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## **Innovative Alkanediol-Based Eutectic Solvents for Extracting/Pre-Formulating Dermatologically Valuable Free Fatty Acids from Spirulina and Porphyridium Cakes**

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# Eutectic Solvents as a Sustainable Solution for the Recovery of High Value Free Fatty Acids from Microalgal Co-products

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## Introduction



Growing demands of phycoproteins  
By-product accumulation



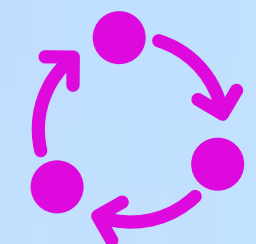
High value nonpolar metabolites  
Free fatty acids (FFA), polyunsaturated  
Pigments (carotenoids, chlorophylls)



FFA = natural antibiotics  
Regulation of skin microbiome  
Interesting for dysbiosis treatment like Atopic dermatitis



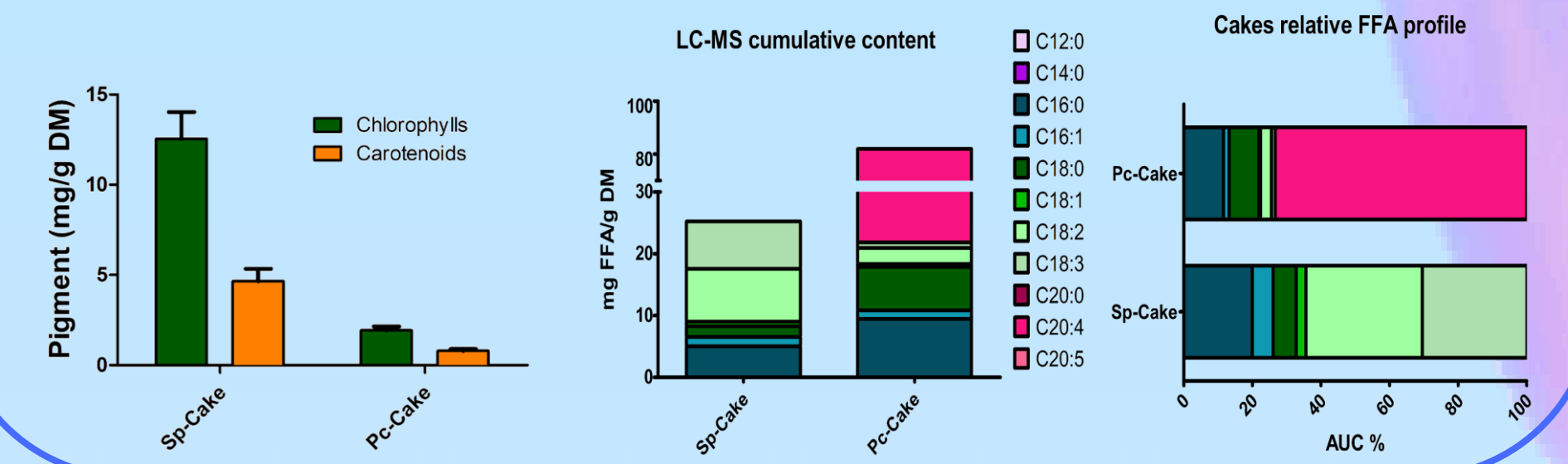
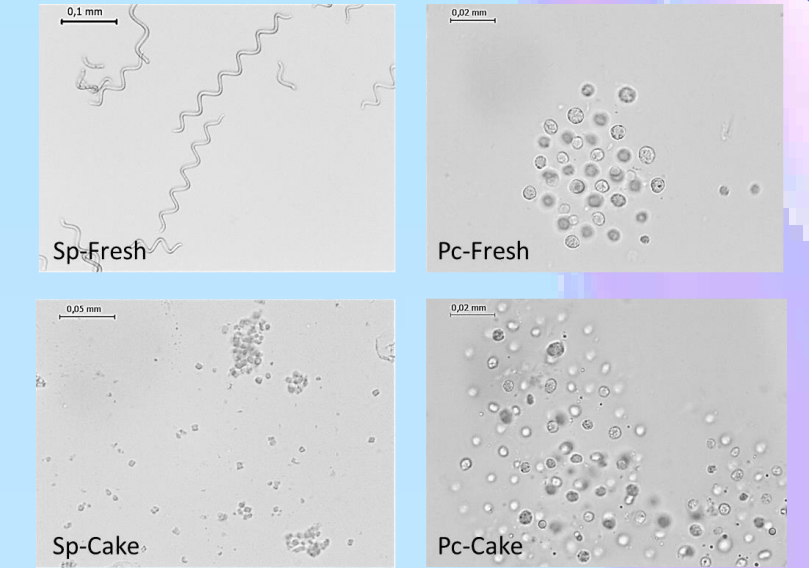
Use Natural Deep Eutectic Solvents  
Compatible with cosmetics  
To extract/pre-formulate FFA



Propose a biorefinery scheme  
Based on green process  
Custom design of NaDES

## Cakes

✓ **Cakes characterization**  
isolated cells & wall damages  
high PUFA content  
low pigment rate (*P. cruentum*)

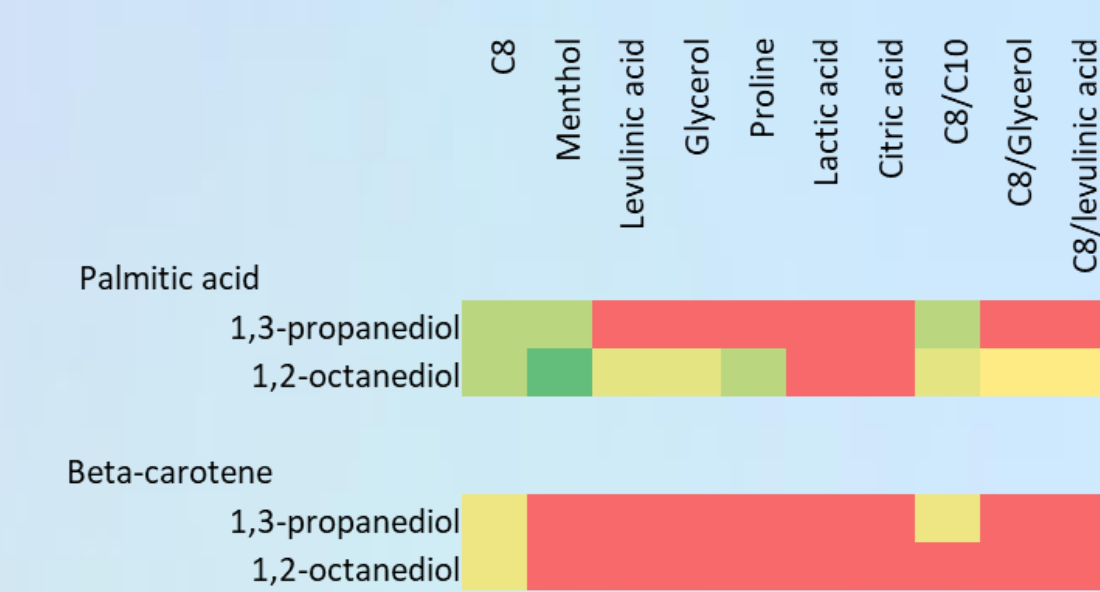


## Alkanediol-based NaDES

### 1. NaDES design

NaDES code	Component 1	Component 2	Component 3	Molar Ratio (water%)
PC8		Octanoic acid	-	1:5
PM		L-Menthol	-	1:1
PG		Glycerol	-	1:1
PCit		Citric acid	-	1:1
PLac		Lactic acid	-	1:1
PLev	1,3-propanediol	Levulinic acid	-	1:1
PP		Proline	-	8:1
PGC8		Glycerol	Octanoic acid	2:1:1
PLevC8		Levulinic acid	Octanoic acid	2:1:1
PC8C10		Octanoic acid	Decanoic acid	1:3:1
OC8		Octanoic acid	-	1:5
OM		L-Menthol	-	1:1
OG		Glycerol	-	1:1
OCit		Citric acid	water	1:1 (20%)
OLac		Lactic acid	-	1:1
OLev	1,2-octanediol	Levulinic acid	-	1:1
OP		Proline	-	8:1
OGC8		Glycerol	Octanoic acid	2:1:1
OLEvC8		Levulinic acid	Octanoic acid	2:1:1
OC8C10		Octanoic acid	Decanoic acid	1:1:2

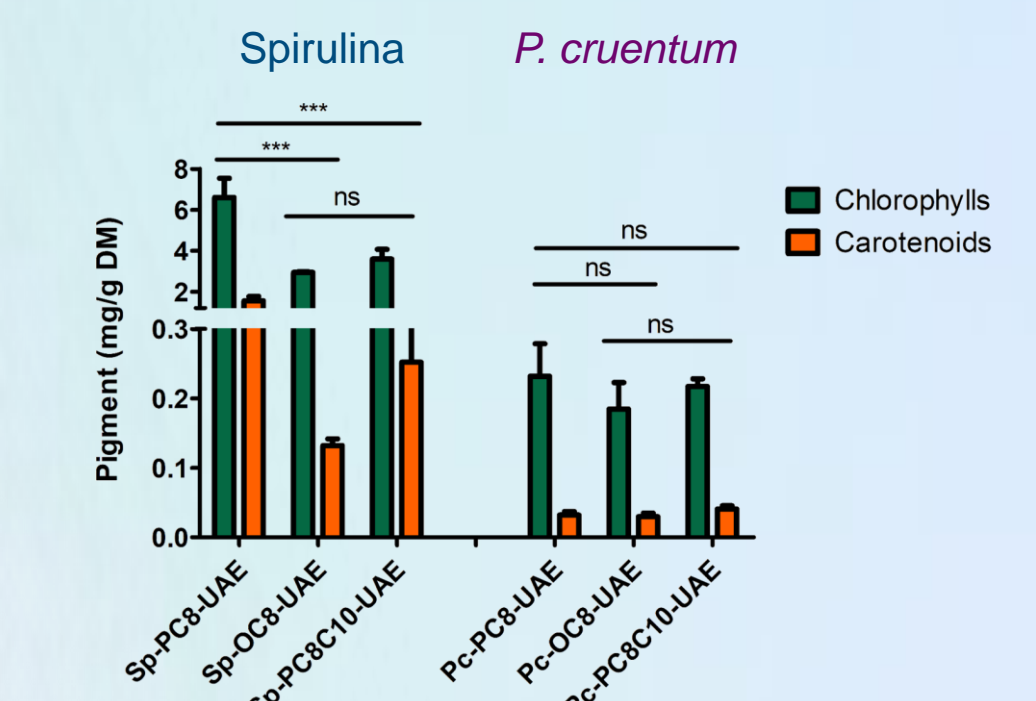
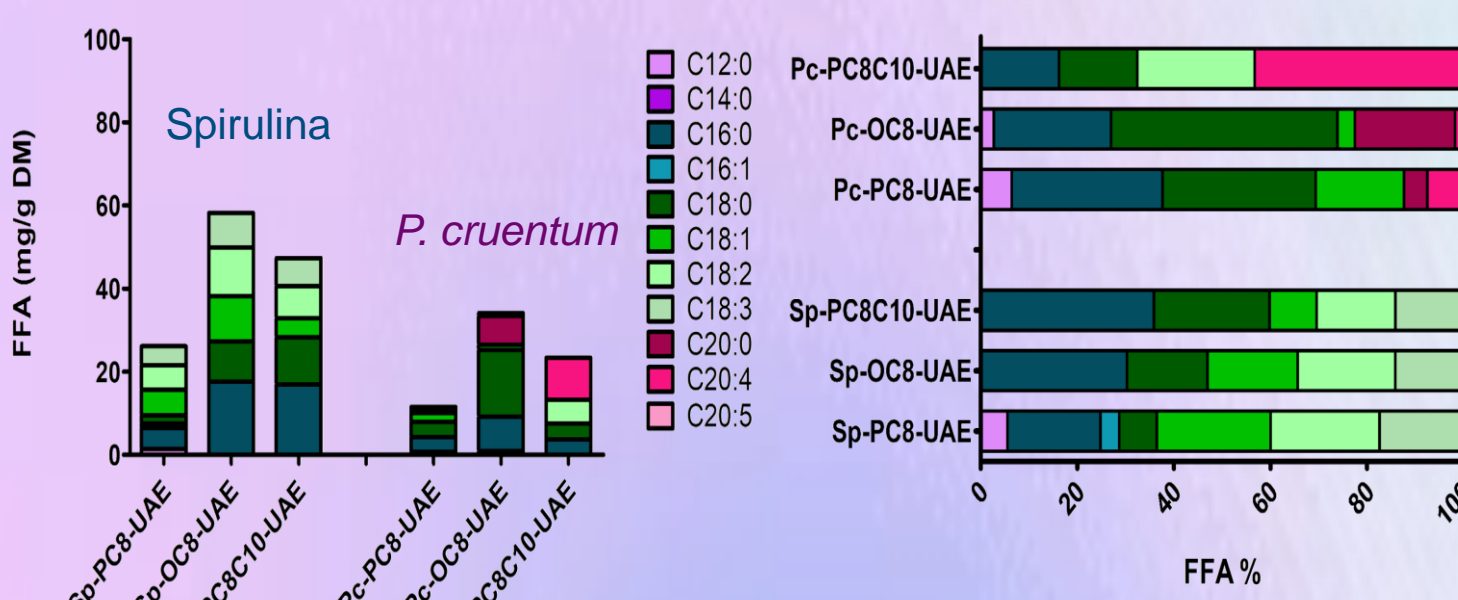
### 2. Reference solubilization test beta-carotene & palmitic acid heat map vs reference solvent



→ 3 NaDES highlighted  
→ PC8, OC8 and PC8C10

### 3. Extraction screening

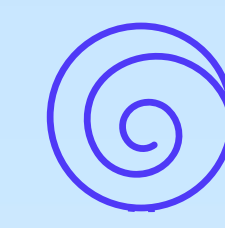
PC8 = singularity of FFA profile  
PC8C10 = higher FFA recovery  
OC8 = high rates  
but difficult biomass/NaDES separation



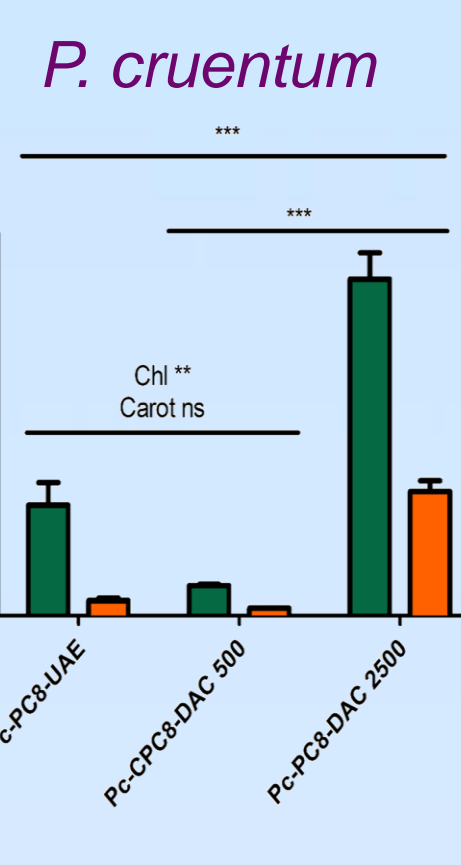
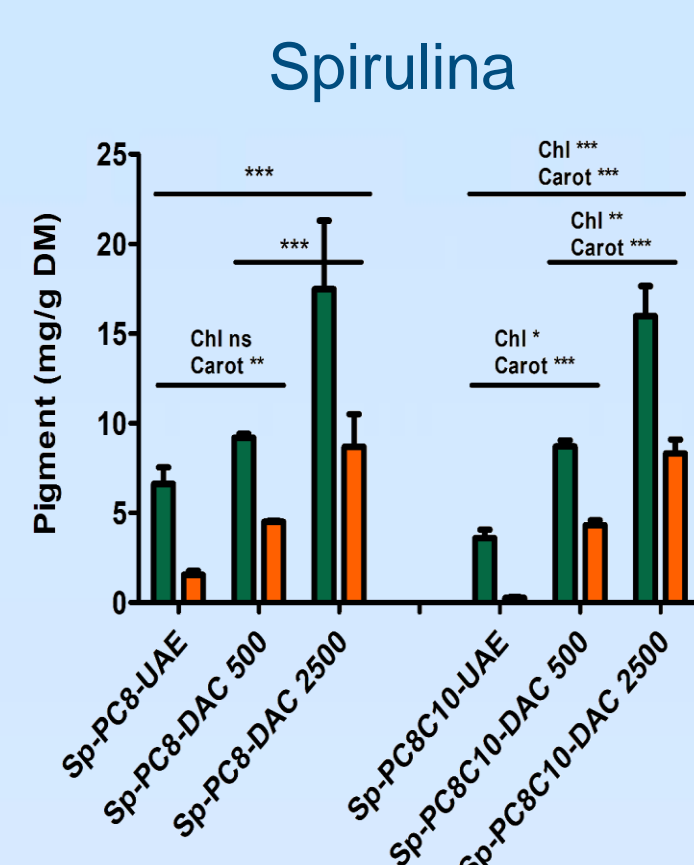
## Process impact



✓ Ultrasound assisted extraction (UAE)  
✓ Green process  
✓ Enhanced solvent penetration  
✓ Rising temperature up to 60°C

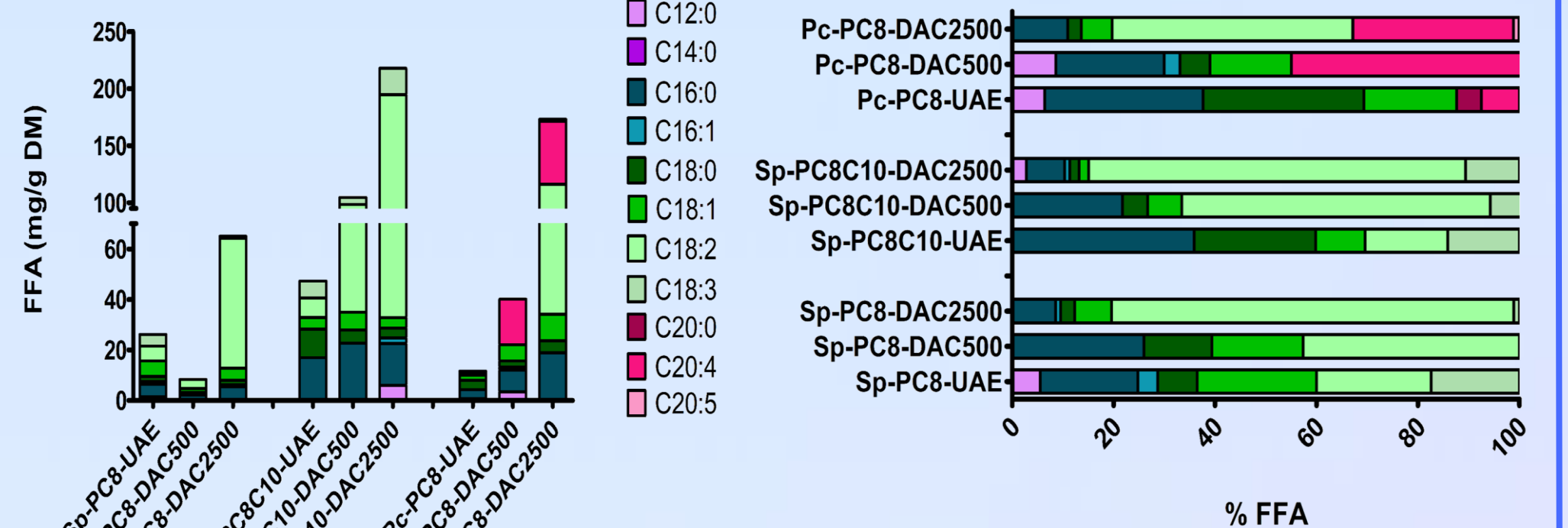


✓ Dual Asymmetric Centrifugation (DAC)  
✓ Green process  
✓ Room temperature  
✓ Modulated speed 500 vs 2500 rpm



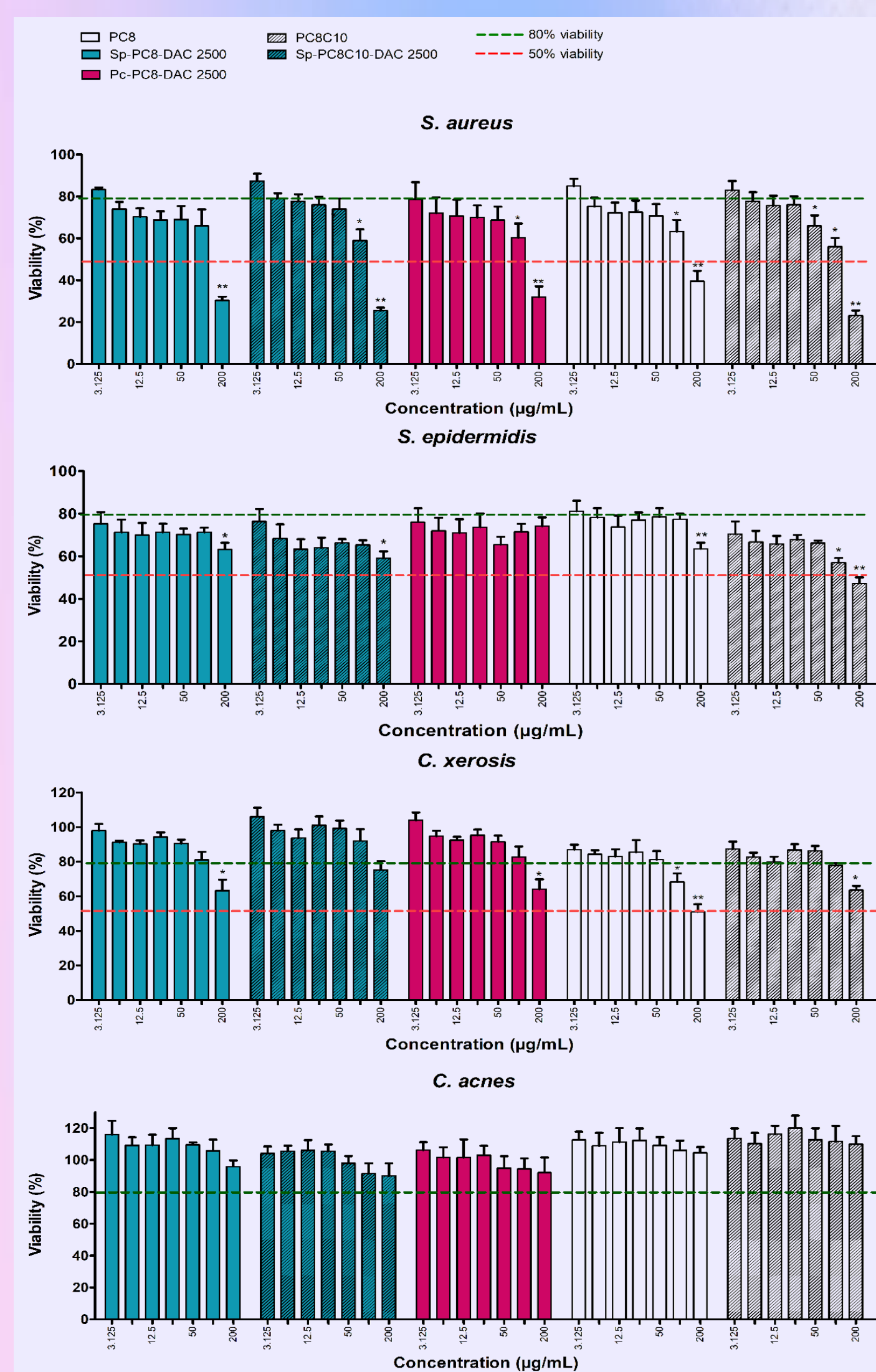
✓ **Impact on pigments**  
DAC at 2500 rpm >>> UAE  
For both microalgae  
Enhanced transfer or preservation?

✓ **Impact on FFA**  
DAC at 2500 rpm >>> UAE  
For both microalgae  
Increased of PUFA +++  
Smooth conditions



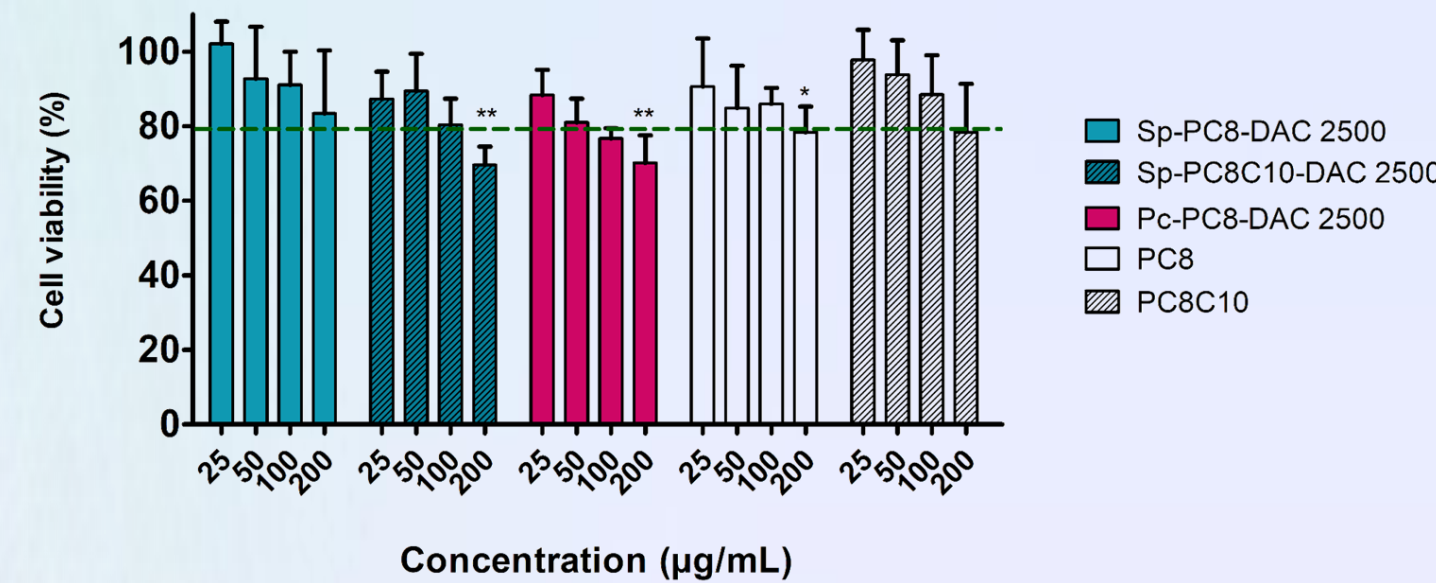
## Impact on skin

✓ Impact on 4 cutaneous strains



✓ NaDESs decrease *S. aureus* viability  
✓ PUFA enriched extracts boost commensal strains  
✓ Combined effect of NaDES/PUFA

✓ Impact on keratinocytes

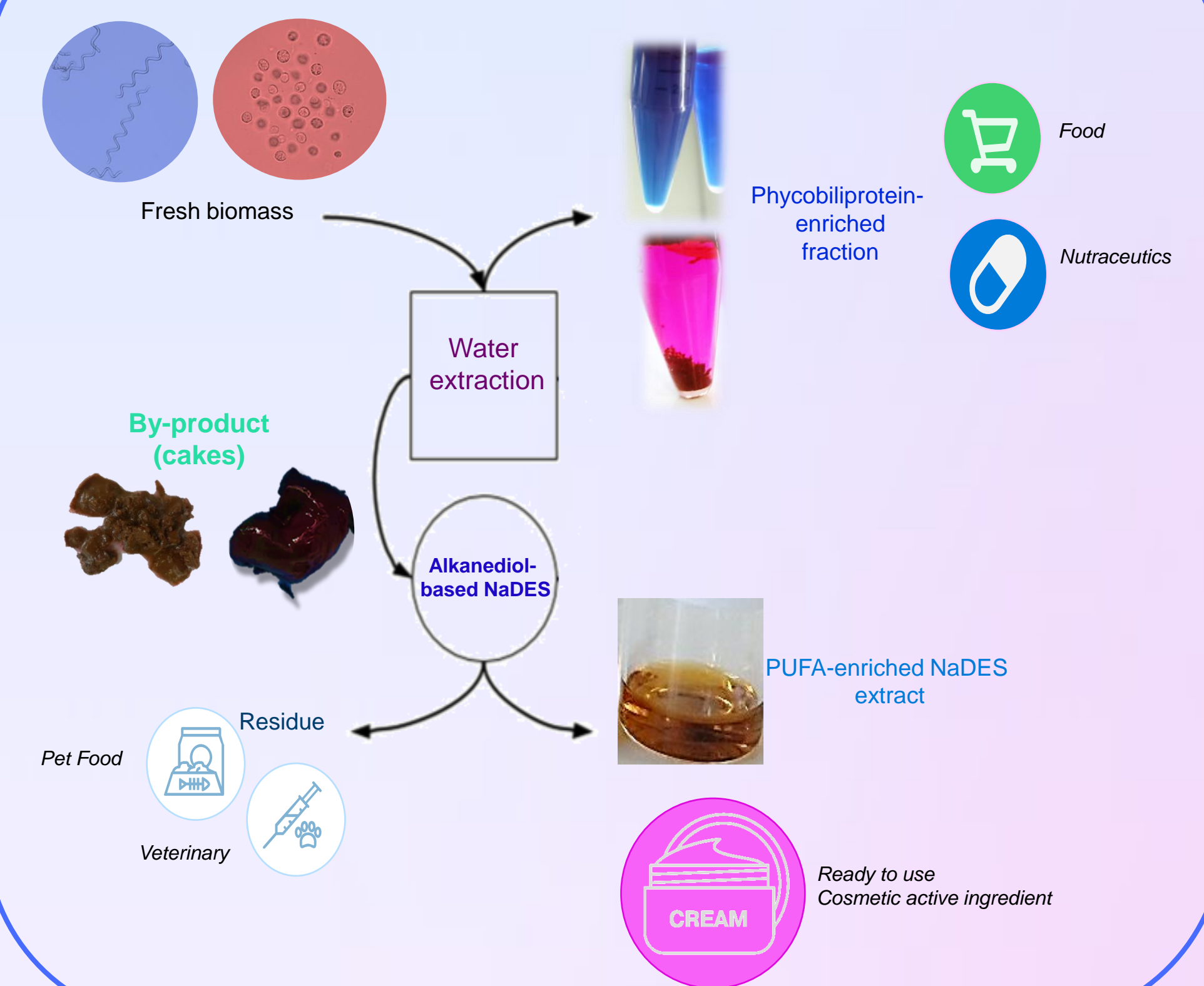


✓ No impact on cells viability at regular concentration

✓ Suitable innocuity for cosmetic use

Downregulation of *S. aureus*  
Upregulation of commensals  
Rebalance of skin microbiota

## Biorefinery



## Conclusions

