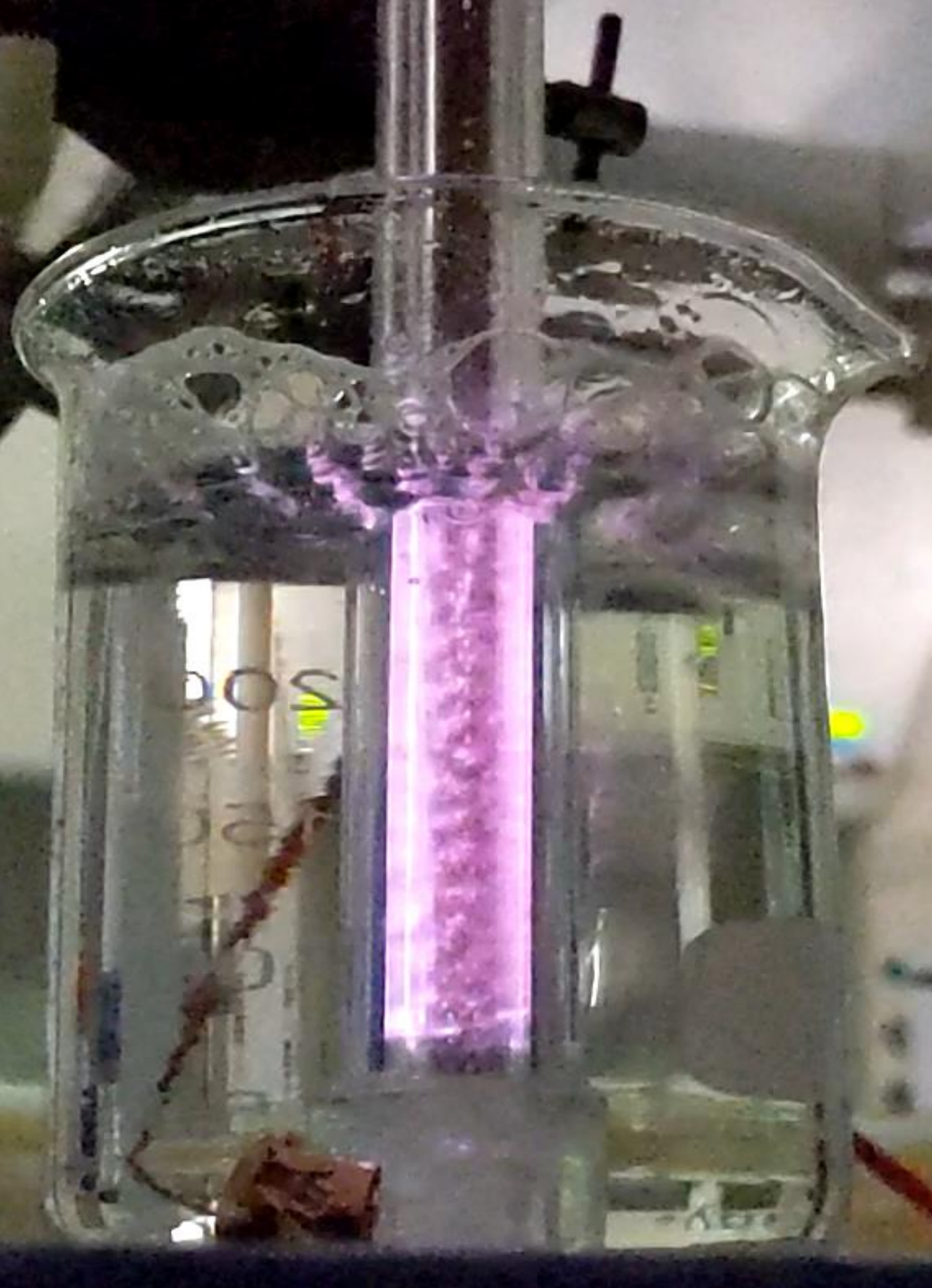
- Fruits
- Grains
- Water

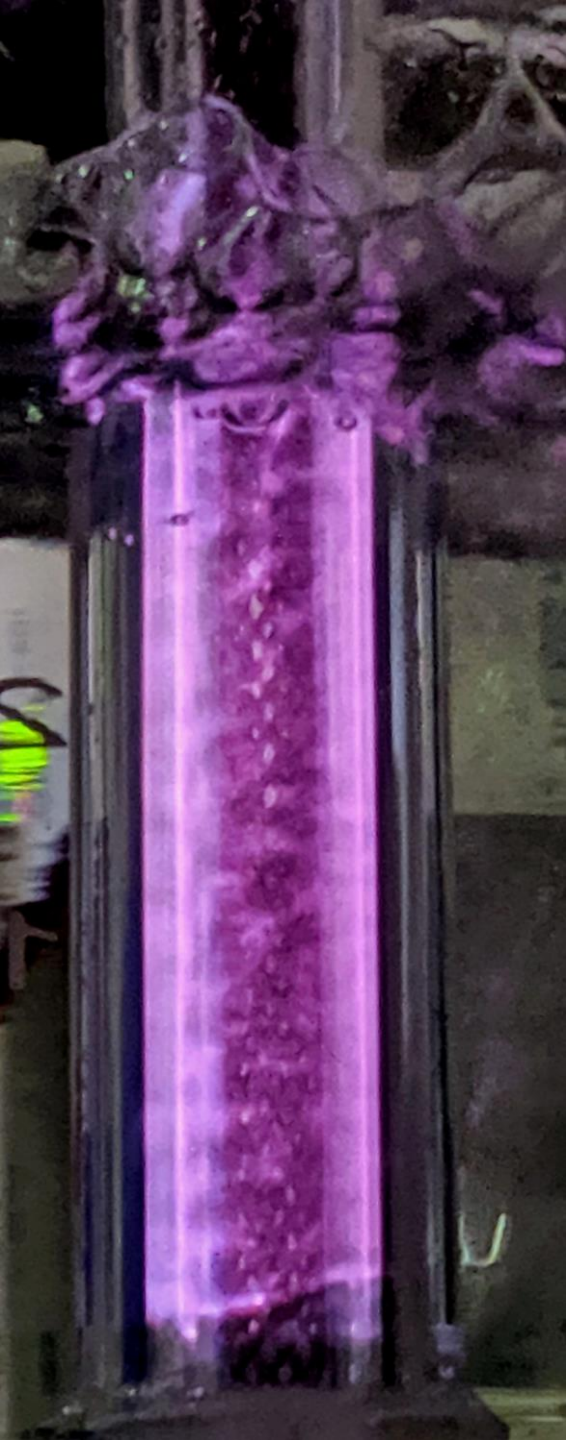


TRL
5

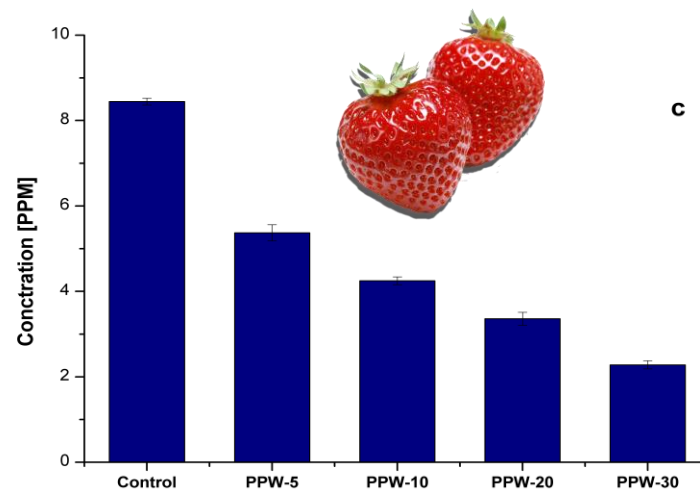
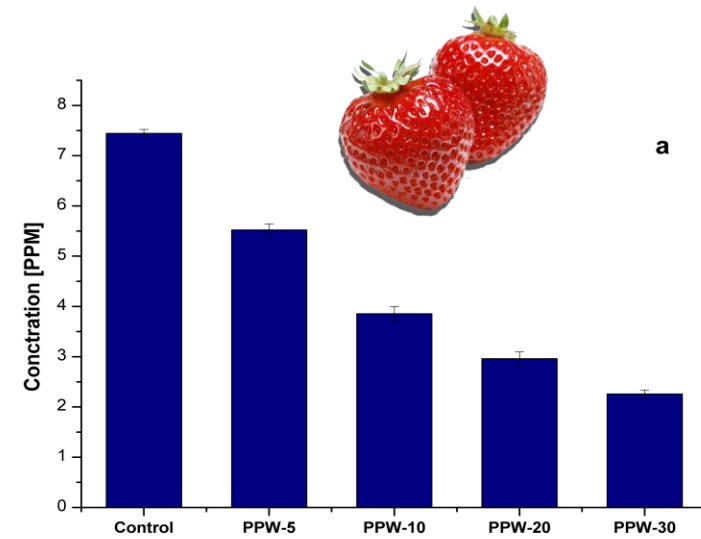


Plasma activated water

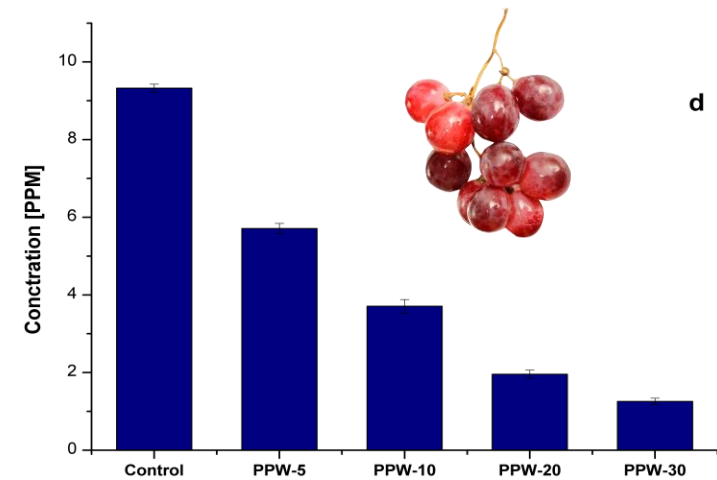
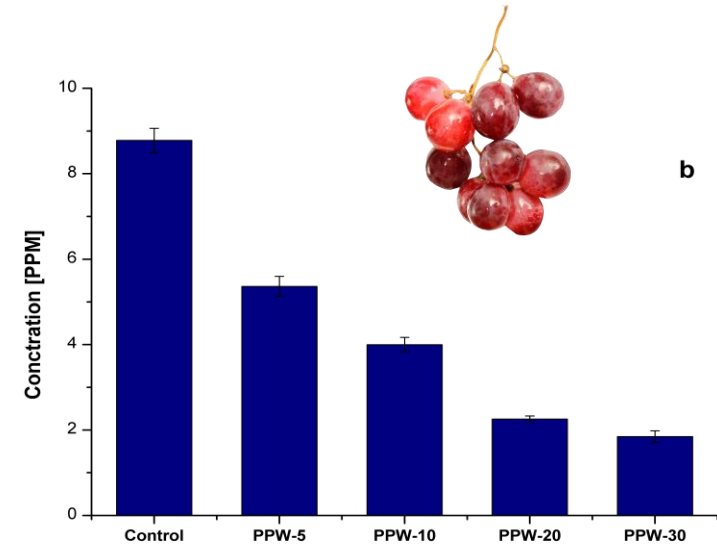




Chlorpyrifos

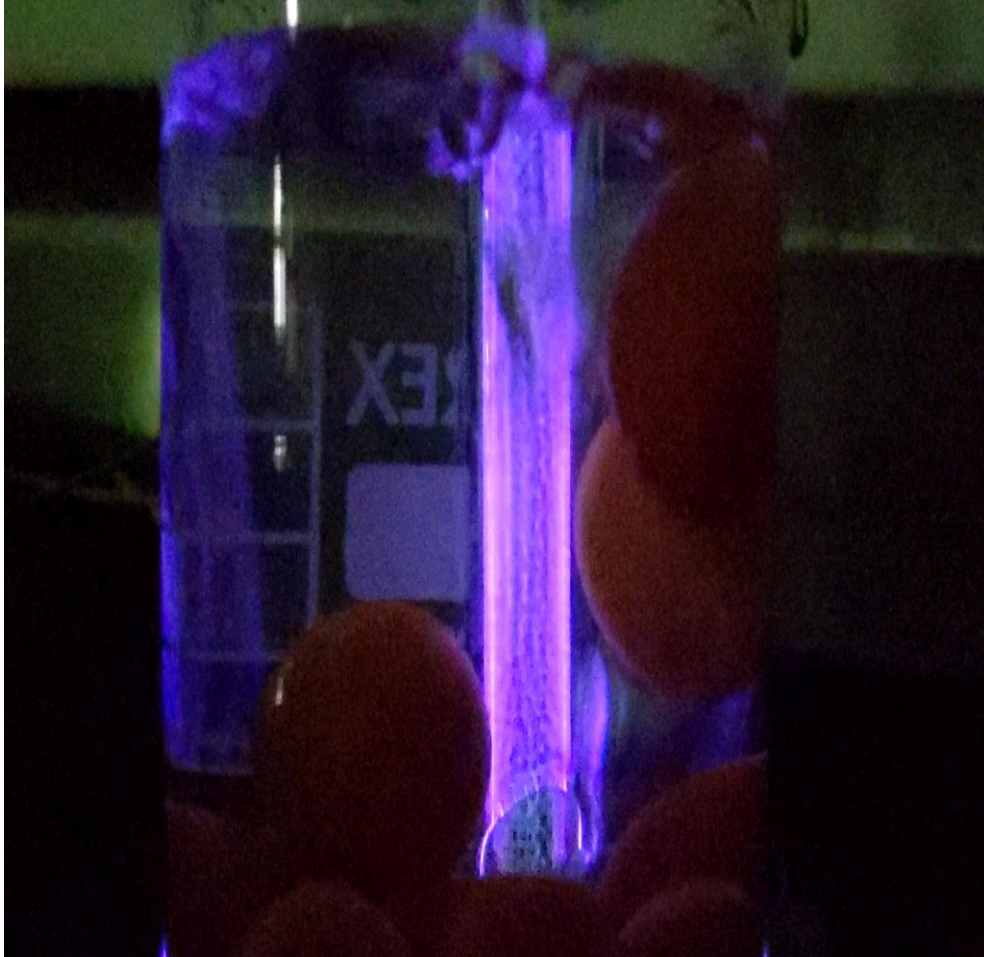


Carbaryl

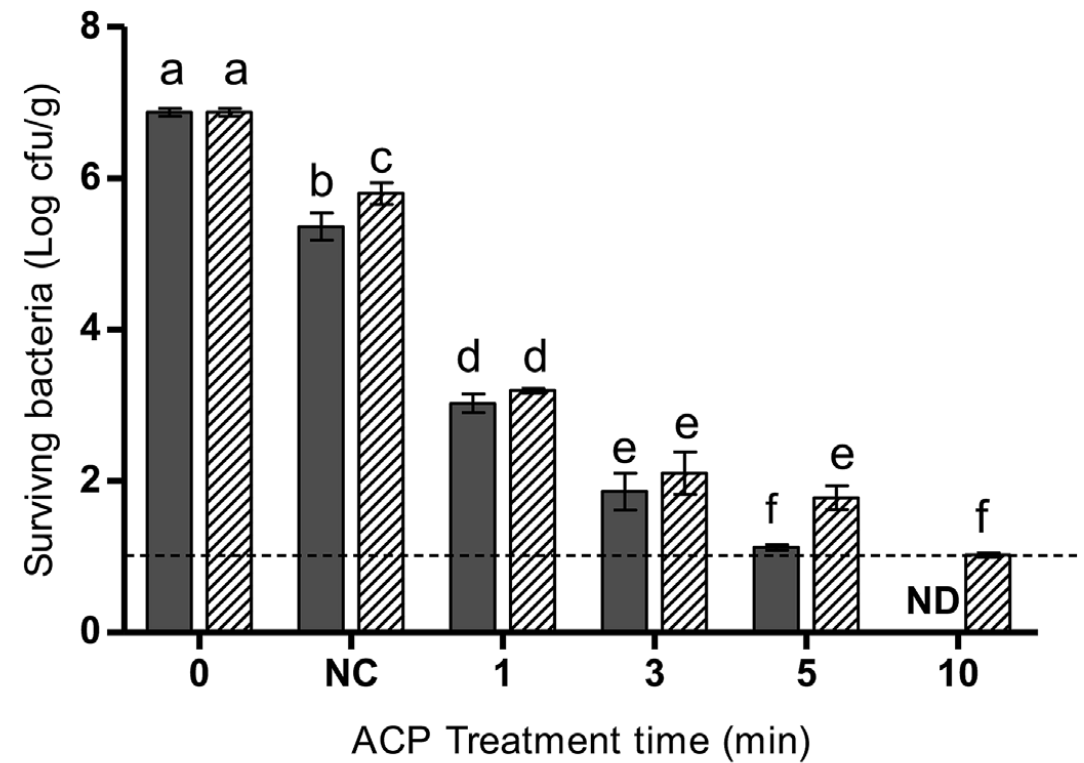


TRL
6

Jacuzzi plasma system



PAW lettuce washing

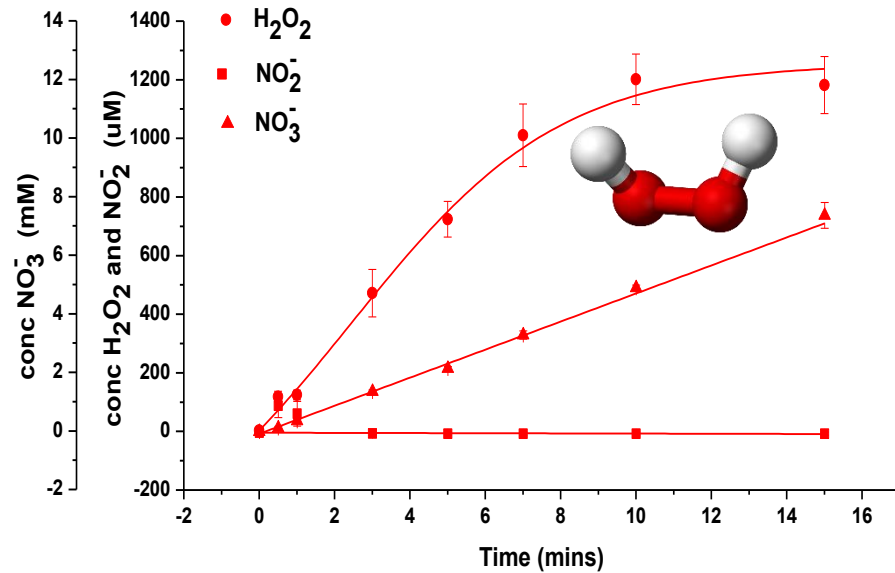




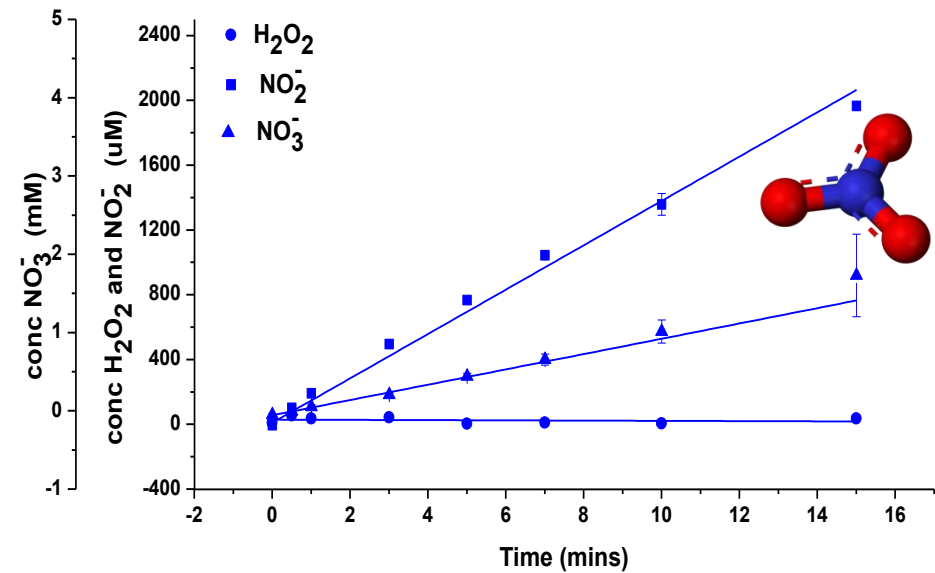
TRL
3

Plasma
Activated Ice

Tailoring Reactive Species



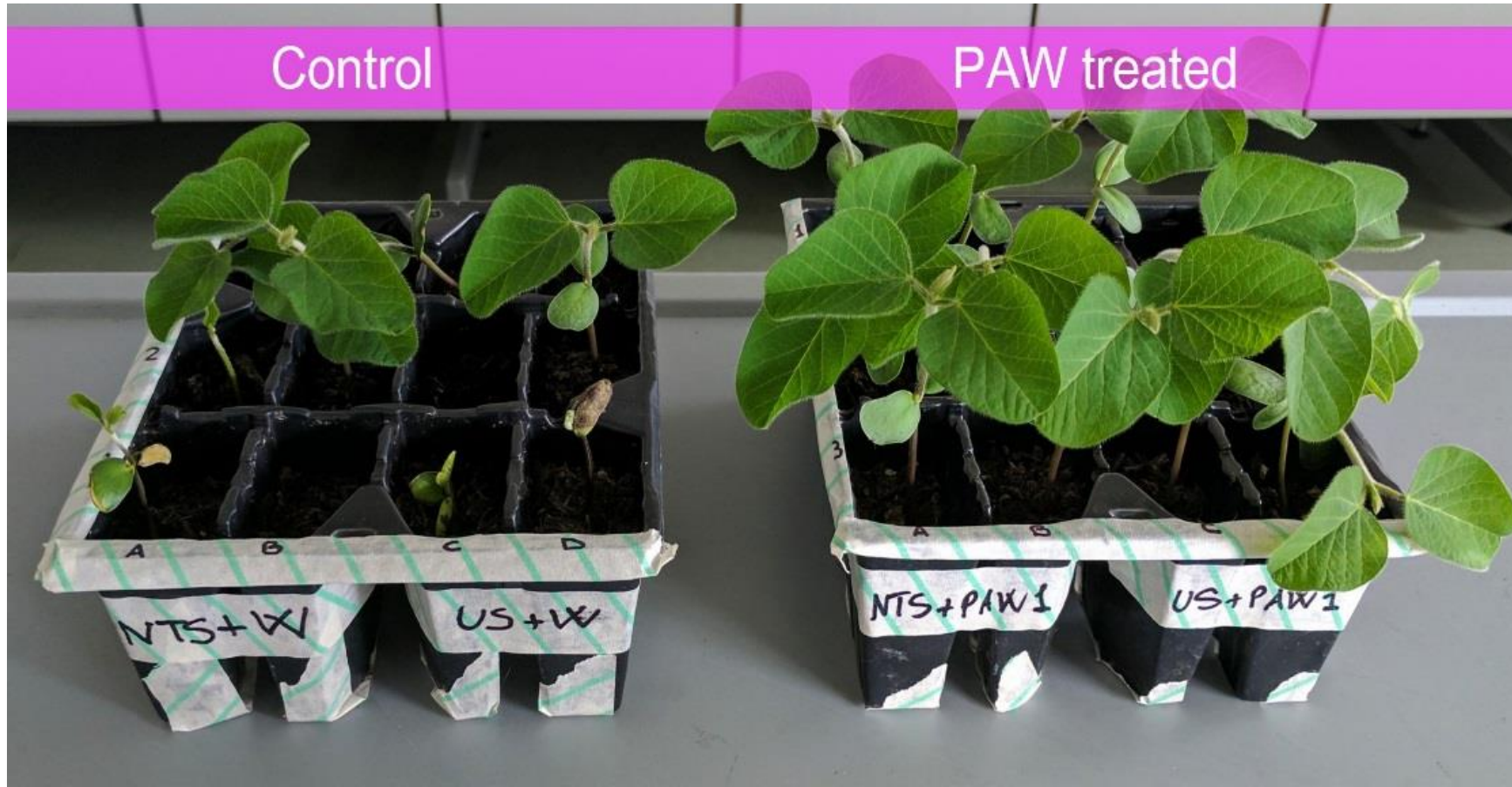
↑
Reactive Oxygen Species
Tech disinfection



↑
Reactive Nitrogen Species
Tech fertilizer

PAW: Soybean growth

TRL
6



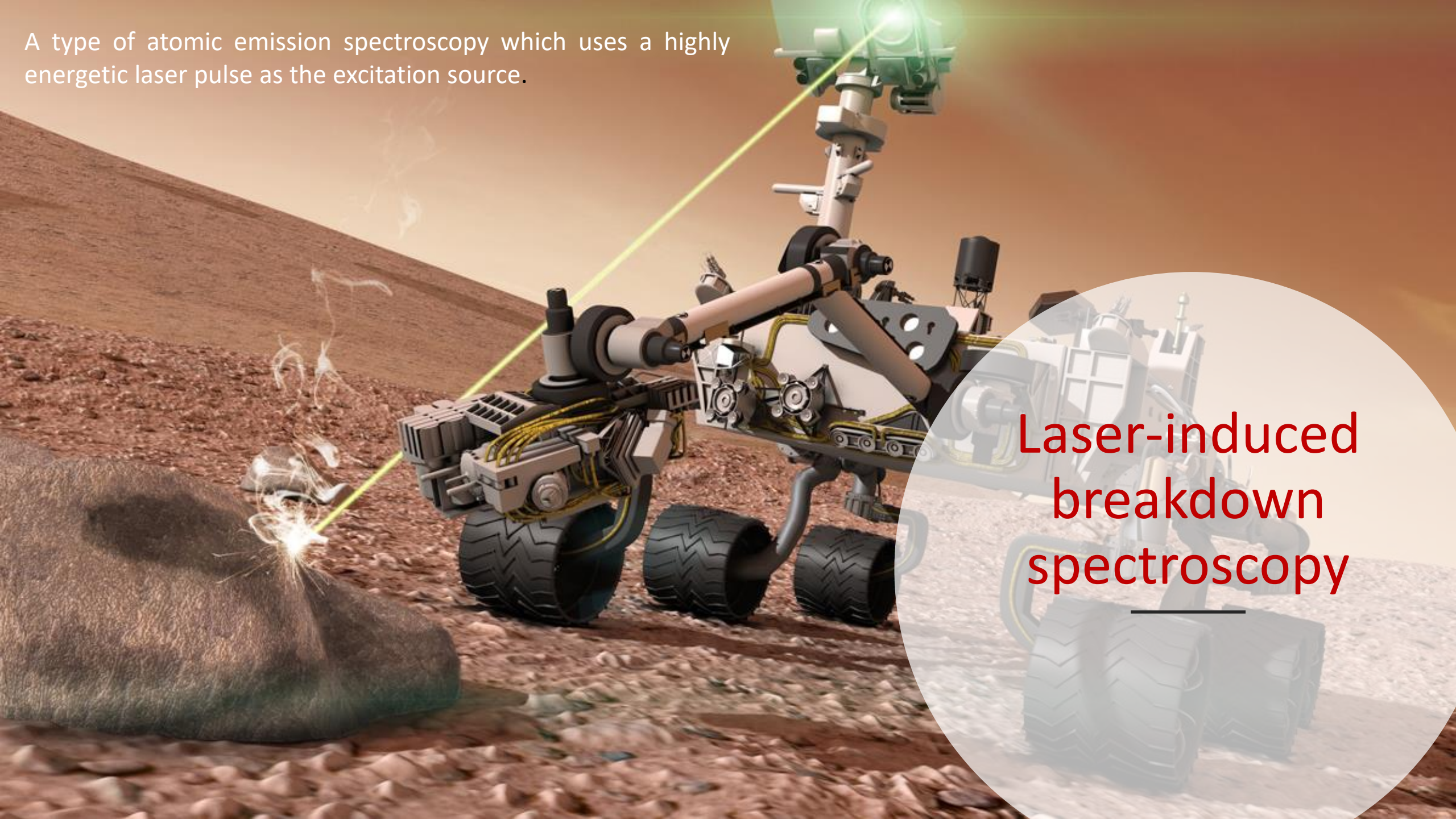
Scale-up trials at greenhouse scale are on-going

Biomass conversion

- Coffee grounds
- Brewers spent grain
- Microalgae
-
- ..



A type of atomic emission spectroscopy which uses a highly energetic laser pulse as the excitation source.



**Laser-induced
breakdown
spectroscopy**

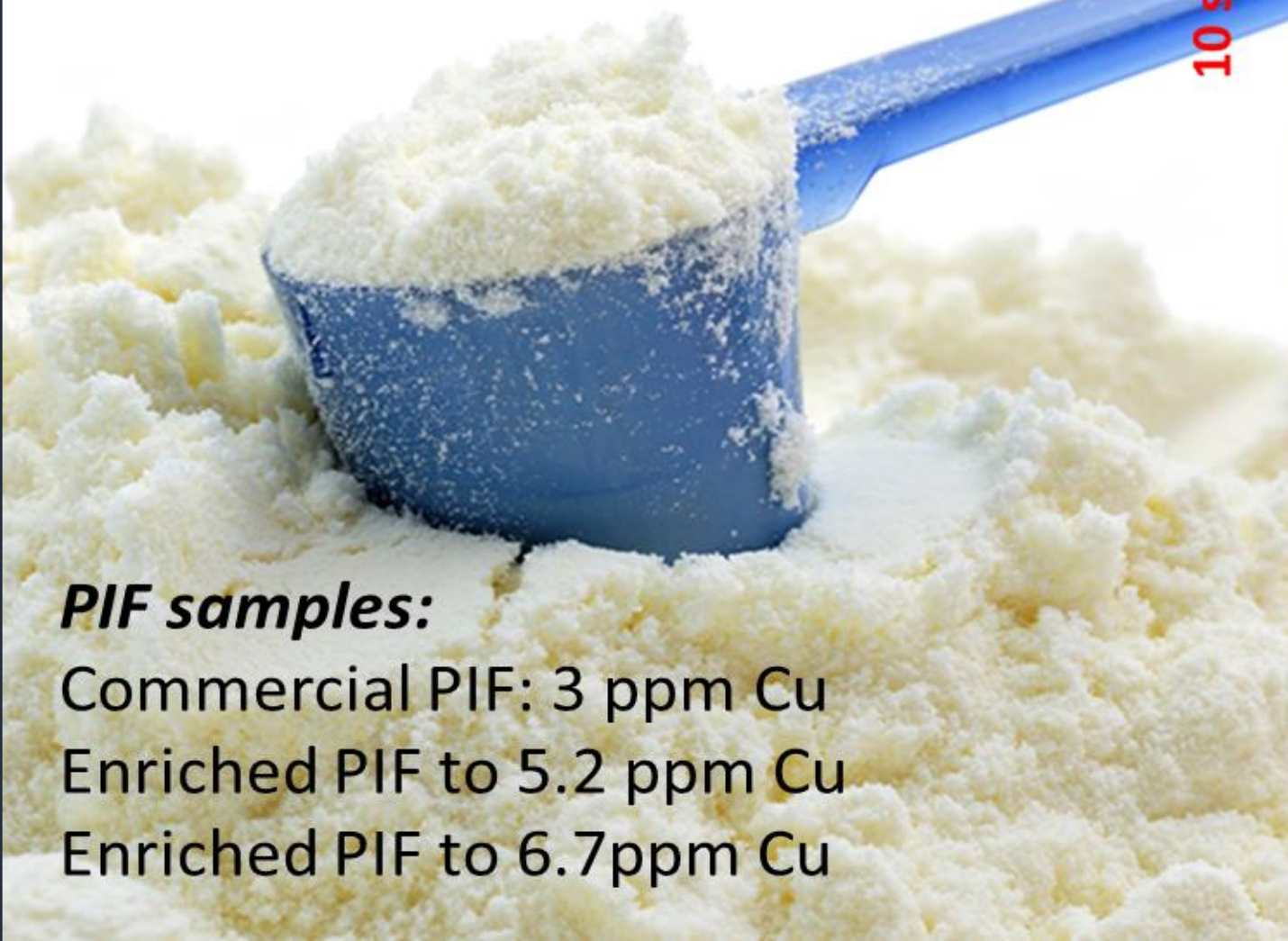
***DIT system:***

Laser: Nd:YAG Wavelength: 1064 nm

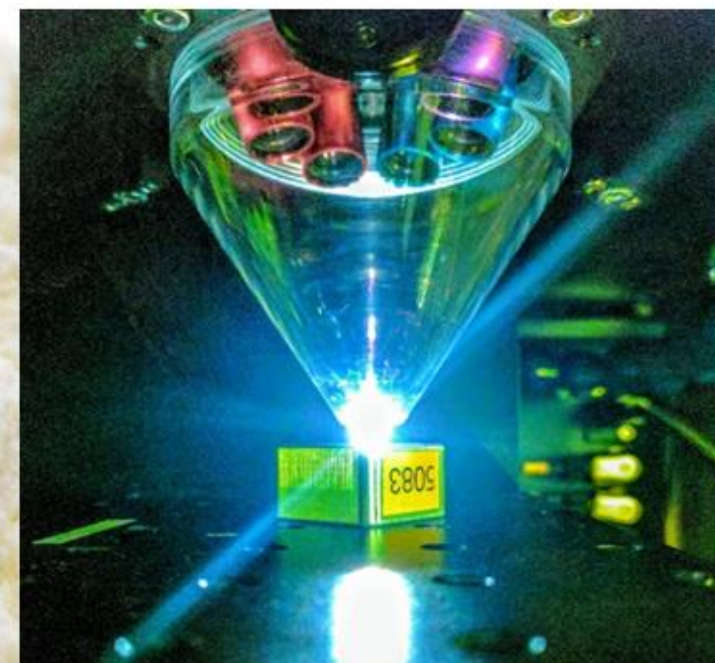
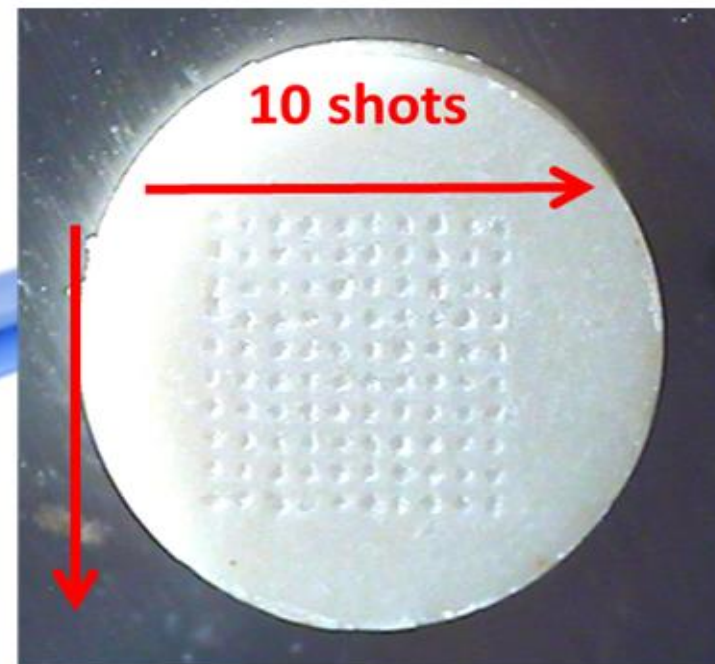
Energy stability: <10% Pulse duration: ~4 - 6 ns

Energy: 0-150 mJ Rep rate: up to 5 Hz

Spectral range : 185 – 904 nm.



10 shots

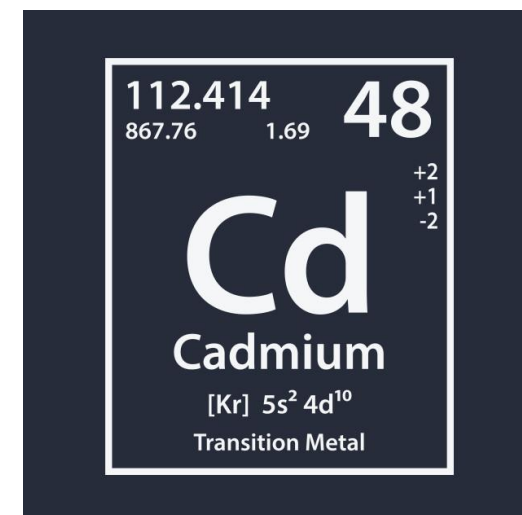
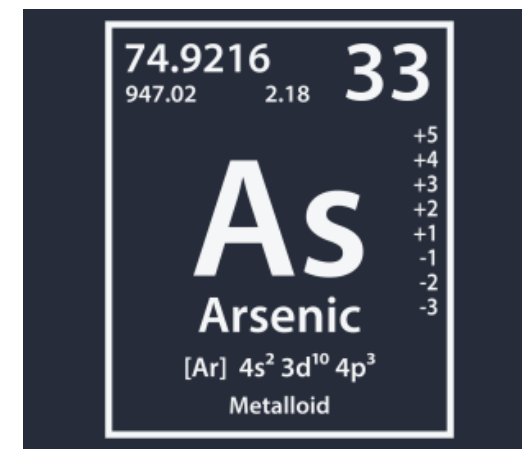
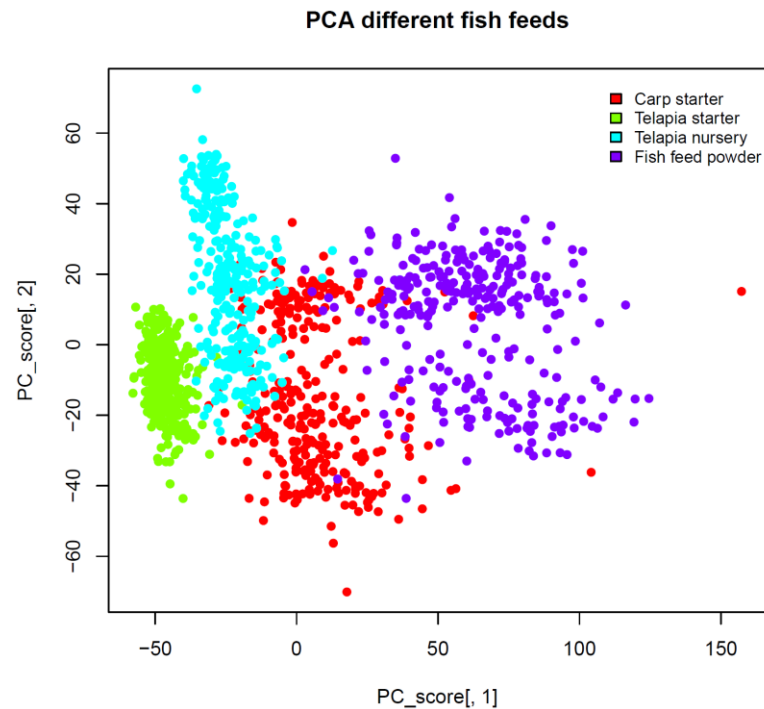


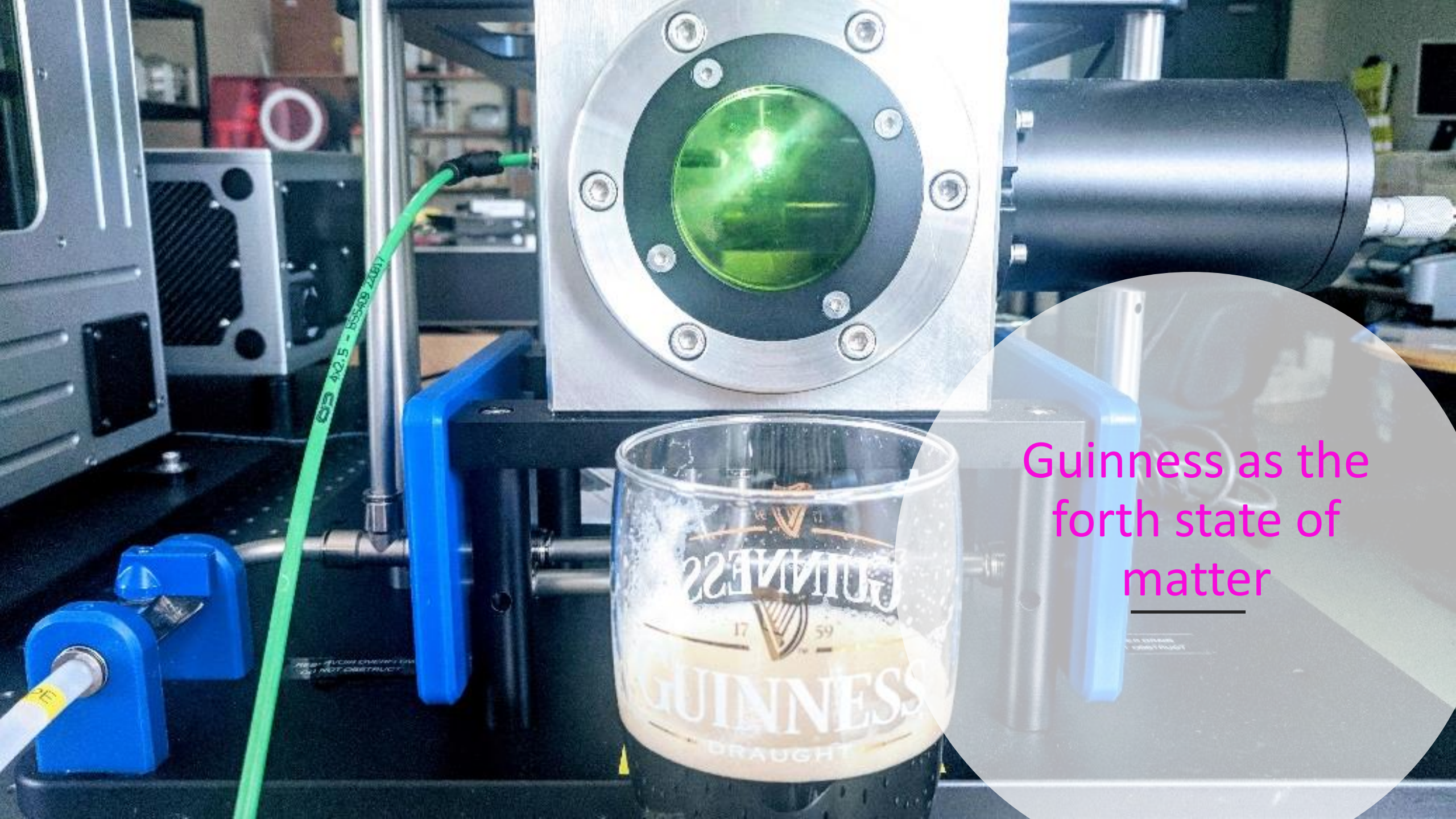
PIF samples:

Commercial PIF: 3 ppm Cu
Enriched PIF to 5.2 ppm Cu
Enriched PIF to 6.7ppm Cu

Heavy metals in fish feed, seafood

Food authenticity





Guinness as the
fourth state of
matter