

Reduction of Food Waste: new challenge for photodynamic, photo reaction and oxidative (program in São Carlos – Brazil)

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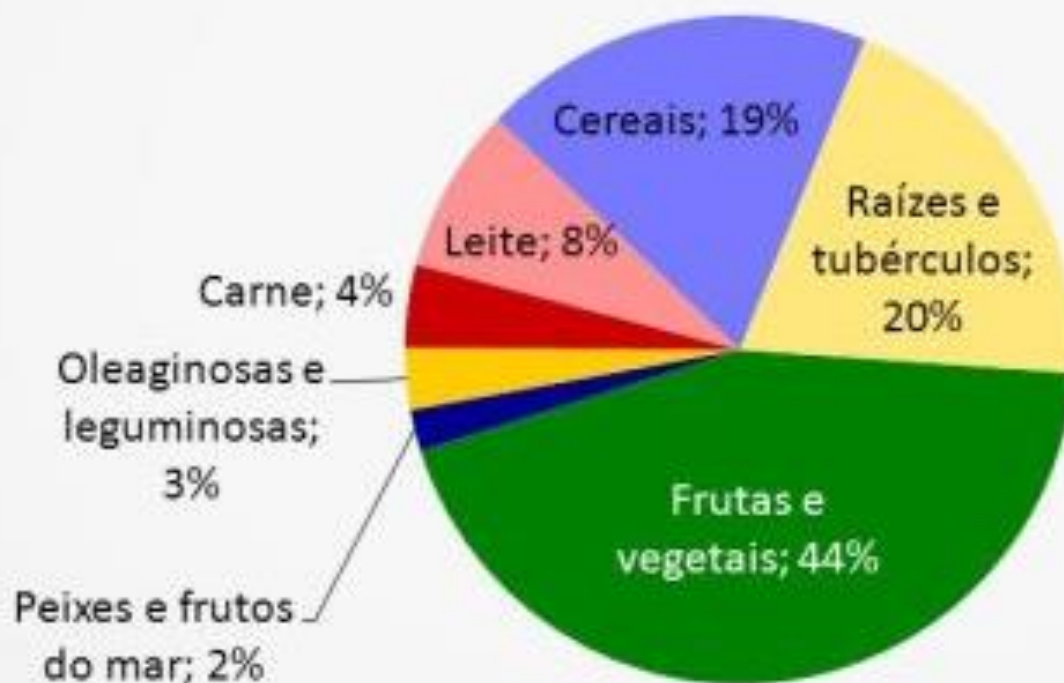
UNITED NATIONS

World Science Day for Peace and Development 10 November

- Strengthen public awareness on the role of science for peaceful and sustainable societies;
- Promote national and international solidarity for shared science between countries;
- Renew national and international commitment for the use of science for the benefit of societies;
- Draw attention to the challenges faced by science and raising support for the scientific Endeavour.

Food waste in the World

1,3 bilhões de toneladas de alimentos vão para o lixo todo ano



In Brazil, much of the food waste happens during the handling and logistics of production:

at harvest, the waste is 10%.

During transportation and storage, the figure is 30%.

In commerce and retail, the loss can be as high as 40%,

while in households 10% goes to waste.



Foodborne Illness Statistics

Each year in U.S., foodborne illness causes:

- **48 million** gastrointestinal illnesses
- **128,000** hospitalizations
- **3,000** deaths

orange



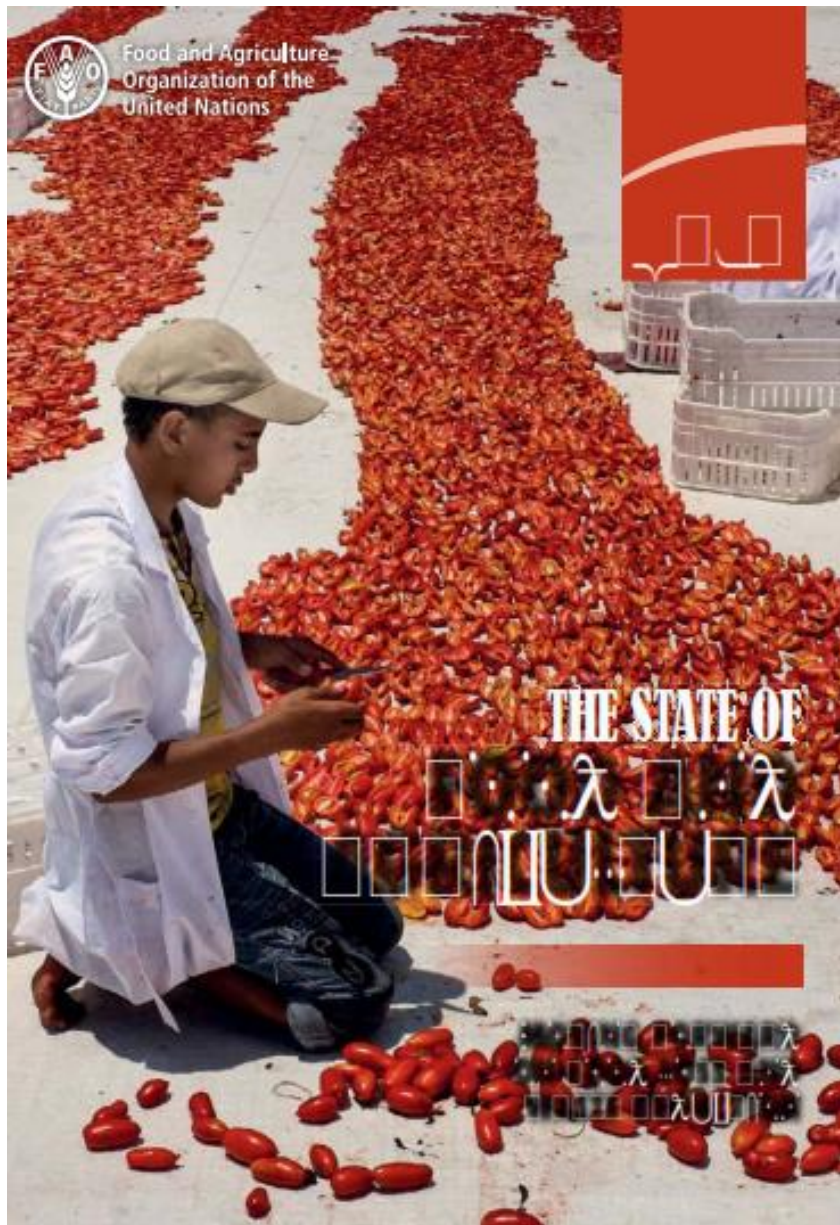
Beef - E.Coli,
Salmonella, etc



Transport and distribution

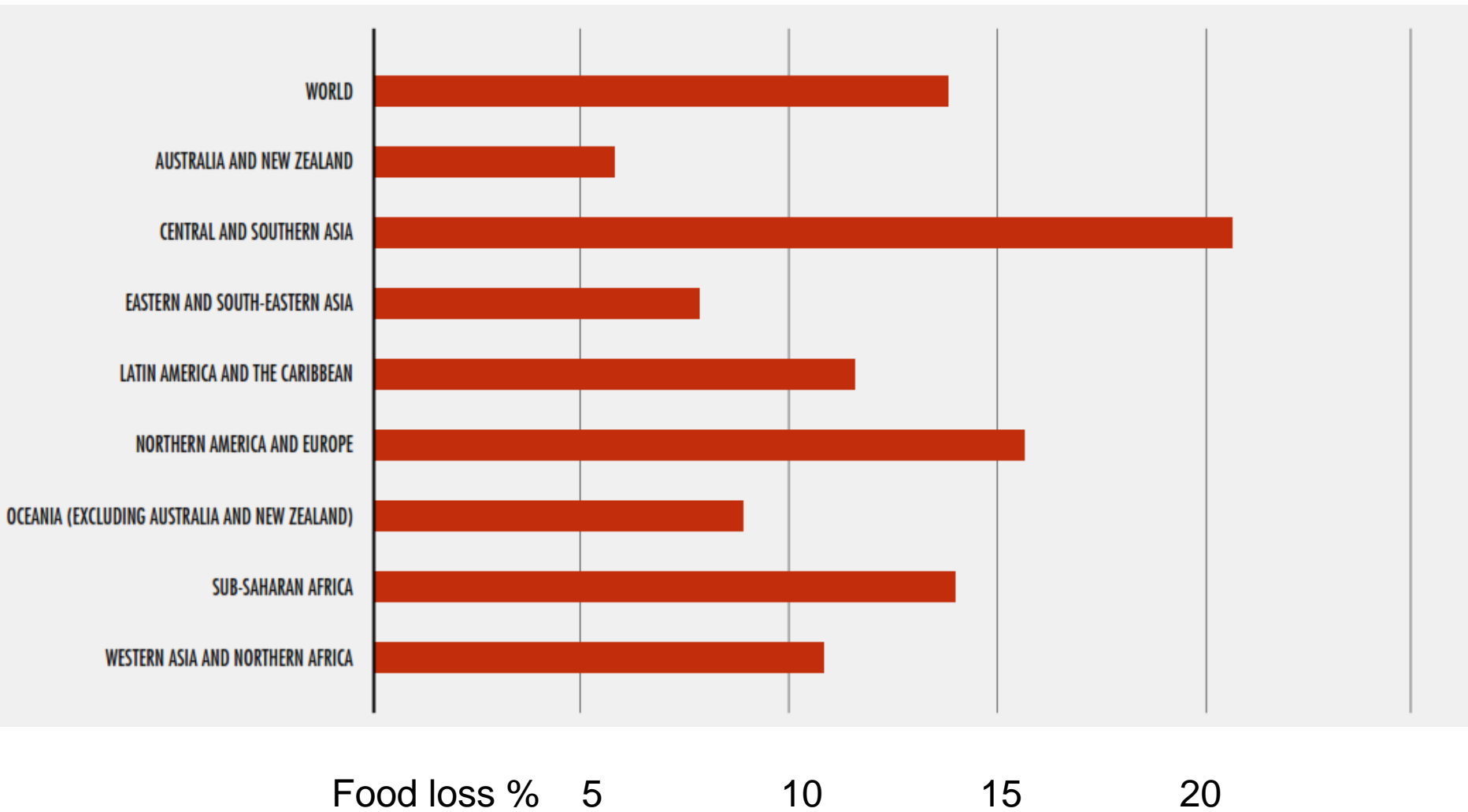


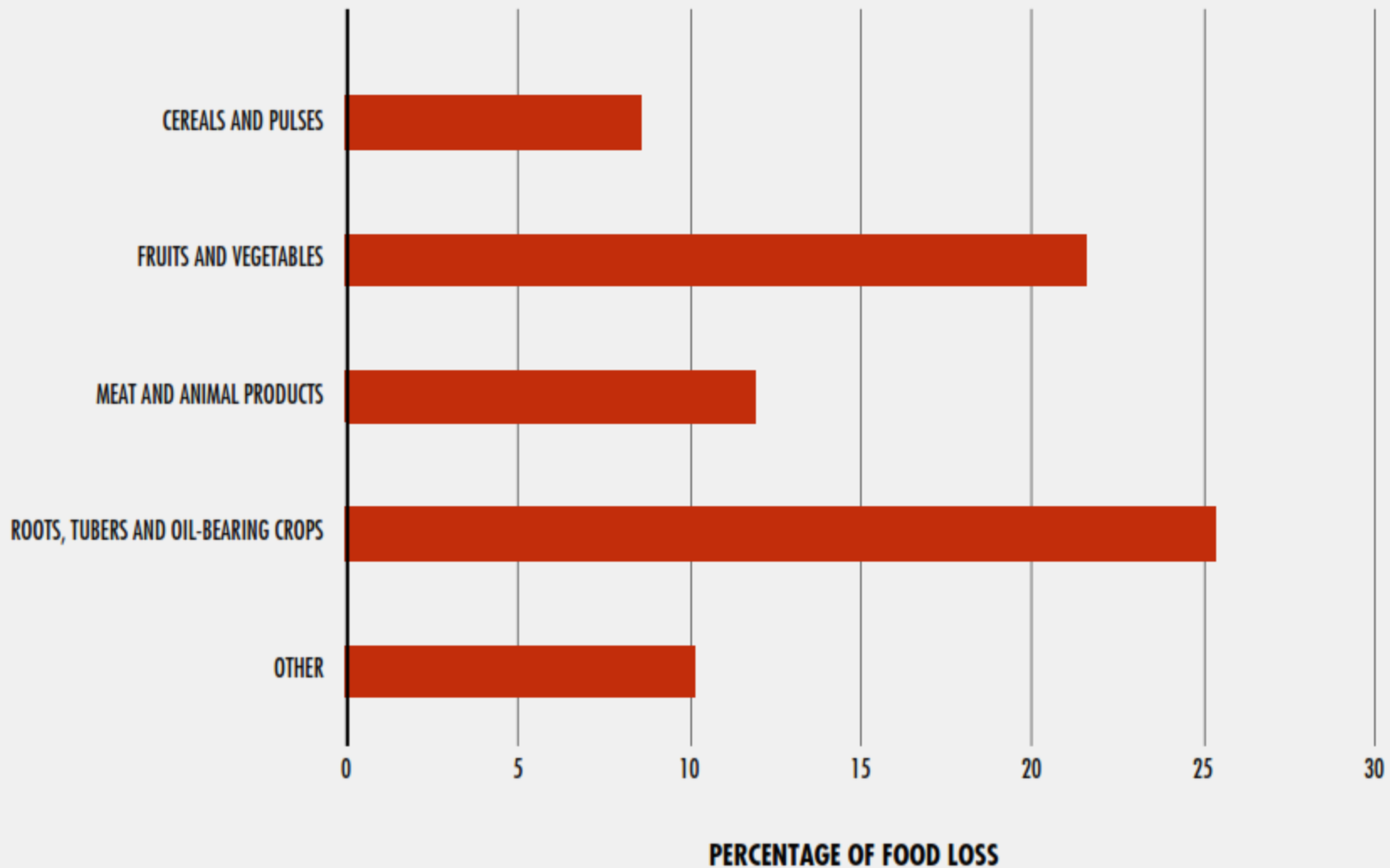
Losses: 36%

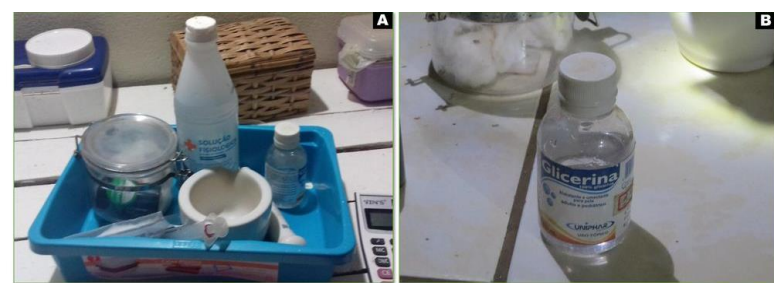


FOOD AND AGRICULTURE

MOVING FORWARD ON FOOD LOSS AND WASTE REDUCTION







A LARGE NUMBER OF POPULATION
SOFFER FROM THE ADDITIVES AND
POISONS USED IN FOOD

MICROBIAL CONTROL



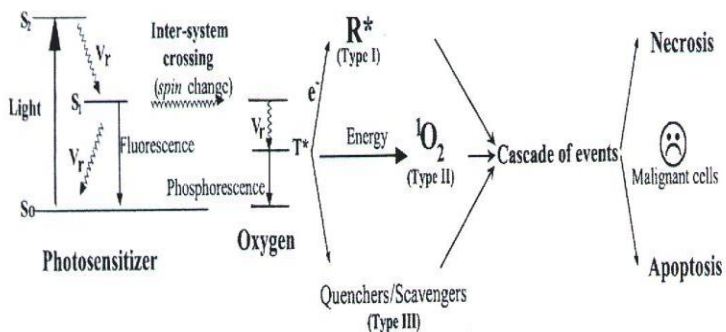
3.8% of Global Economy will be lost because of resistant bacteria

Photodynamic action

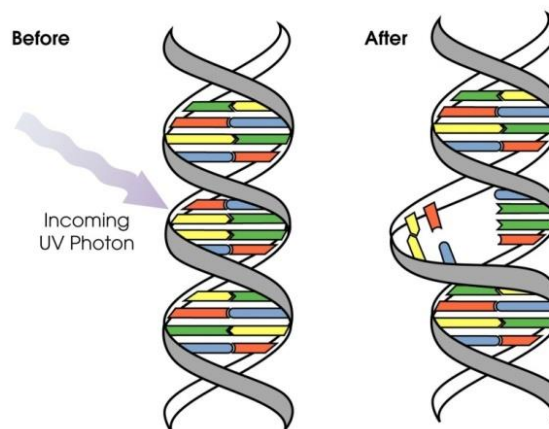
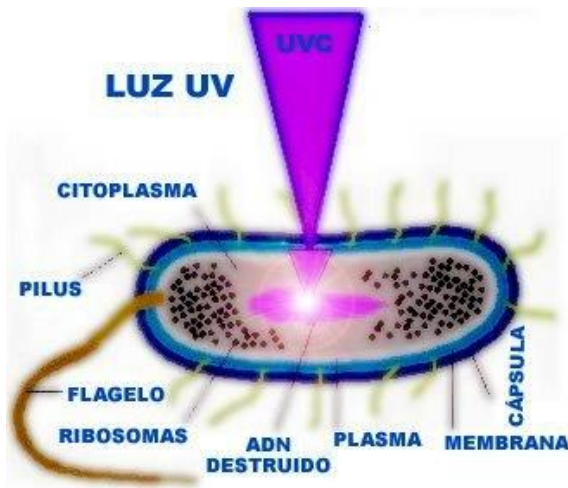


LIGHT+ MOLECULE+ O₂

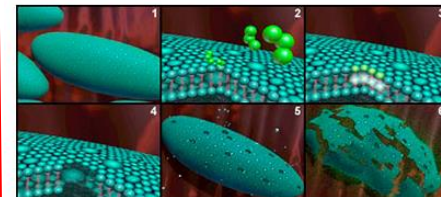
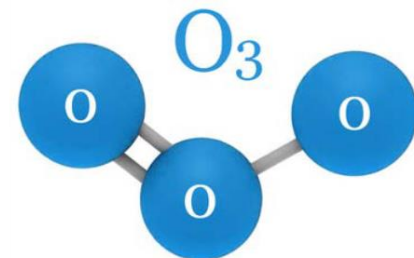
SEVERE OXIDATION
Cells or MICROORGANISMS



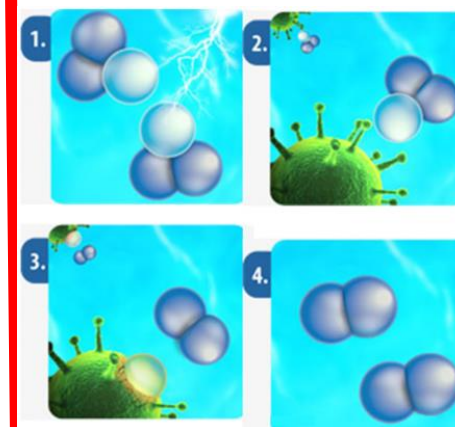
Ultra-violet



Ozone



Ozônio - Fases da Desinfecção e Destruição da Bactéria no Tratamento com Ozônio



MANY EXPERIMENTS AND CLINICAL WORK FROM OUR GROUP

A Financiadora de Estudos e Projetos (FINEP) participa intensamente da maioria dos projetos apresentados neste livro, apoiando a empresa MMOptics.



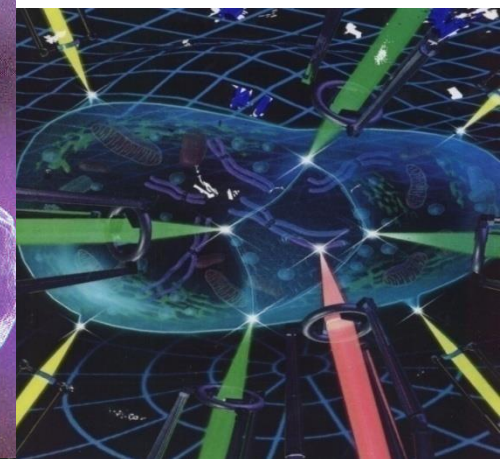
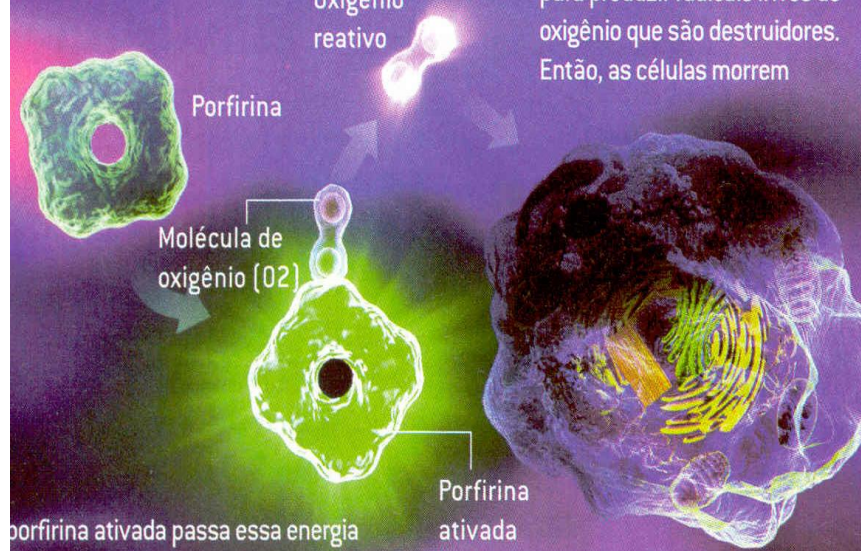
A Indústria Farmacêutica PDT Pharma LTDA, também viabilizou grande parte destes projetos, oferecendo os insumos farmacêuticos (curcumina, ALA e MAL) a preço de custo e mantendo contato direto com os pesquisadores e os responsáveis clínicos participantes destes estudos.

PDT Pharma



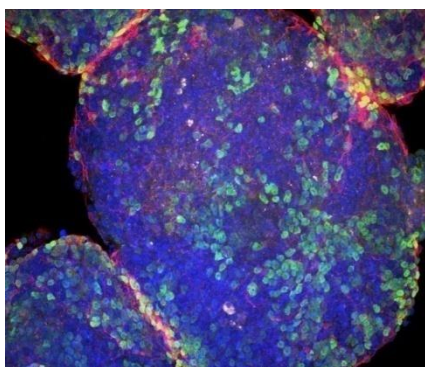
O IFSC-USP agradece os apoios dos órgãos de financiamento FAPESP (Centro de Pesquisas em Óptica e Fotônica - CEPOF), CAPES e CNPq, garantindo a qualidade das produções científicas compatíveis com o nível destes projetos.



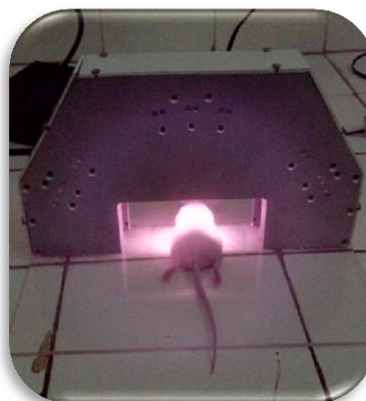


Photodynamic Therapy, Microbial control, Photodiagnostics
Phototherapy and Optics applied to Agriculture and Environment

Cells



Experimental models

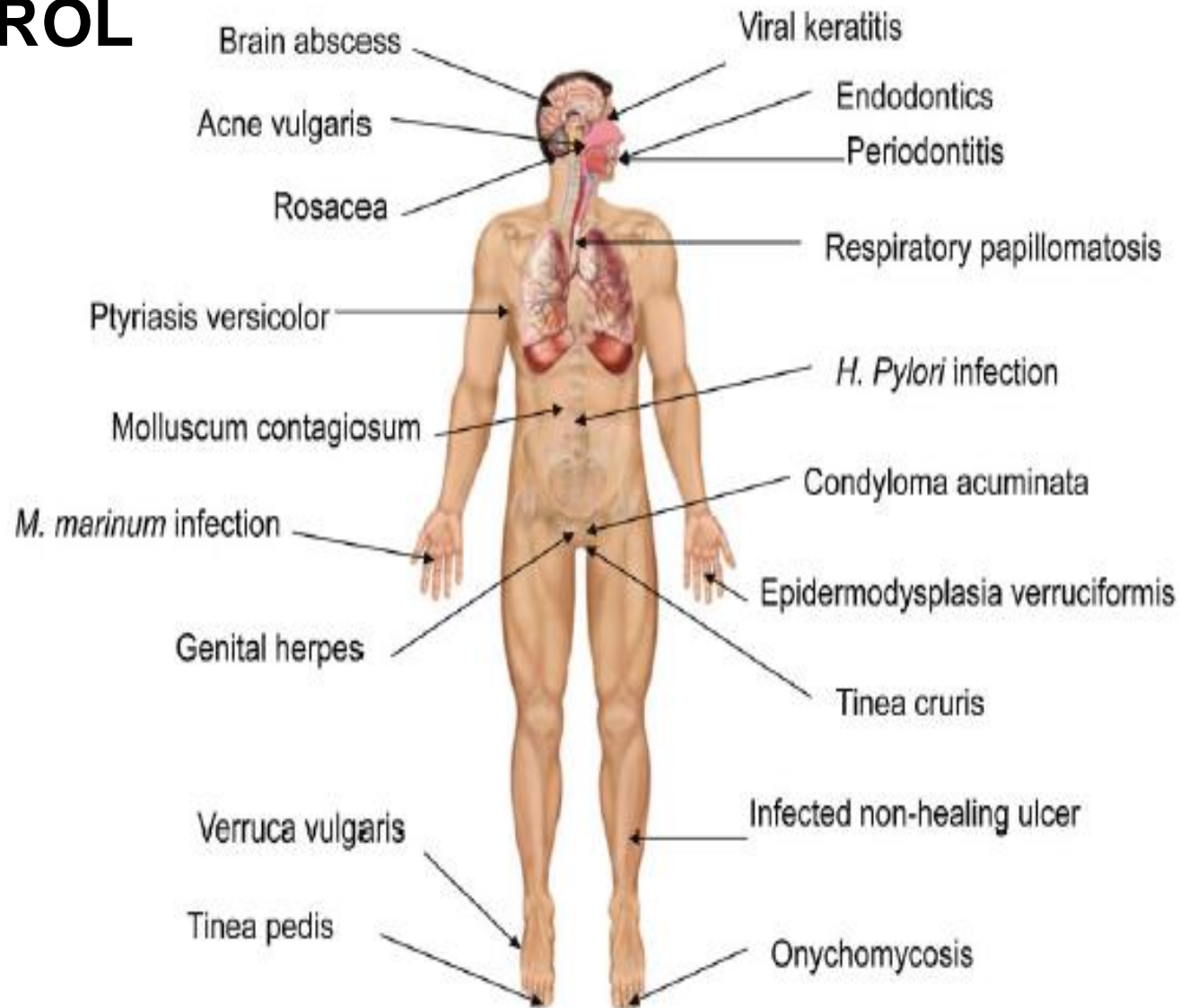


Clinics

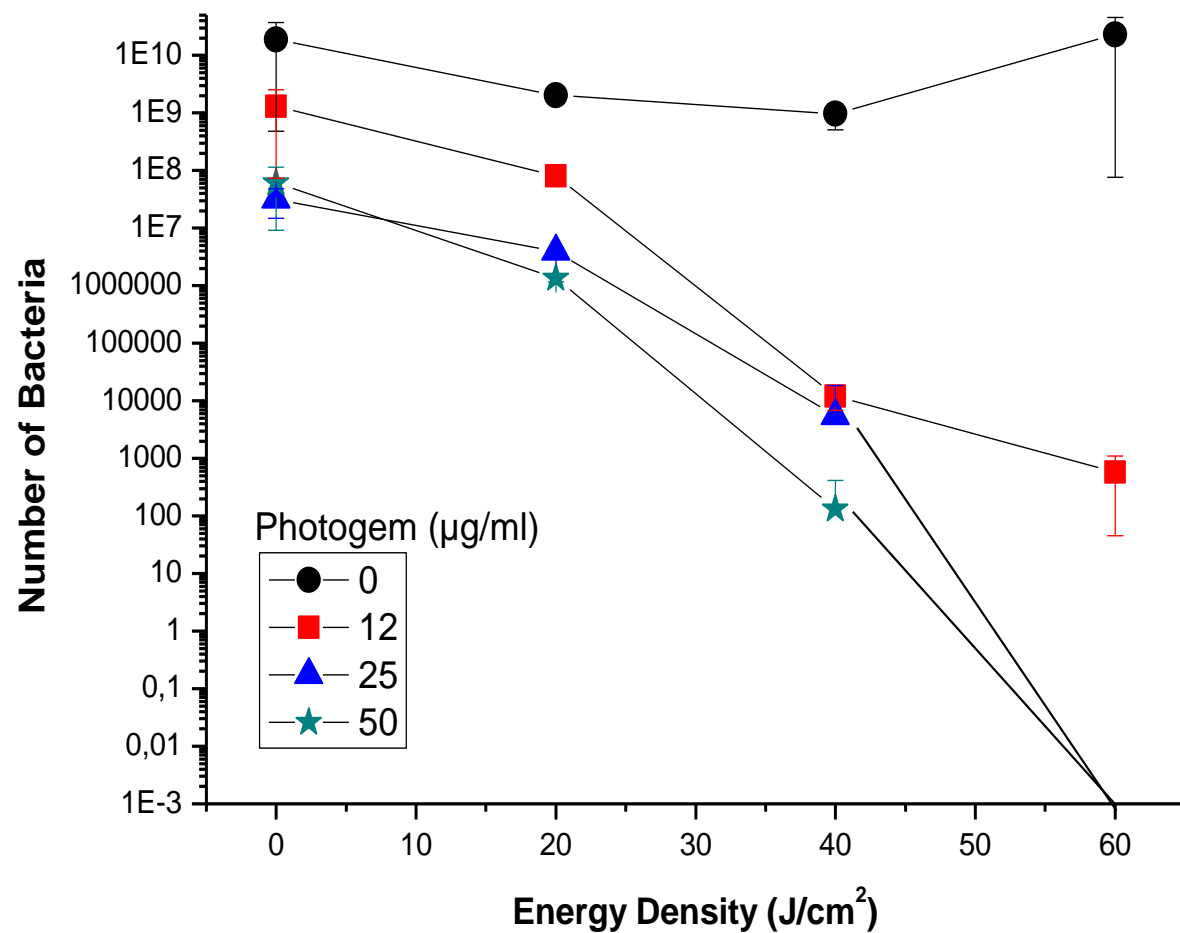


From principles to instrumentation and clinical

MICROORGANISMO CONTROL

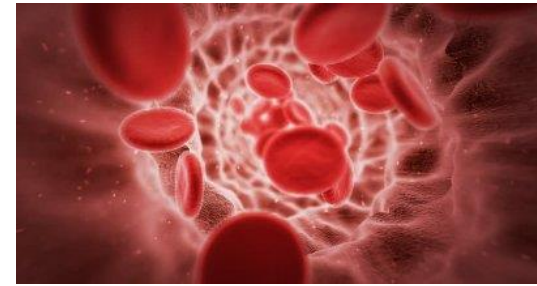


Picture : M. Hamblin and collab.



Effect of *in vitro* PDT on the *Staphylococcus aureus* viability

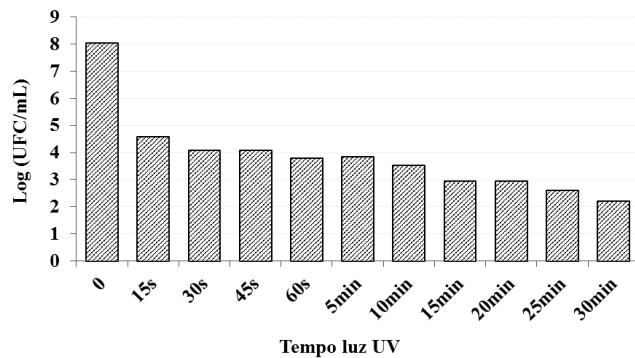
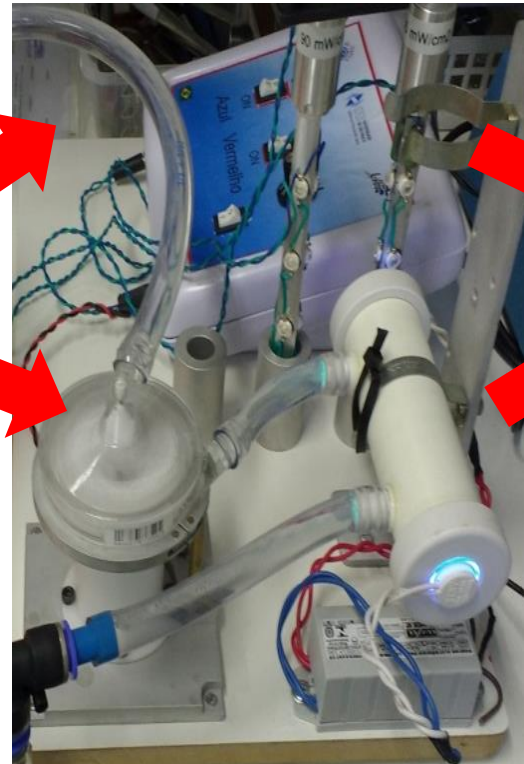
Photodynamic Therapy and blood cleaning

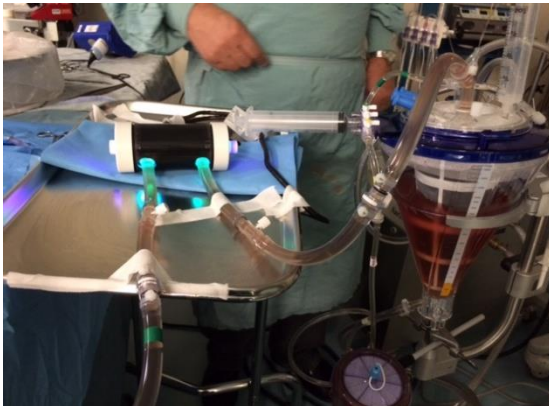
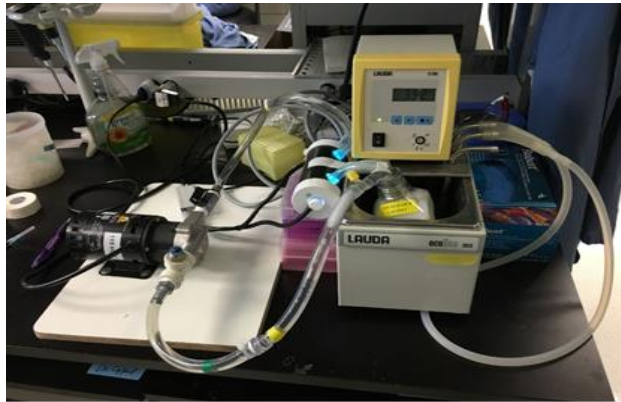
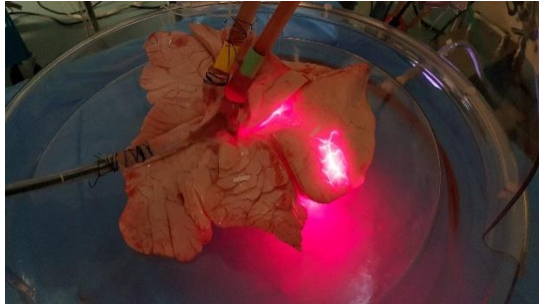


UV
circulator

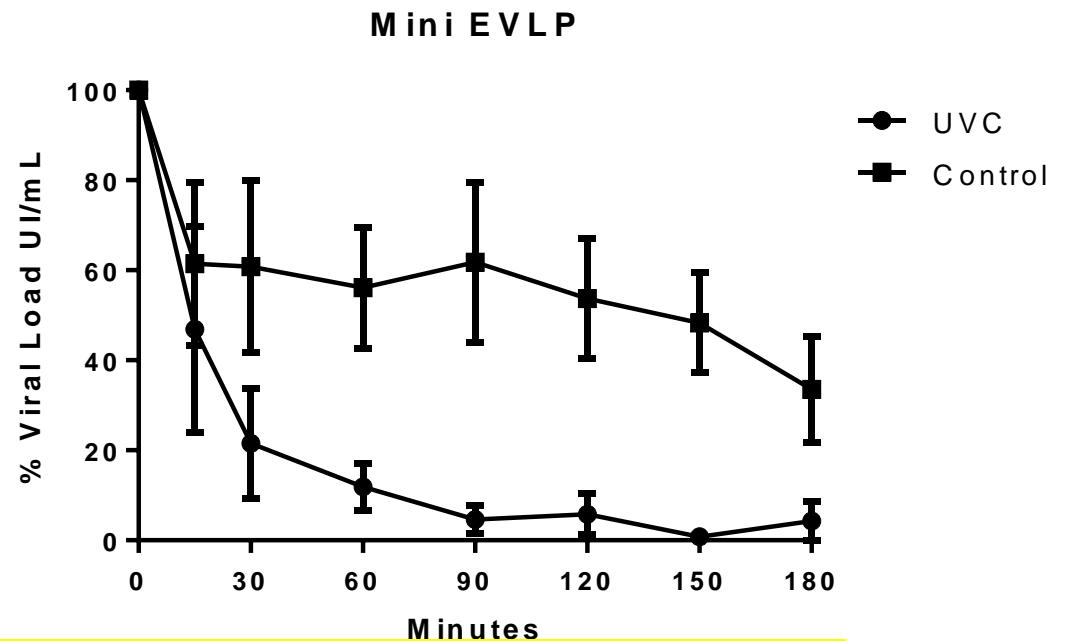
Physical
separation

- Cells
- Plasma

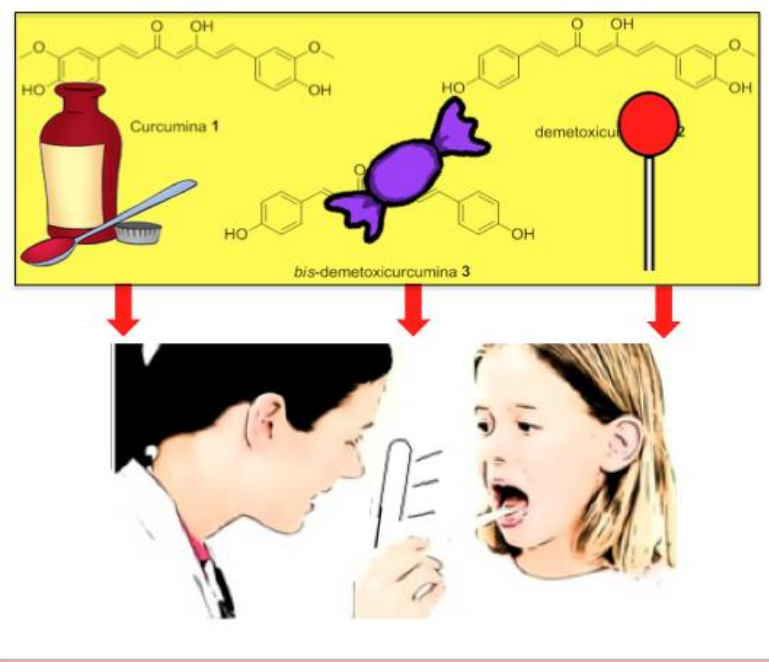




DECONTAMINATION OF ORGANS FOR TRANSPLANTATION (LUNG - COLLABORATION U.TORONTO)



Presently doing experiments with liver
and kidney (animal models) in Brazil



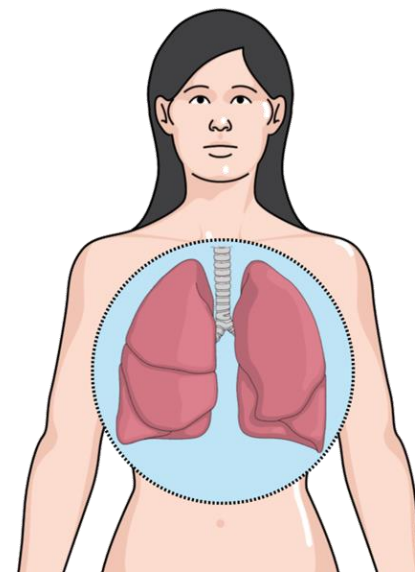
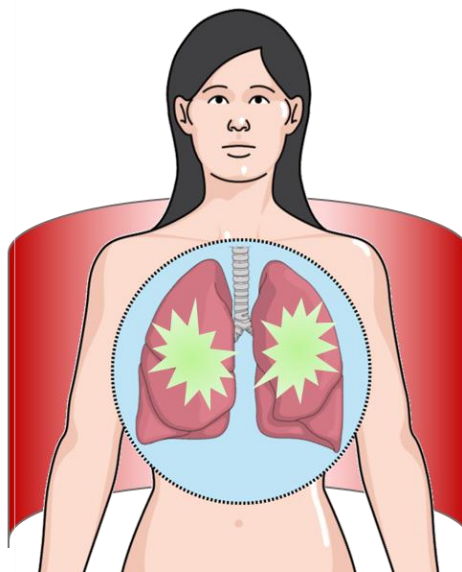
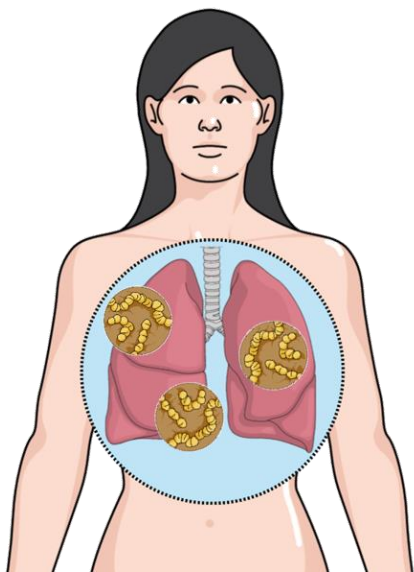
Fever and symptoms after 24 hours

Presence
6%

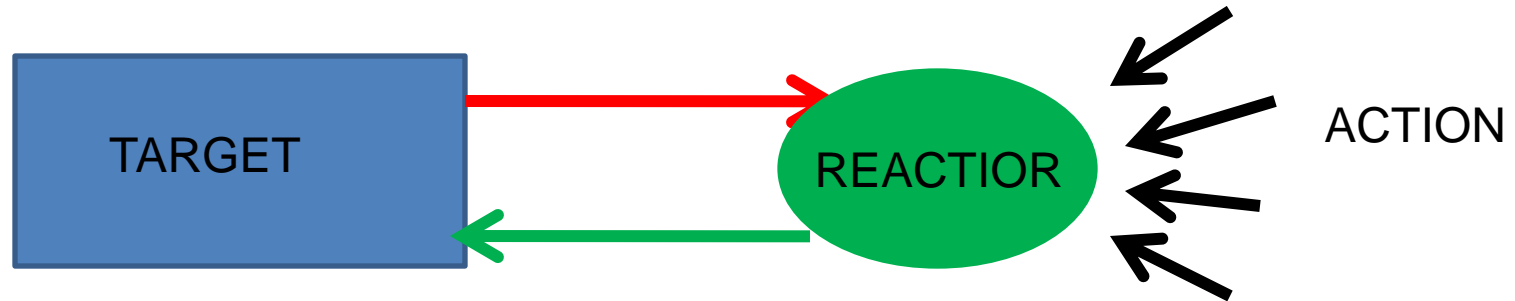


Next step

- ICG nebulization

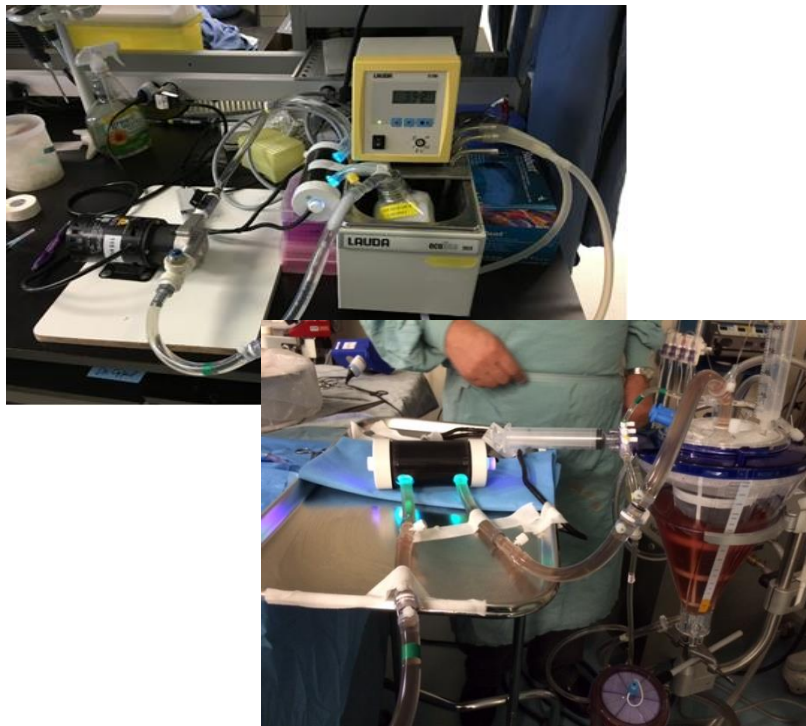


CIRCULATING LIQUID PHOTO ACTION

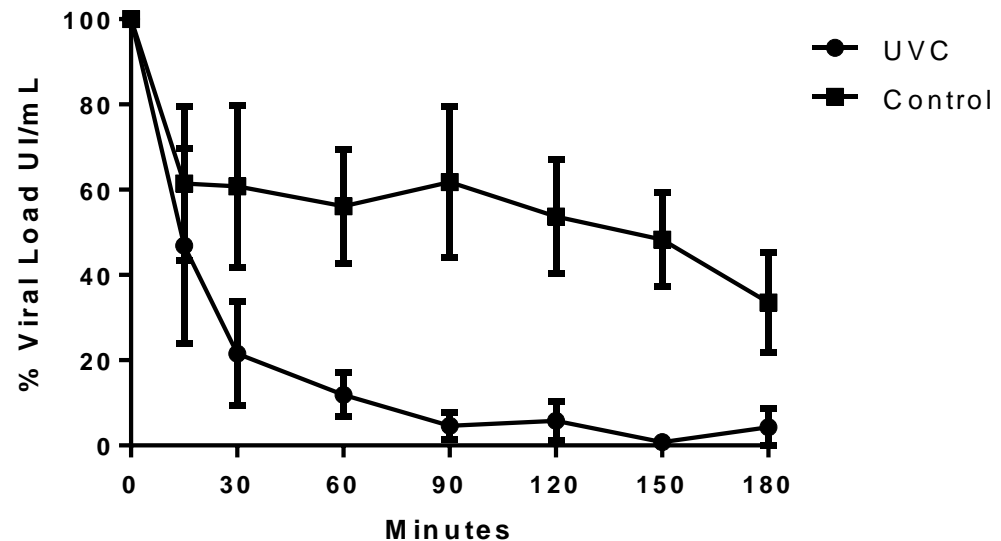


EXAMPLES

DECONTAMINATION OF ORGANS FOR TRANSPLANTATION

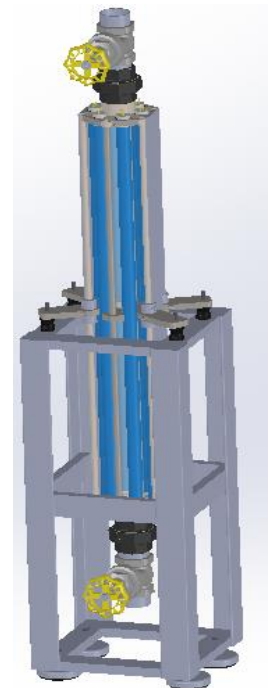
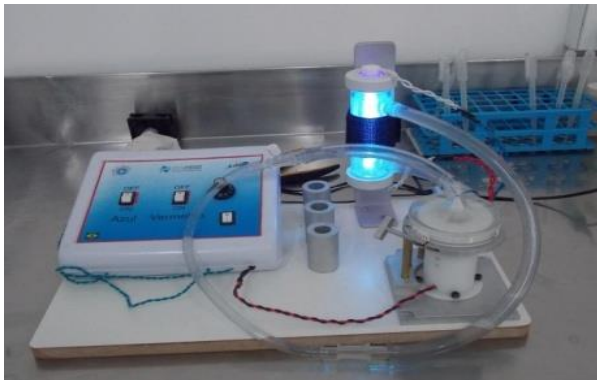


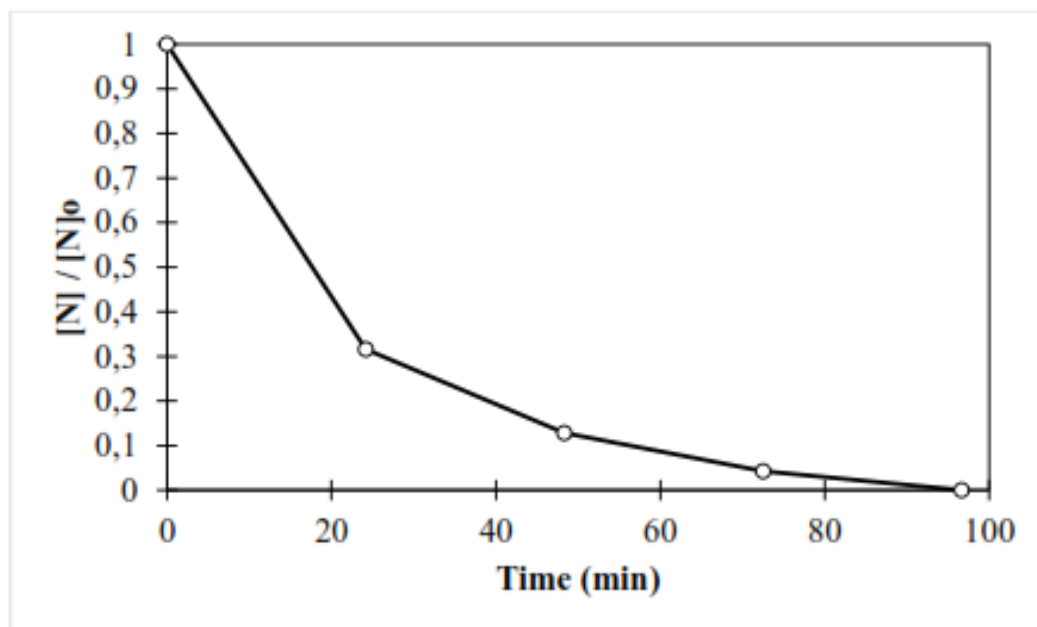
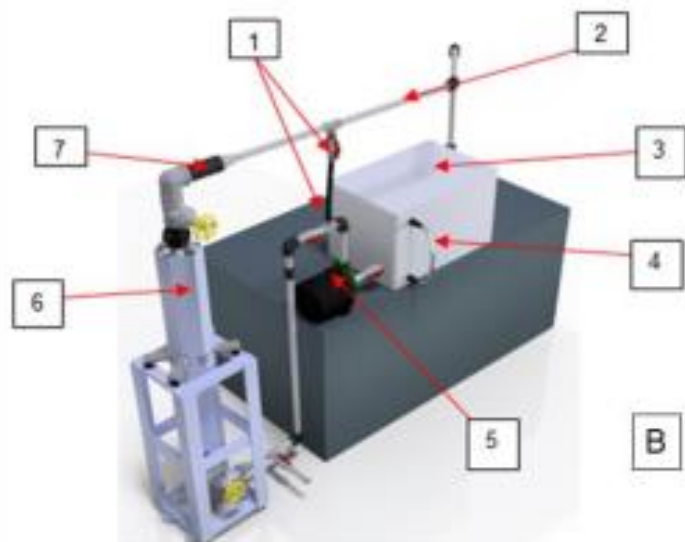
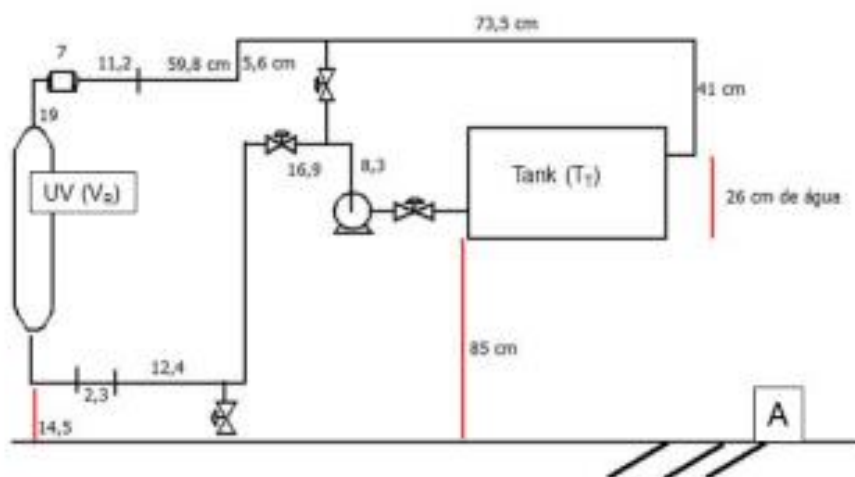
Mini EVLP

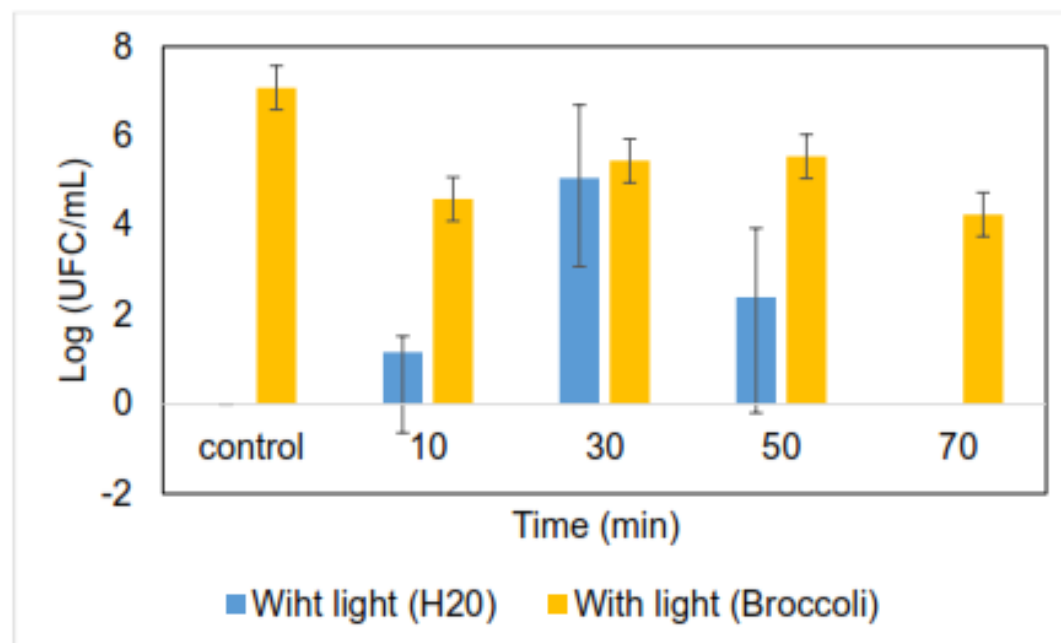
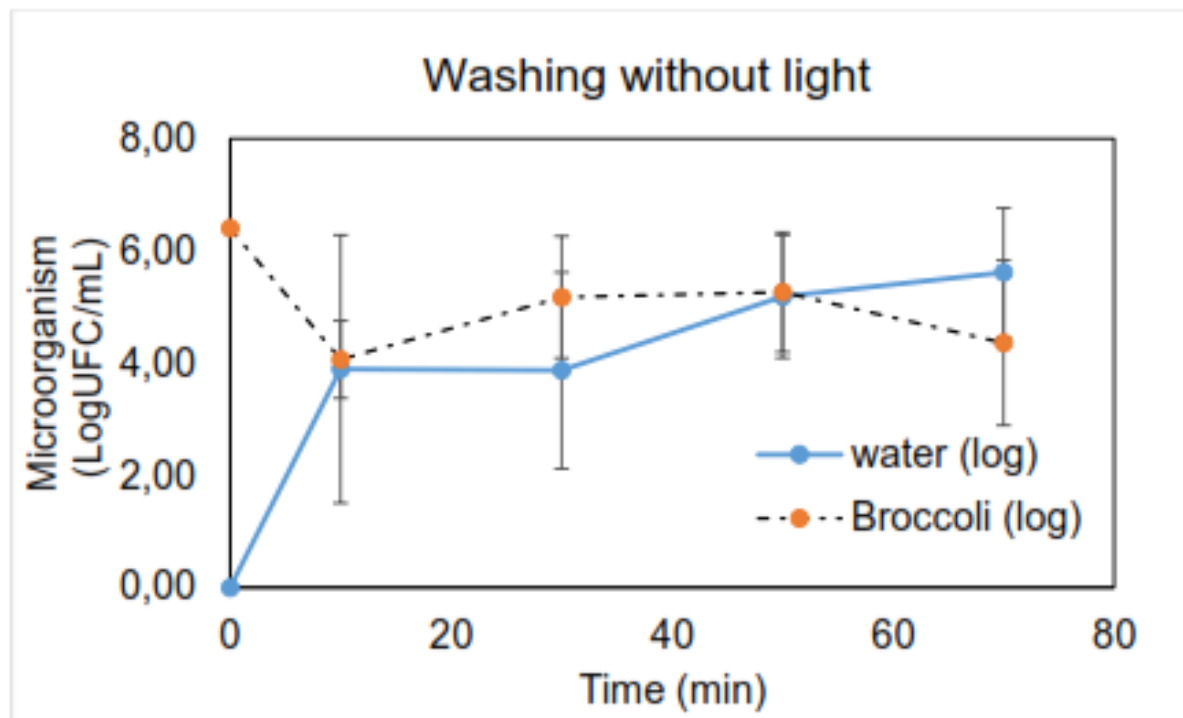


Broccolis decontamination using water recirculation and UV (México)

50 liters of water/broccoli







Defining γ as the probability of destroying one microorganism per unit of time

$$\frac{dN}{dt} = -\gamma * N \quad \text{From the data } \rightarrow \sim 0.1 \text{ min}^{-1}$$

$$\gamma \sim 0.04 Q / 20 \text{ (for } q \text{ in L/min)}$$

Having the broccolis

$$\frac{dN_s}{dt} = L(N_B, t) - \gamma N_s \quad L(N_B, t) = \alpha (N_B - N_s)$$

$$\frac{dN_s}{dt} = -\alpha (N_B - N_s) - \gamma N_s \rightarrow \frac{dN_B}{dt} = -\beta (N_B - N_s)$$

$$\frac{dN_s}{dt} > 0$$

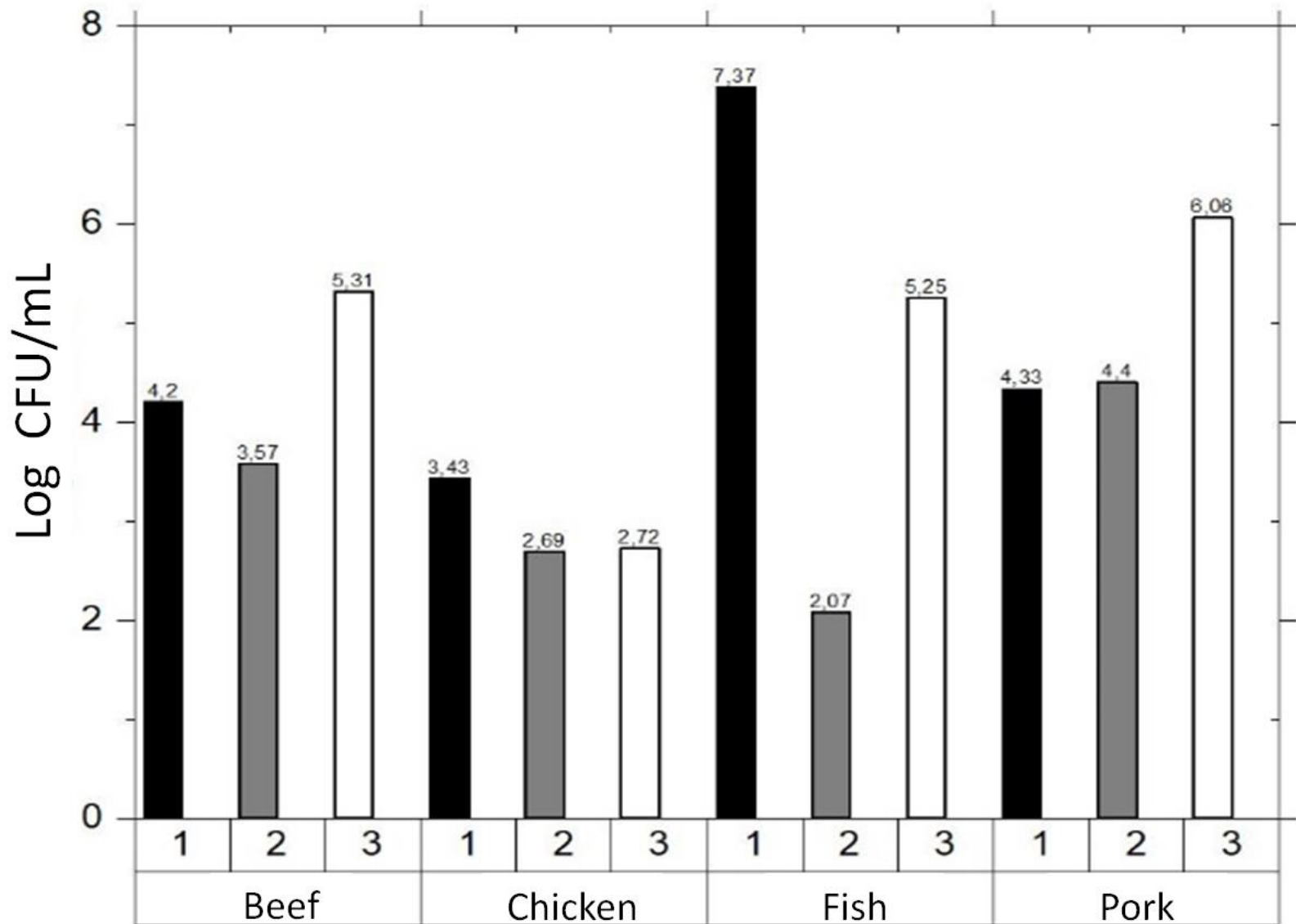
$$\frac{dN_s}{dt} = 0$$

$$\frac{dN_s}{dt} < 0$$



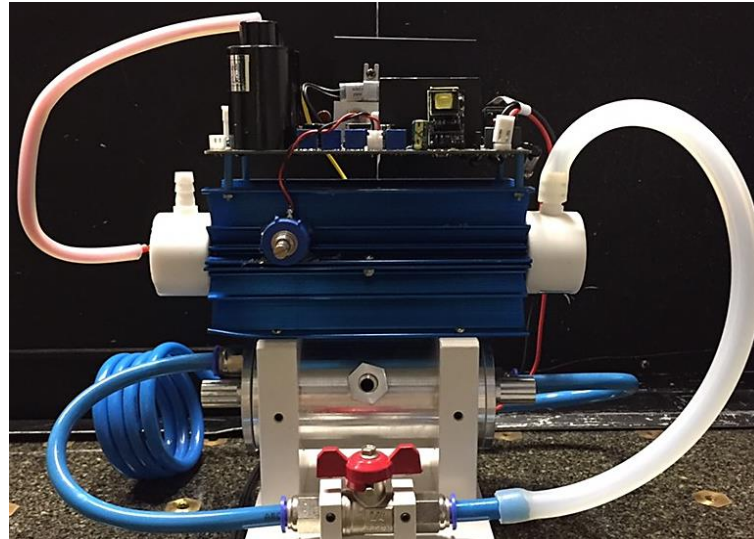
UV IN FISH
FARMS

Contamination levels of different types of meat (regular fresh meat places)



Ozone

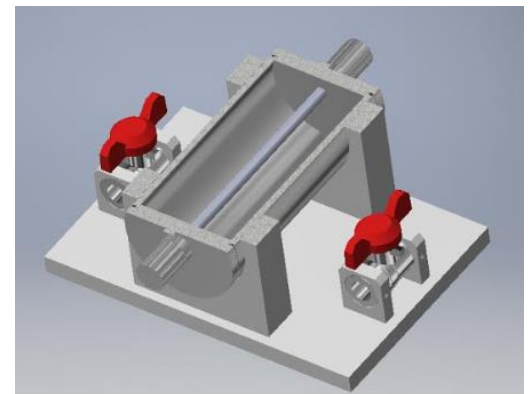
Gaseous ozone or in solution system



Concentration:
13 – 15 ppm

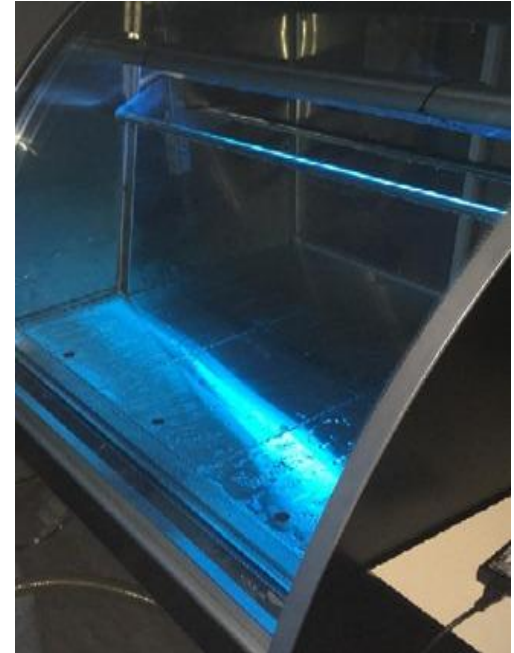


Exposure time:
1 – 10 – 30 min

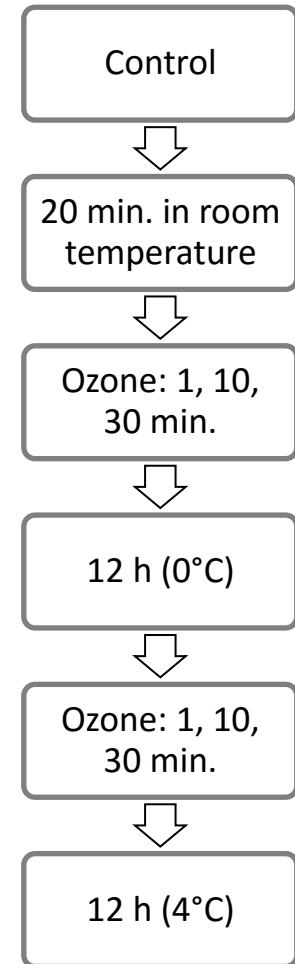
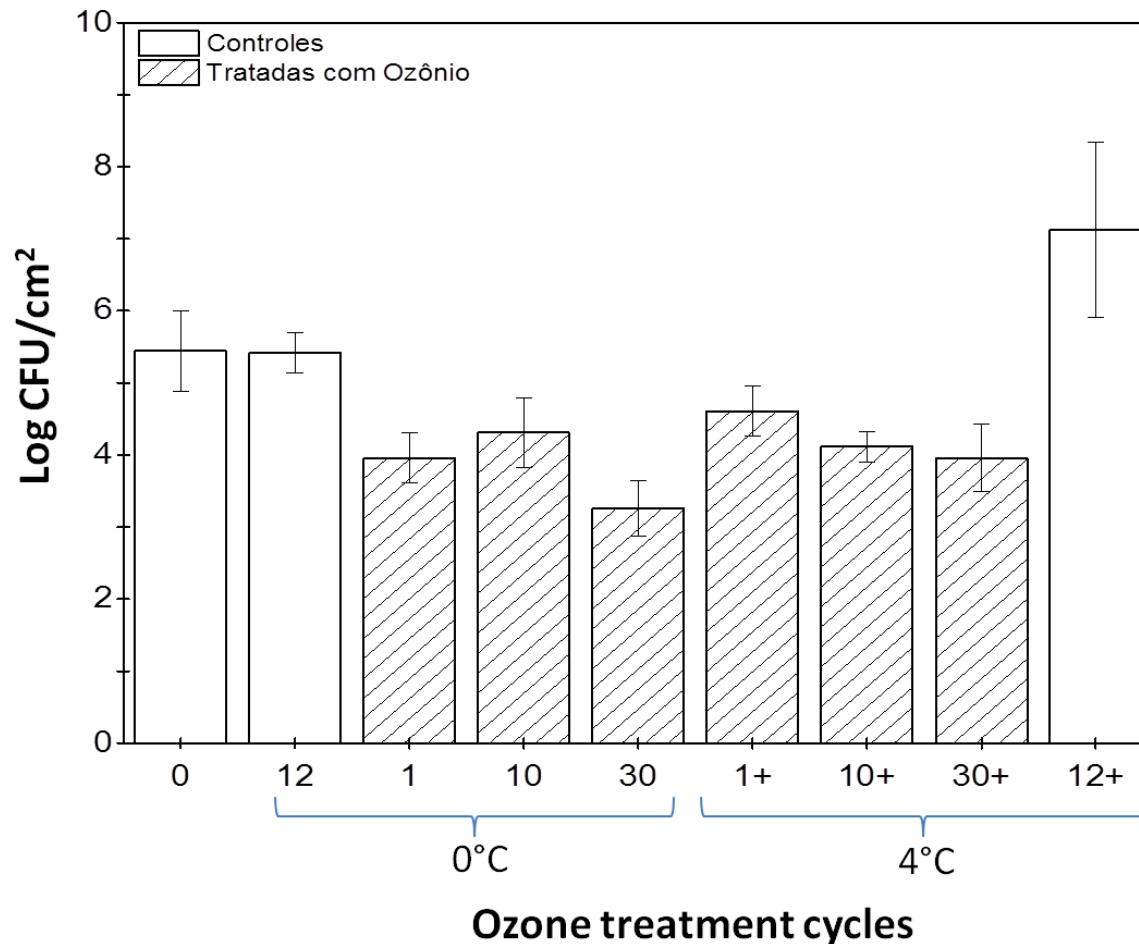


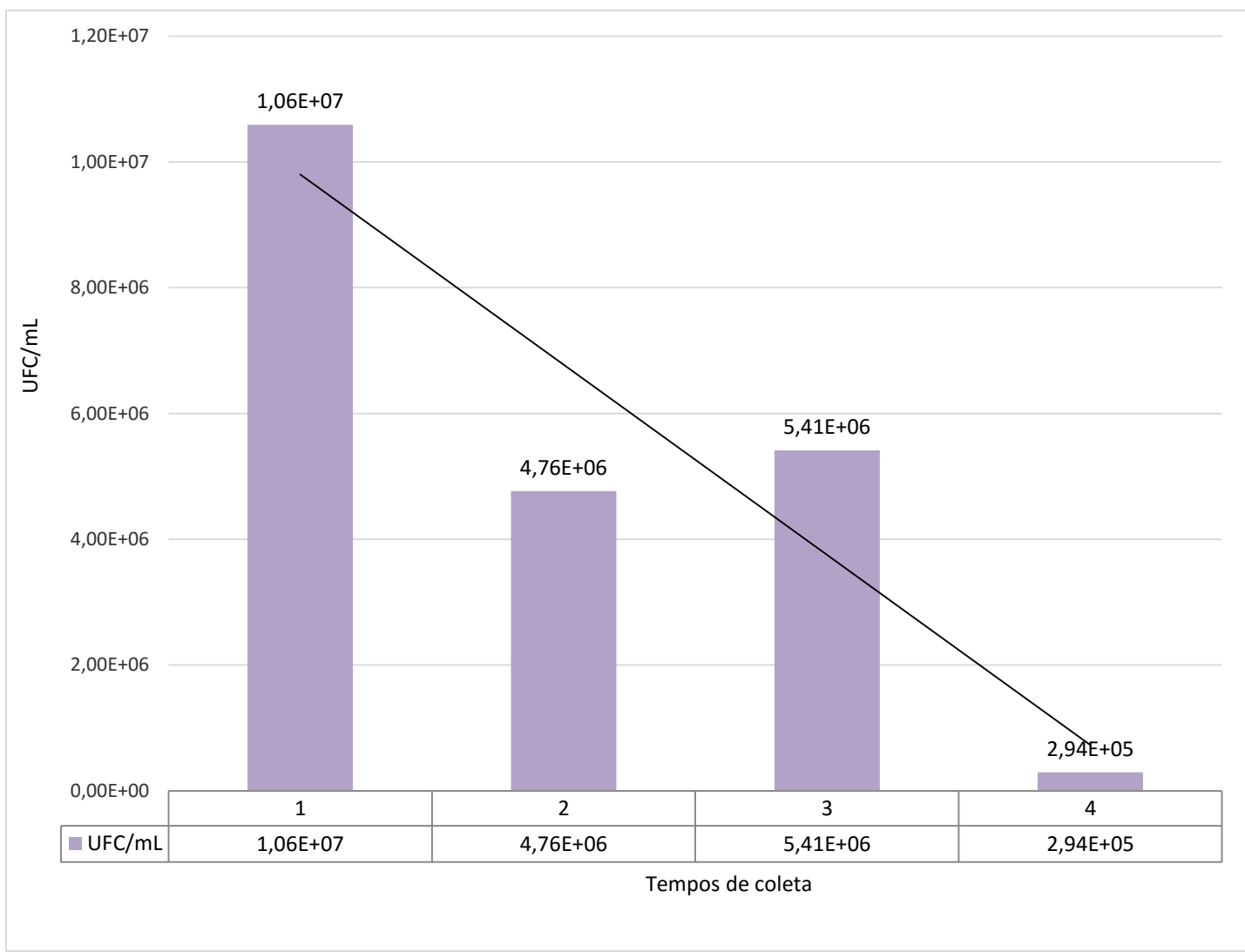
Photonic and oxidative decontamination of food

Ozone + UVC

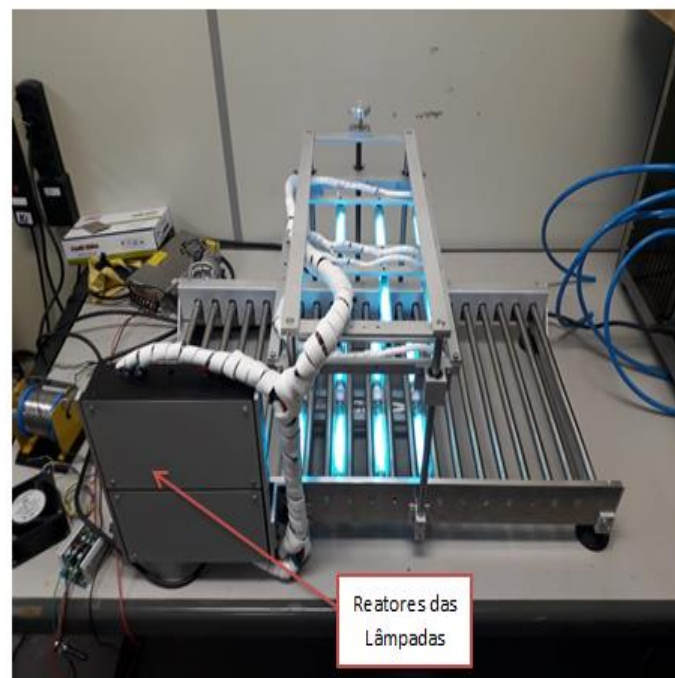
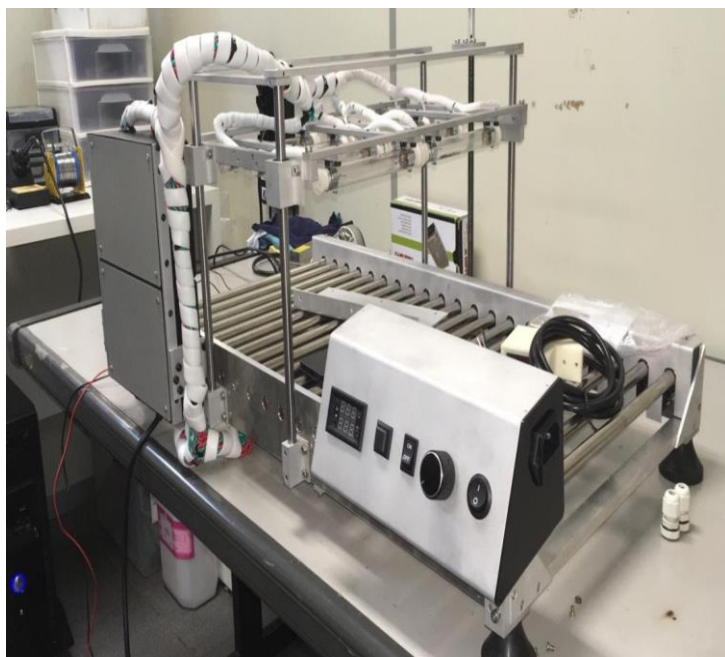


Refrigeration cycles and gaseous ozone treatment in beef with different microbial species contamination





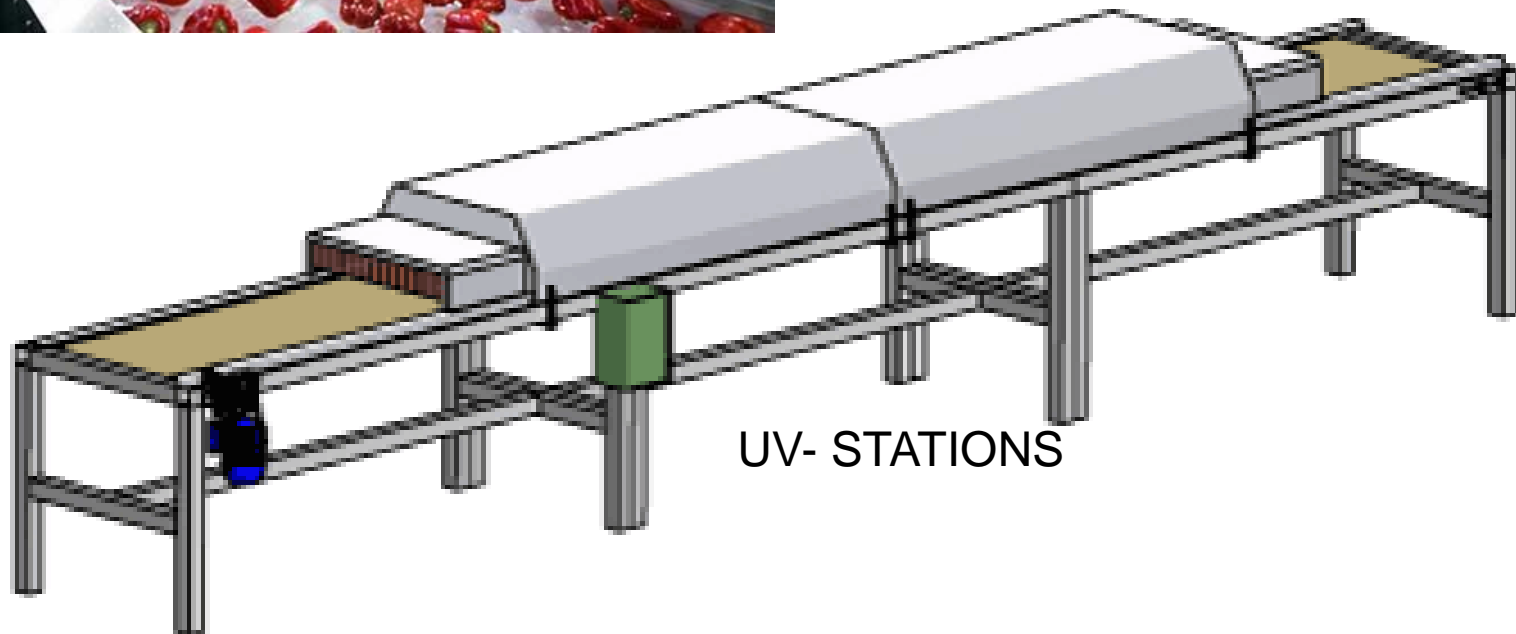
- **Montagem da mecânica com a eletrônica**



- Equipamento pronto para os testes

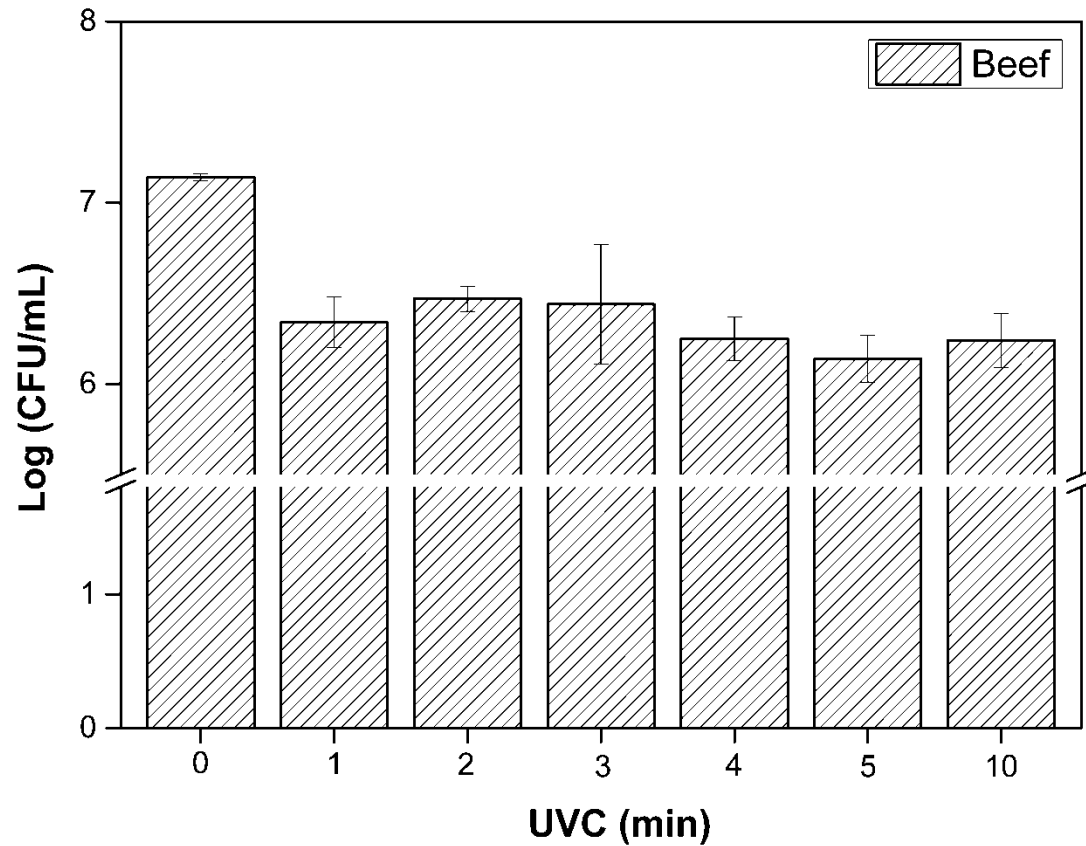


UV IN FOOD PROCESSING



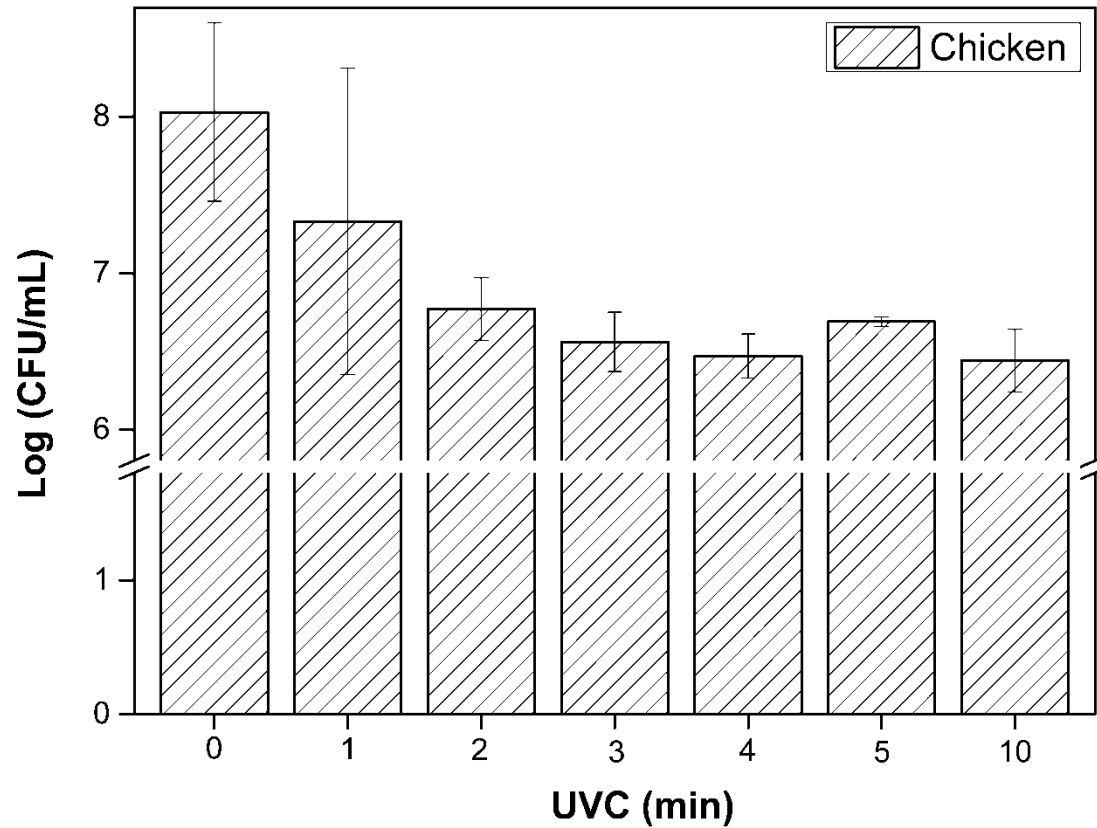
UV- STATIONS

Results of the UVC system for beef with different microbial species contamination



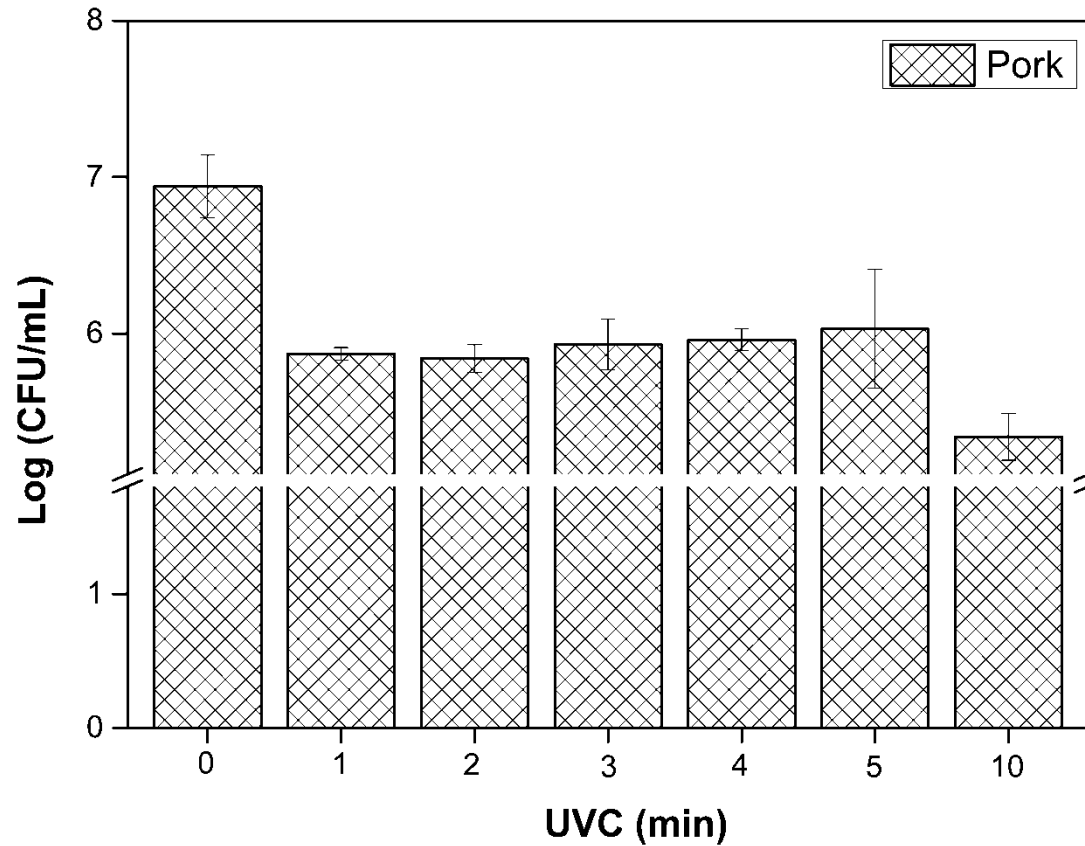
1.0 log reduction
(5 min)

Results of the UVC system for chicken with different microbial species contamination



1.6 log reduction
(10 min)

Results of the UVC system for pork with different microbial species contamination



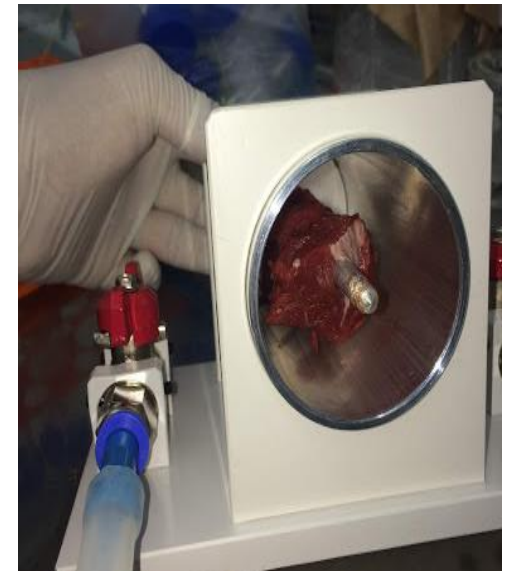
1.6 log reduction
(10 min)

Ozonio in gas or solution

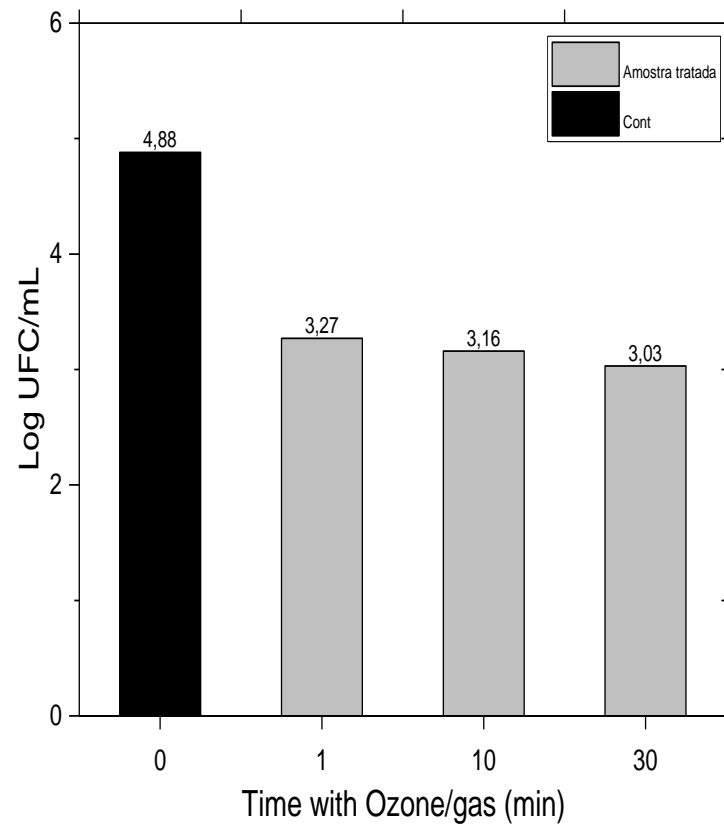
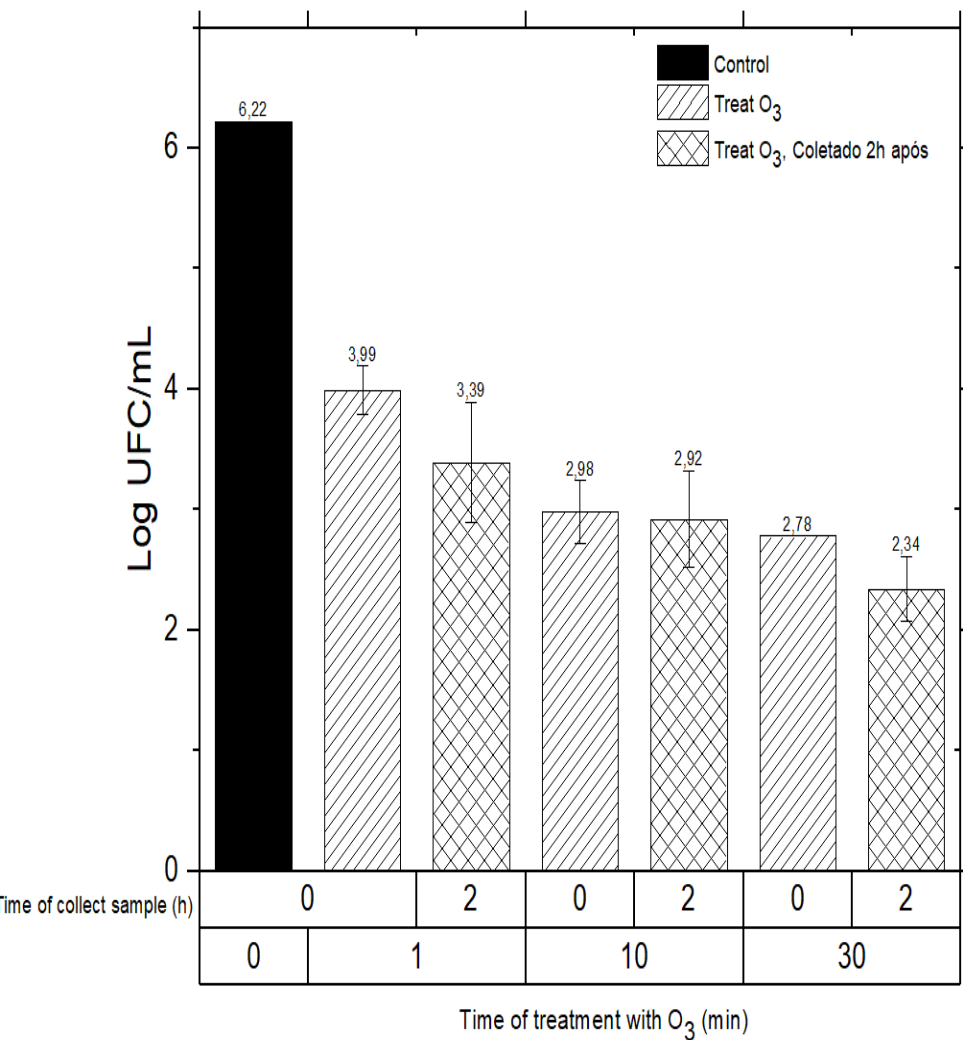
Fonte de Oxigênio: Industrial 99,5% Pureza



Ozone sensor



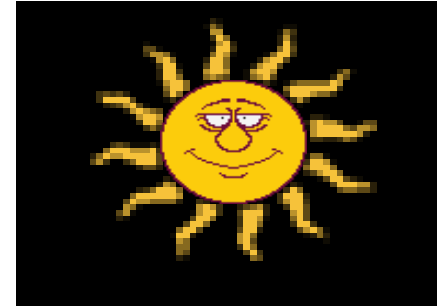
Prova de conceito/ Superfície inerte



Photodynamic action



Curcumin

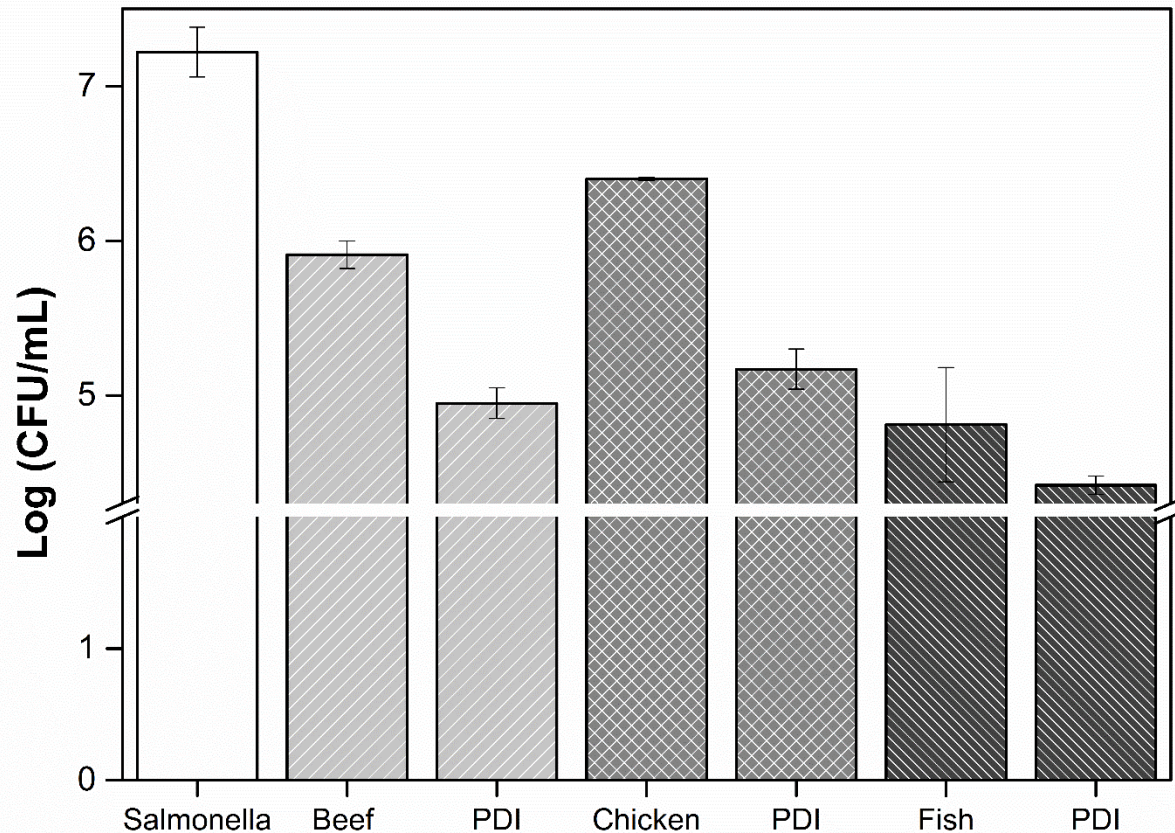


Before irradiation



After irradiation

Results of PDI for beef, chicken and fish with *Salmonella* spp. contamination

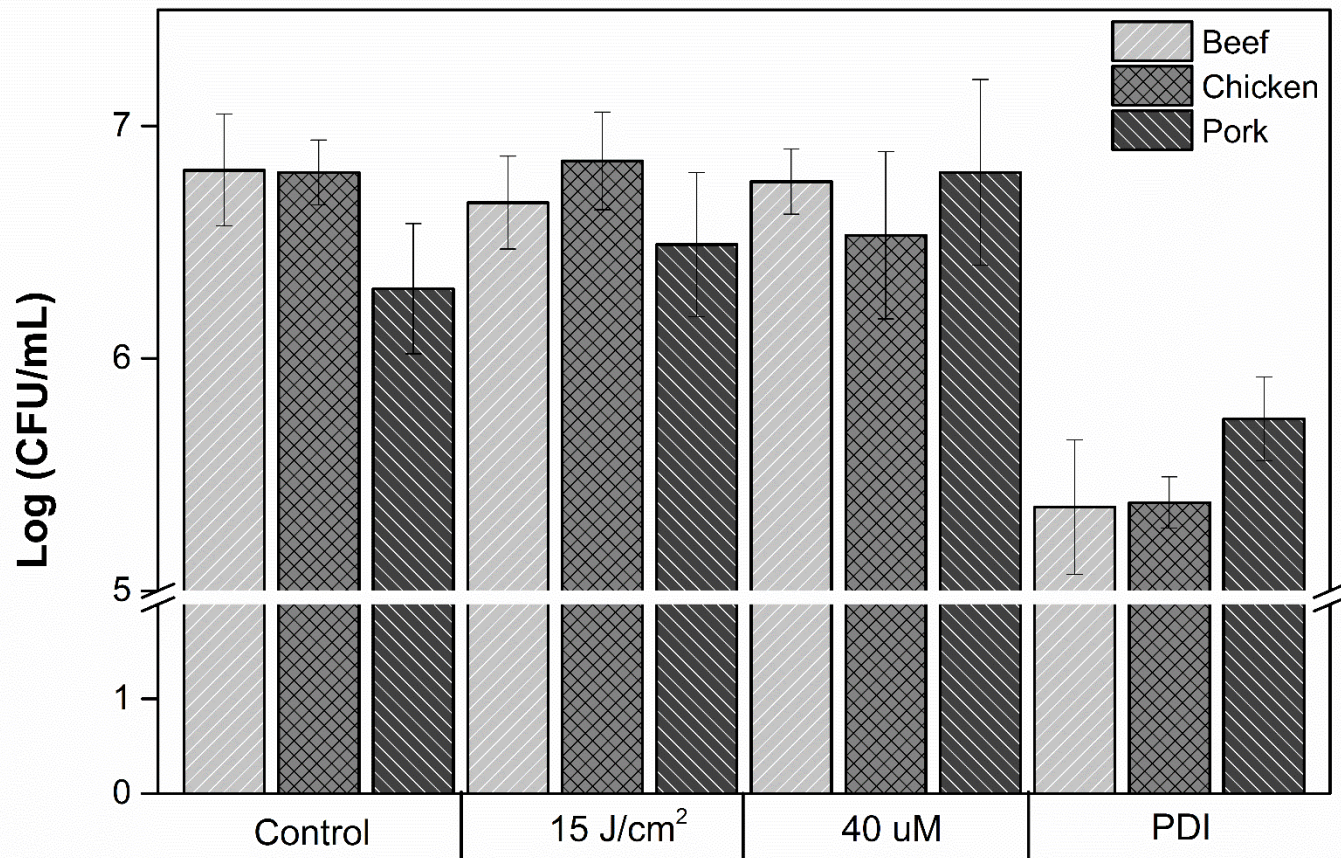


Curcumin = 40 μ M

Led 450 nm = 5 J/cm²

1.3 log reduction
(chicken)

Results of PDI for beef, chicken and pork with *S. aureus* contamination

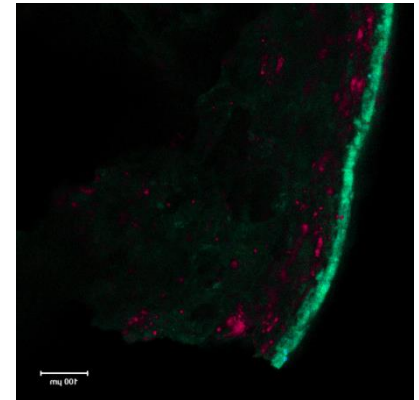
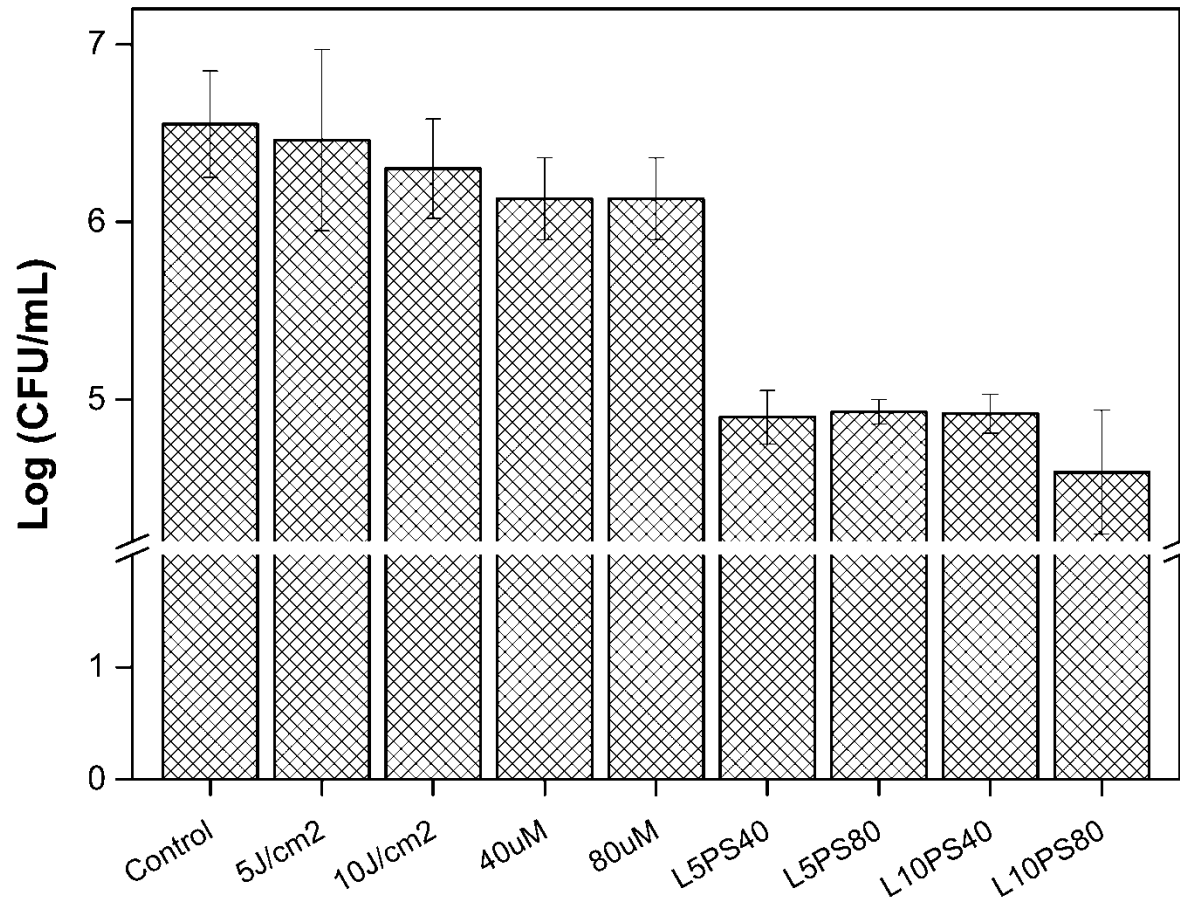


Curcumin = 40 μ M

Led 450 nm = 15 J/cm²

1.5 log reduction
(beef/chicken)

Results of PDI for apple with *S. aureus* contamination



2.0 log reduction

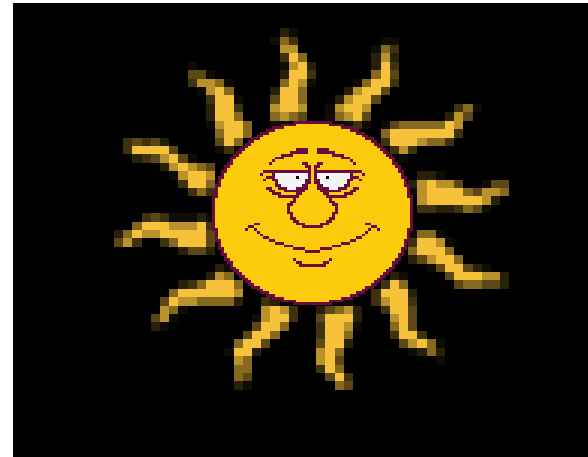
Ozone solution → in the fields and in the factory



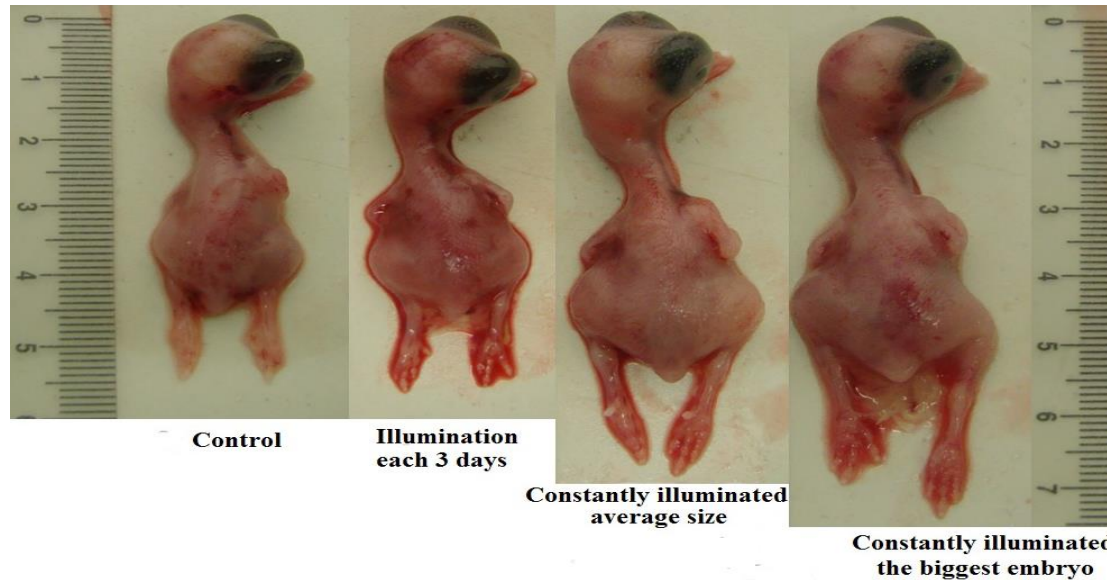
PHOTODYNAMIC ACTION IN FRUITS AND VEGETABLES → LONGER LIFE



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FULL ARTICLE

Photostimulation effects on chicken egg development: Perspectives on human newborn treatment

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