

Exploring the Impact of Ion-Releasing Fabrics on Inflammatory Pathways by 3D In-RED In Vitro Model

Giovanna Della Porta, MS, PhD

Department of Medicine, Surgery and Dentistry
"Scuola Medica Salernitana"
University of Salerno, Italy

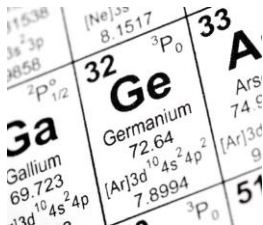


E-mail: gdellaporta@unisa.it



PHILADELPHIA, PA
JULY 13-18, 2025

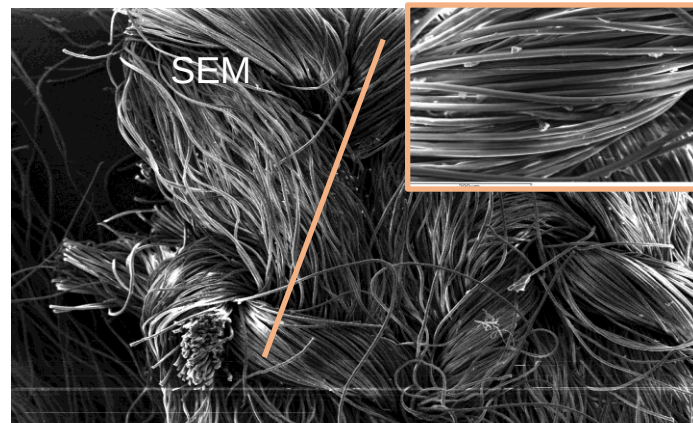
**NEXT-GENERATION
DELIVERY INNOVATIONS**



- ✓ 60% Cellulose plus germanium & carbonized charcoal embedded
- ✓ 30% Nylon
- ✓ 10% Others

- ✓ Germanium fabric releases negative ions, when exposed to heat, friction, or light thanks to the semiconducting properties of germanium.
- ✓ Negative ions (ions/cm³) can positively activating cells stress reduction.

Ion-Releasing Fabrics



germanio

28/05/2025 2:19:14 PM

Project: germanio
Owner: INCA
Site: Site of Interest 2

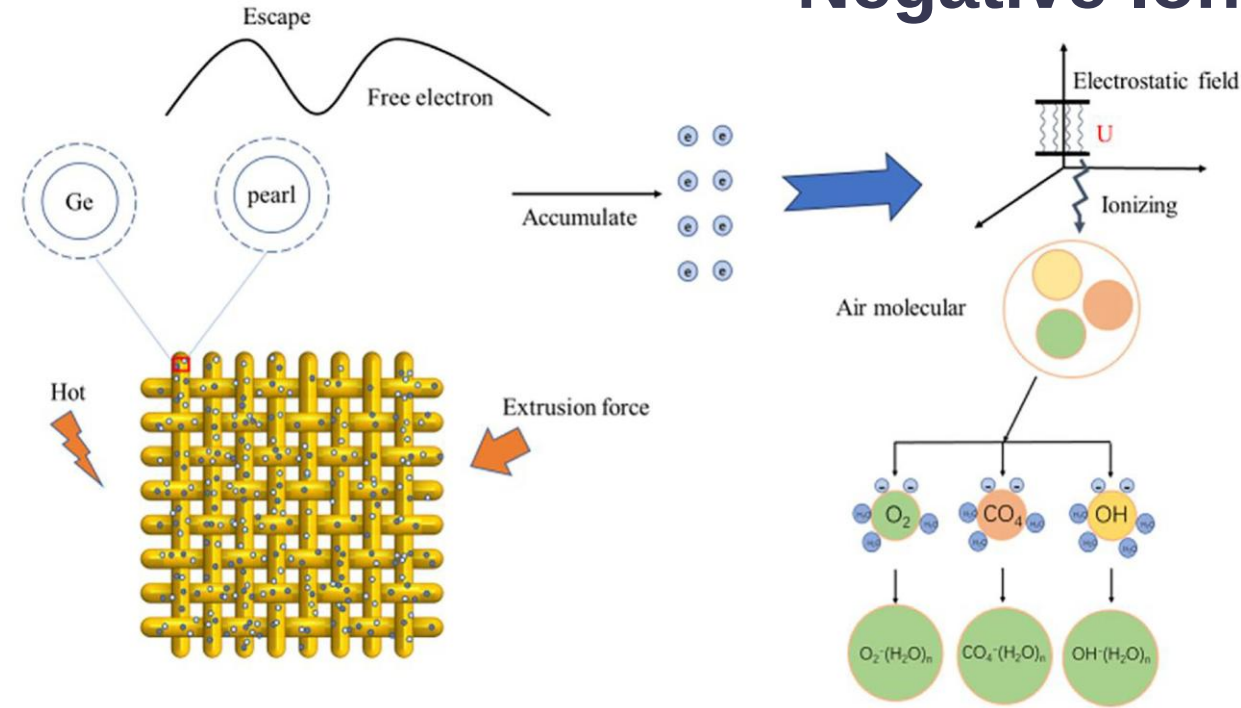
Sample: 1F
Type: Default
ID:

Processing option : All elements analysed (Normalised)

Spectrum	In stats.	C	O	Si	Ti	Fe	Total
Sum Spectrum	Yes	57.87	41.65	0.09	0.21	0.19	100.00
Mean		57.87	41.65	0.09	0.21	0.19	100.00
Std. deviation		0.00	0.00	0.00	0.00	0.00	
Max.		57.87	41.65	0.09	0.21	0.19	
Min.		57.87	41.65	0.09	0.21	0.19	

All results in weight%

Negative Ion-Releasing Fabrics

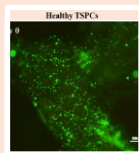


- ✓ A release exceeding 500 ions/cm³ meets health requirements
- ✓ Reaching 1500 ions/cm³ corresponds to good air quality



Zhang J., et al., *J Eng Fiber Fabr* 2021; 16: 155892502110591.
Huang D., et al., *AATCC Journal of Research*. 2025;12(1).

Inflammatory Response and Endothelial Dysfunction (InRED) in vitro model



Cell source (ratio 1:3):

HUVEC (human umbilical vein endothelial cell)

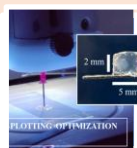
THP-1 (human acute monocytic leukemia cell line)



Stress out. Treating cells with doses of TNF- α or LPS, respectively

Concentrations: **10 ng/mL**

Read out= **cell viability, ICAM-1/VCAM-1, chitokines** (at 3, 5 and 7 days for evaluate best stress induction)



Monitoring Negative Ion (released by fabric) effect on in-vitro model of 2D & 3D co-culture

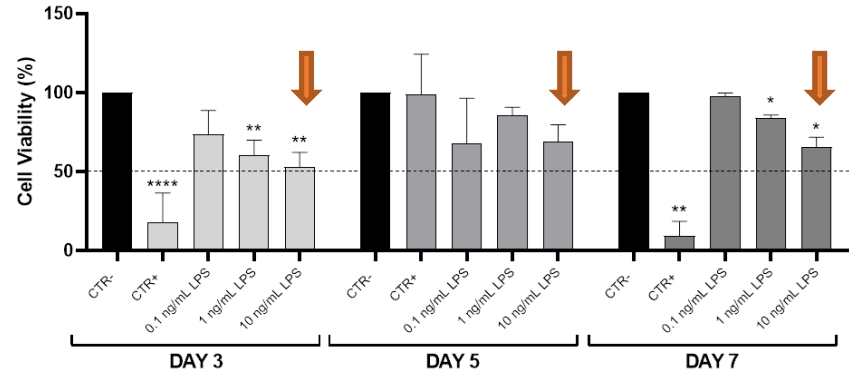
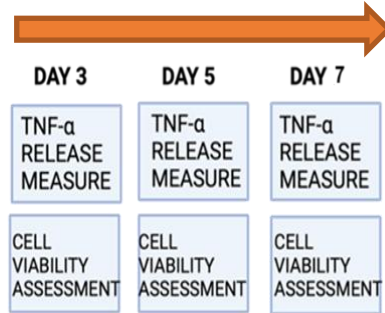
Readout= Changes in **cell viability, pro- and anti-inflammatory cytokines**, NOx production, COx enzyme activity, **ROS production and ICAM-1/VCAM-1 induction will be assessed at day 5, 7**, after 3 days of stress induction.

Stressing agents optimization

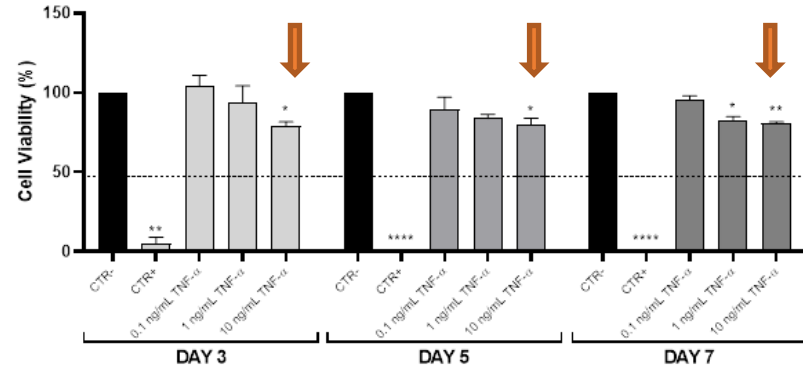
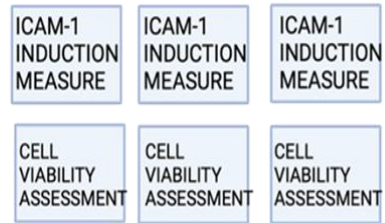
1ST PHASE



LPS (3 concentrations)
TREATMENT



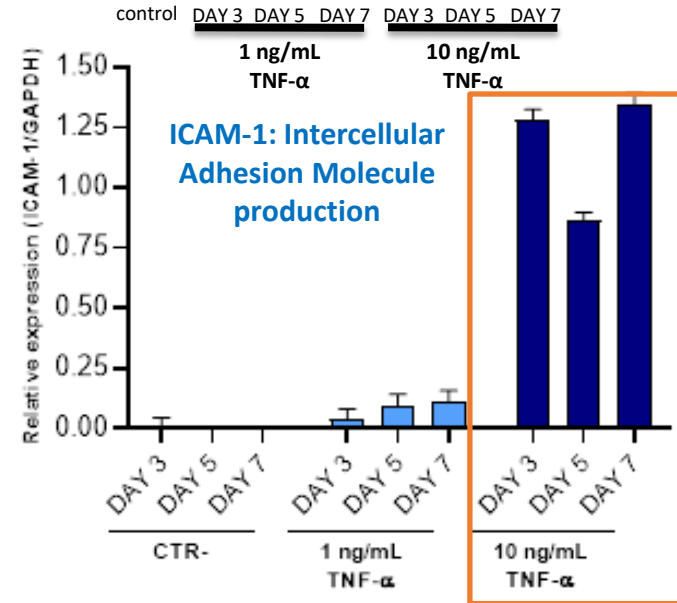
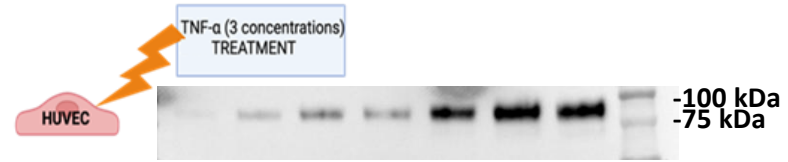
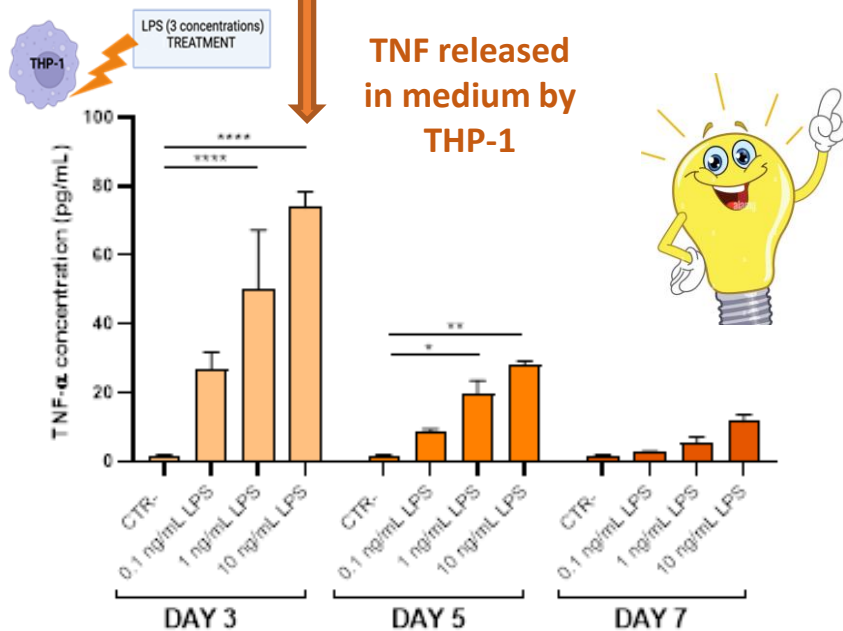
TNF-α (3 concentrations)
TREATMENT



Stressing agents optimization

3 days & 10 ng/mL !

1ST PHASE

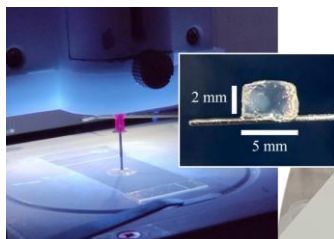


InRED: experimental set up ratio 1:3 HUVEC :THP-1

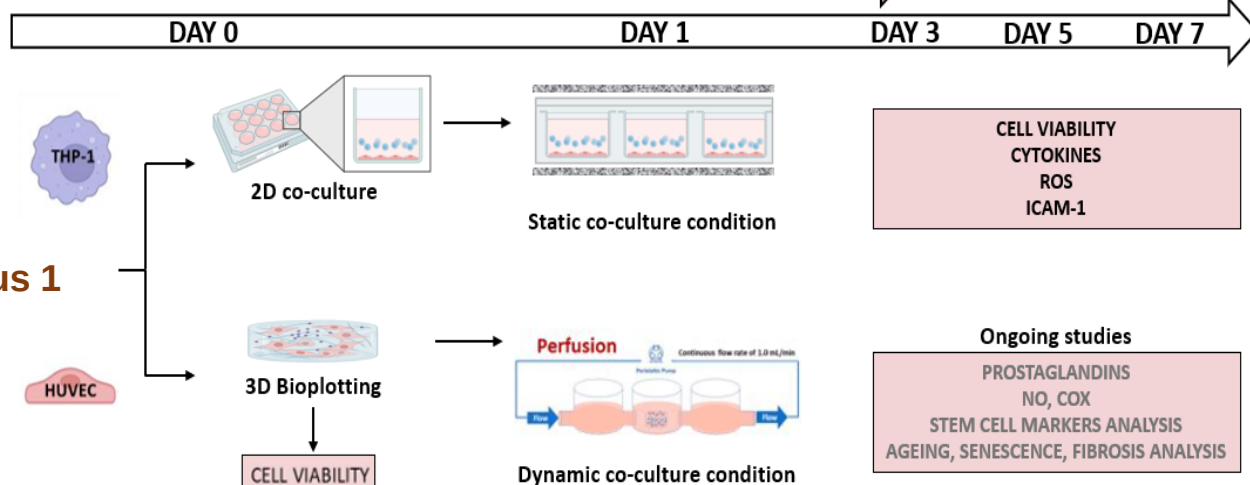
2D culture static-transwell



3D culture in biplotted ColMA plus 1 mL/min perfusion bioreactor



- Incubator conditions:
- ✓ 37 °C
 - ✓ 2 g of fabric per well (200.000 cell, ratio 1:3)
 - ✓ 70% of humidity
 - ✓ No forced air
 - ✓ Built-in shielding from external EMF

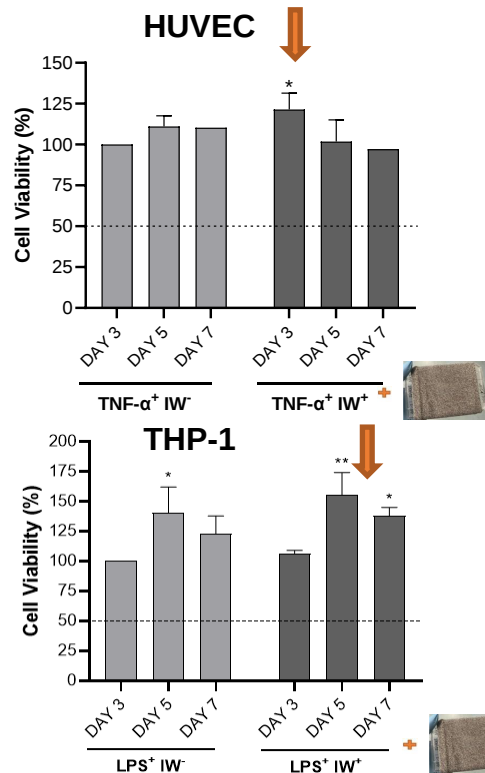


AIR ION COUNTER

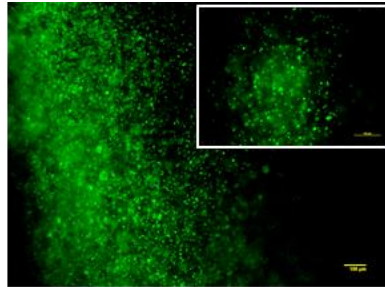


negative ions average
concentration: 800- 1,000
ions/cm³ along the culture

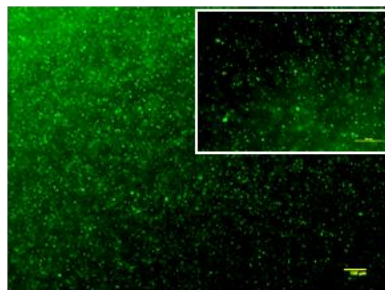
2D CO-CULTURE-static



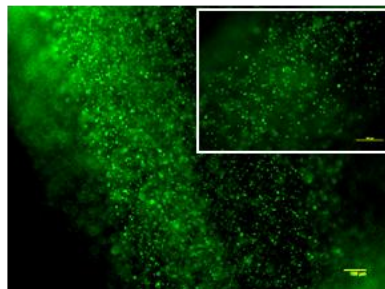
DAY 3



DAY 5

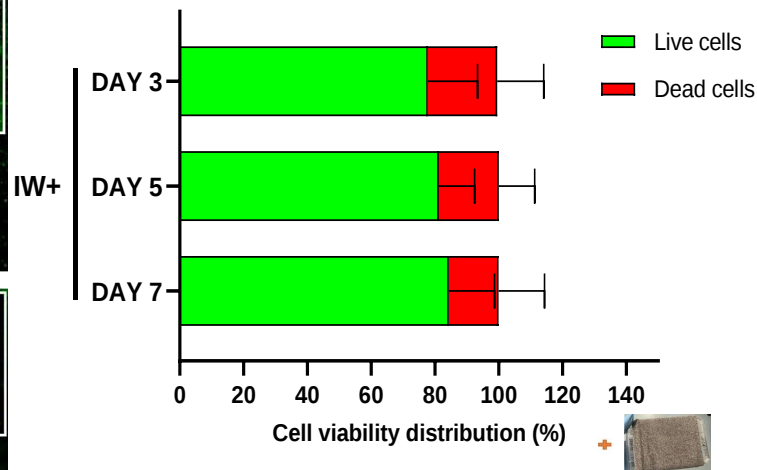


DAY 7



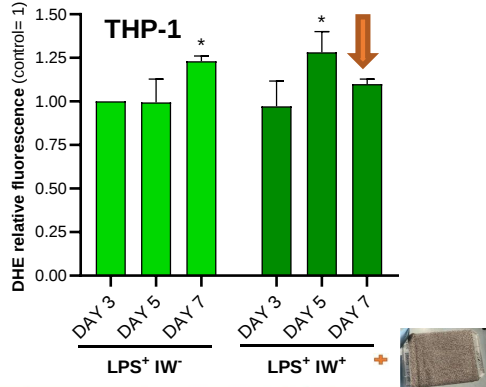
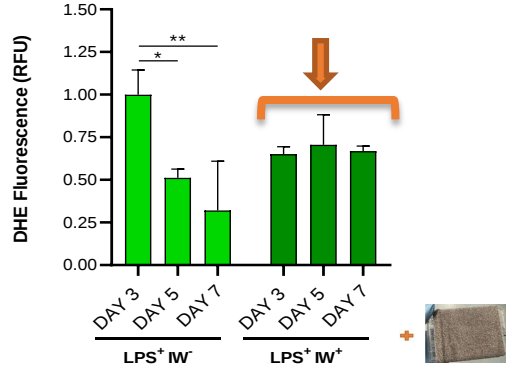
InRED: viability + fabric

3D CO-CULTURE-dynamic



2D CO-CULTURE-static

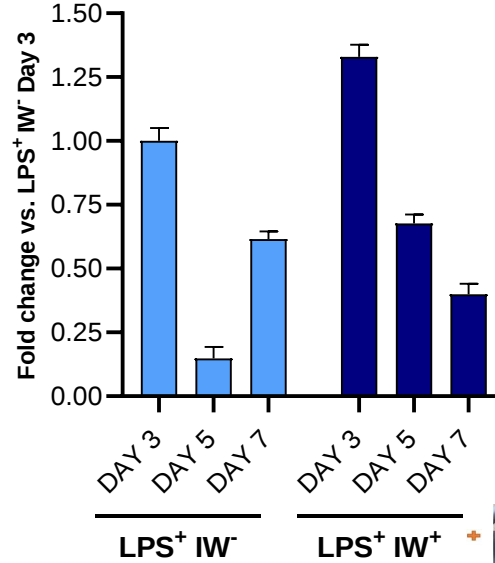
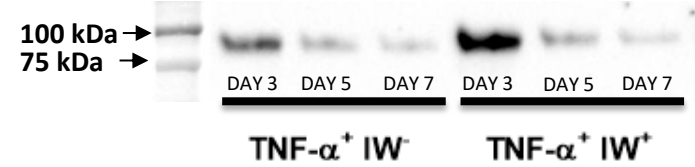
HUVEC



Intercellular Adhesion Molecule production- ICAM

InRED: ROS & ICAM + fabric

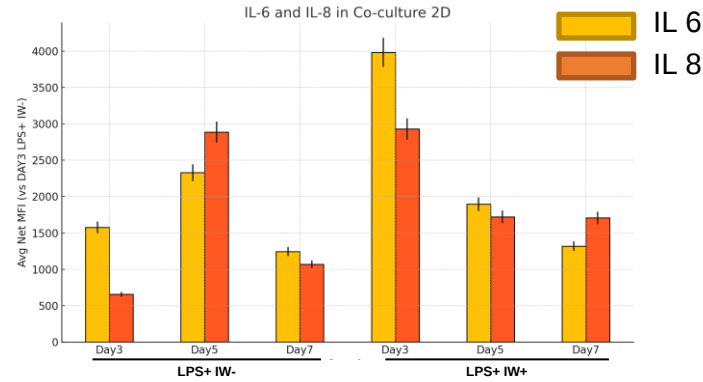
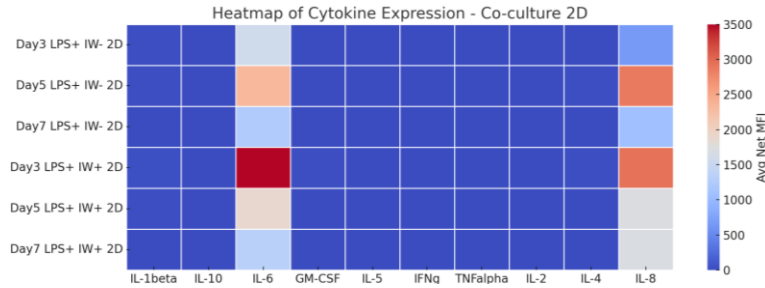
3D CO-CULTURE-dynamic



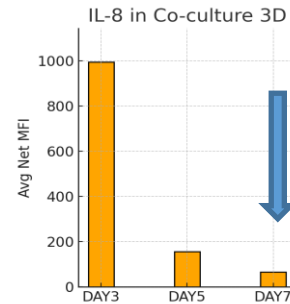
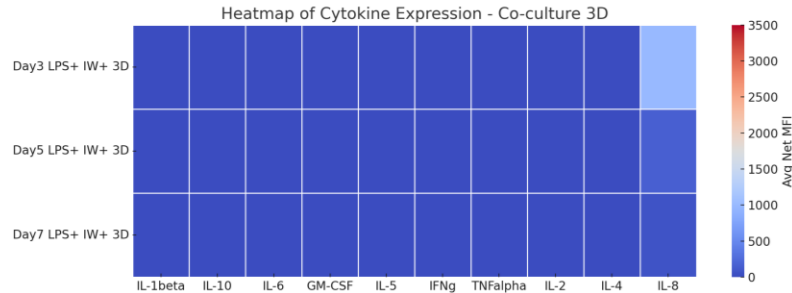
✓ More activity at day 3,
✓ Faster reduction at days 5 and 7

InRED: Cytokines⁺ fabric

2D CO-CULTURE-static



3D CO-CULTURE-dynamic



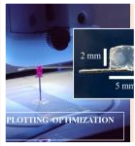
3D culture—dynamic culture seemed the most affected by the fabric effect



Conclusions



The Inflammatory Response and Endothelial Dysfunction (InRED) in vitro models demonstrated sensitivity to the fabric-induced effects



Cell viability, ICAM-1/VCAM-1 expression, and cytokine levels at days 3, 5, and 7 appeared to be influenced by the fabric, with the 3D culture condition showing the most pronounced effects



Further experiments are ongoing to assess fibrosis, prostaglandin concentrations, and senescence markers

Acknowledgments



iNCREDIWEAR



CRS 2025
ANNUAL MEETING
& EXPOSITION

PHILADELPHIA, PA
JULY 13-18, 2025



**NEXT-GENERATION
DELIVERY INNOVATIONS**