PEF4AlgBiotics

Valorization of microalgal extracts obtained by pulsed electric field in lactic acid fermentation

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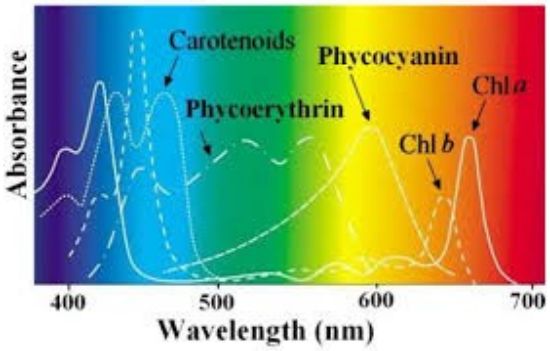
Microalgae

Lipids

-

Polyunsaturated fatty acids

Pigments



Proteins

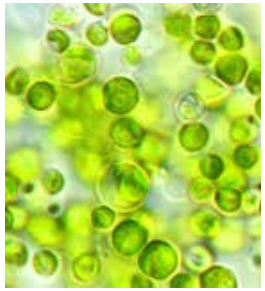
Chlorella vulgaris

1000 L photobioreactor, KIT

CO2

minerals

H2O

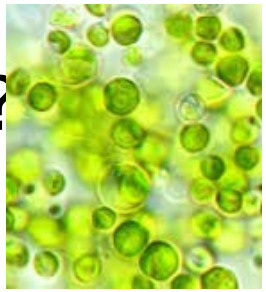


Biodiesel

Not enough!

More products to make it economically viabl

How to get more from *C. vulgaris* biomass?



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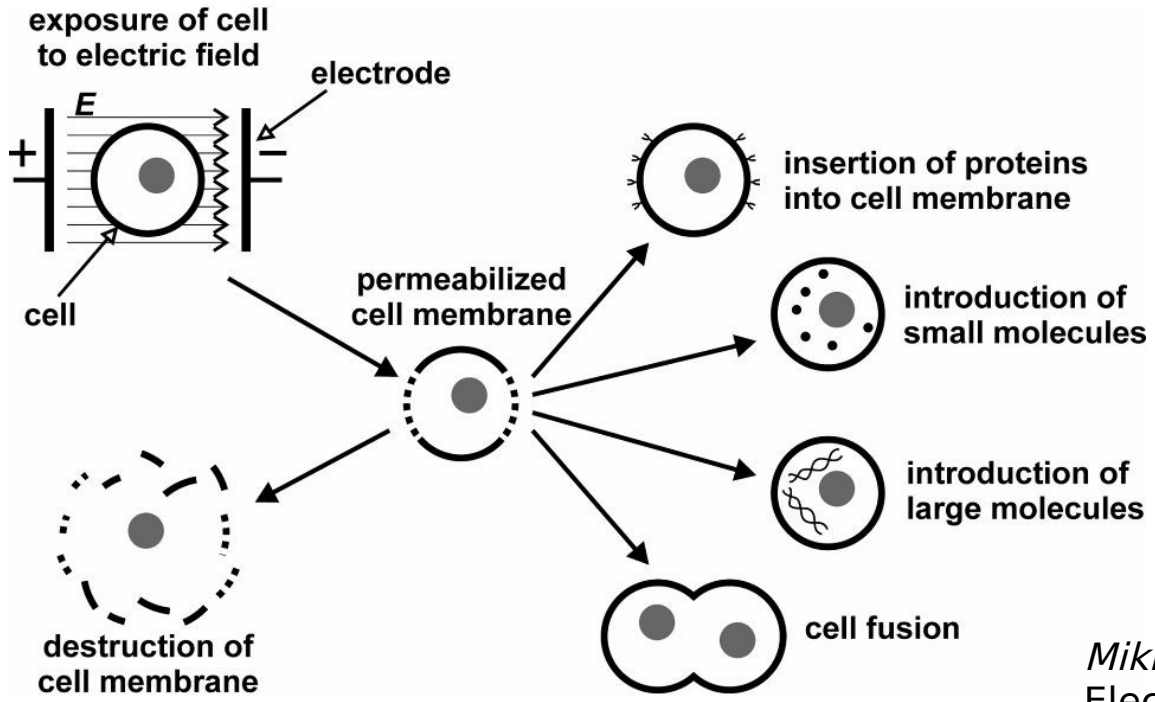
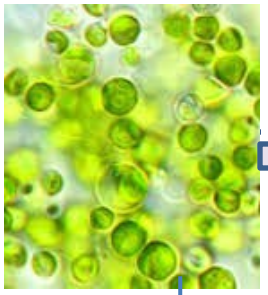
Pulsed Electric Field – PEF treatment

- ✓ of adequate strength and duration
- ✓ on eukaryotic and prokaryotic cells
- ✓ causing increase in cell membrane permeability, if increase in transmembrane voltage surpasses certain value



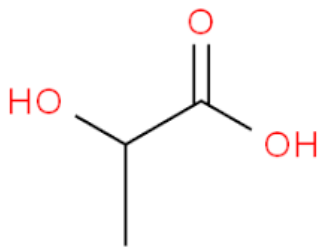
Miklavčič, 2014, Electroporation based technologies and treatments



PEF4AlgBiotics

Lactobacillus rhamnosus
Lactobacillus paracasei

FERMENTATION



lactic acid
+ probiotics

1. **Valorization of released components**

2. **Valorization of proteins**

Nutrients recycling

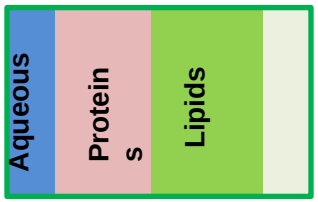
Release of small water soluble components

Water soluble proteins

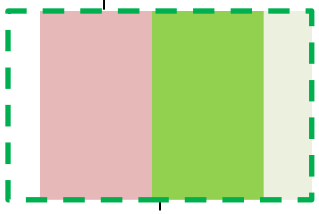
3. **Biofuel**

Lipids

Microalgae biomass



PEF treatment



Ethanolic extraction

Anaerobic digestion

Thermo -chemical conversion

Process scheme from IHM/KIT

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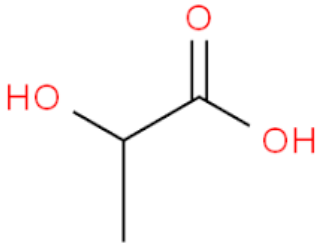
PEF obtained aqueous fraction of microalgae

Lactobacillus rhamnosus
Lactobacillus paracasei



lactic acid

As chemical

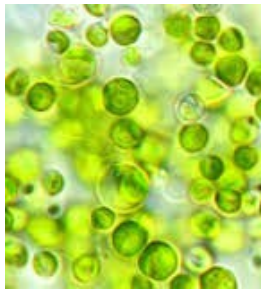
As preservative

As monomer for poly(lactic) acid

Content of proteins in PEF obtained extracts

***C. vulgaris* suspension was concentrated (of approx. 0.8 g/l)**

Centrifugation: 10000 g, 6 minutes and resuspended – adjusting conductivity



PEF treatment

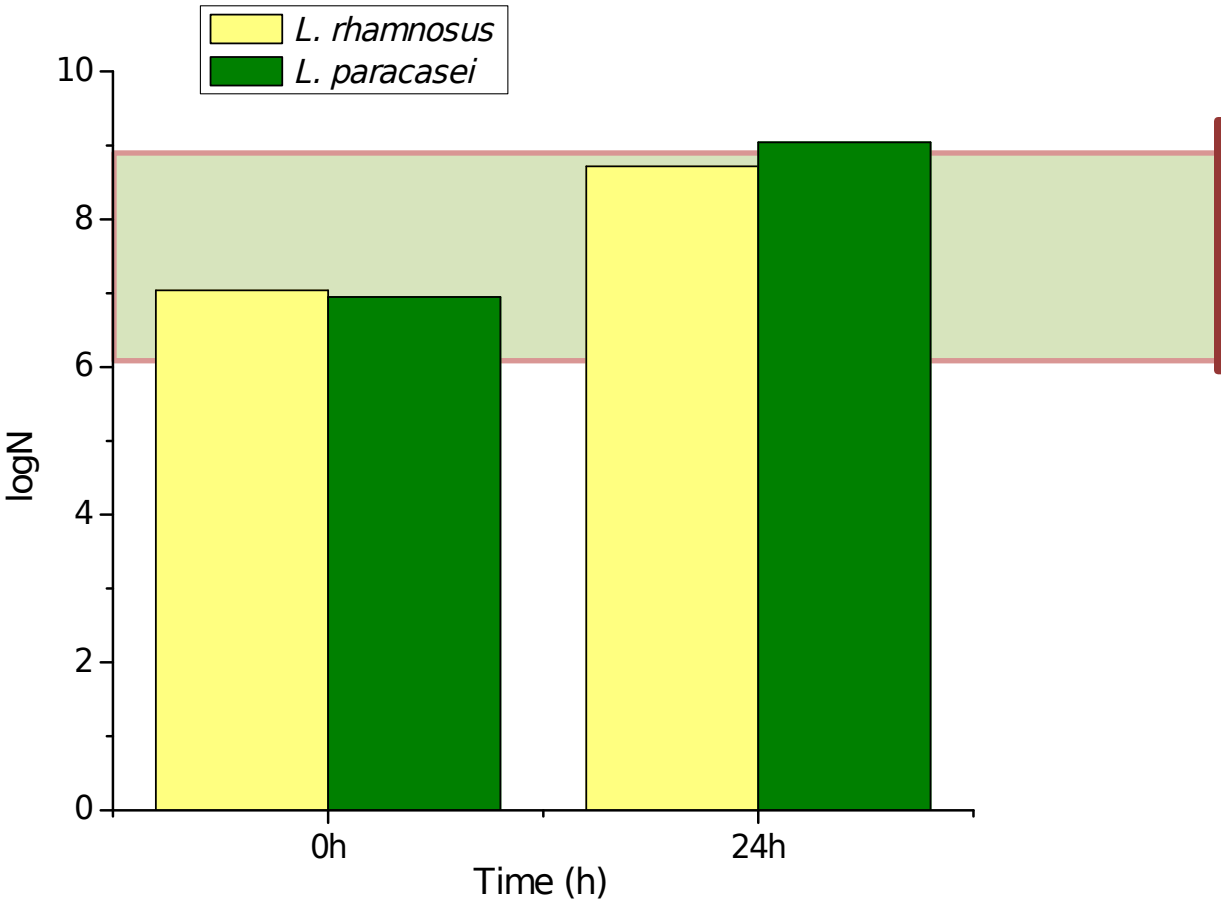
- Continuous treatment,
- 10 kV/cm, 100 ns, 4.5 s^{-1}
- 20 h incubation, 23 ˚C

- **20-23% of proteins extracted**
- **Protein concentration: 0. 950 g/L (by Lowry)**
- **Role of C/N ratio for lactic acid fermentation**

Supplementation with fermentable sugars

FERMENTATION

- **Growth of *L. rhamnosus* and *L. paracasei* on extracts**

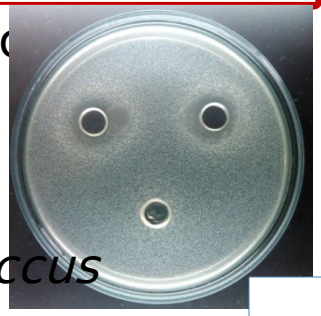


Recommended number of viable cells in probiotics **10^6-10^9 CFU/g**

Important probiotic characteristics of selected bacteria

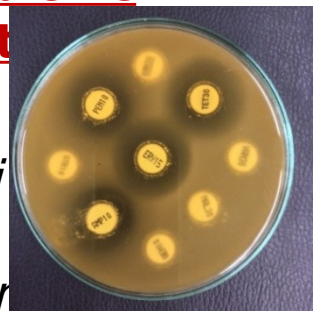
- **Antimicrobial activity** of lac

Against:
- *Salmonella enteritidis*
- *Staphylococcus aureus*
- *Shigella sonnei*

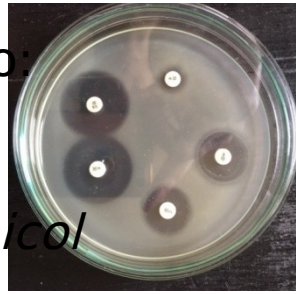


- **Antibiotic resist**

Resistance to:
- *Gentamicin*
- *Kanamycin*
- *Steptomycin*
- *Vancomycin*

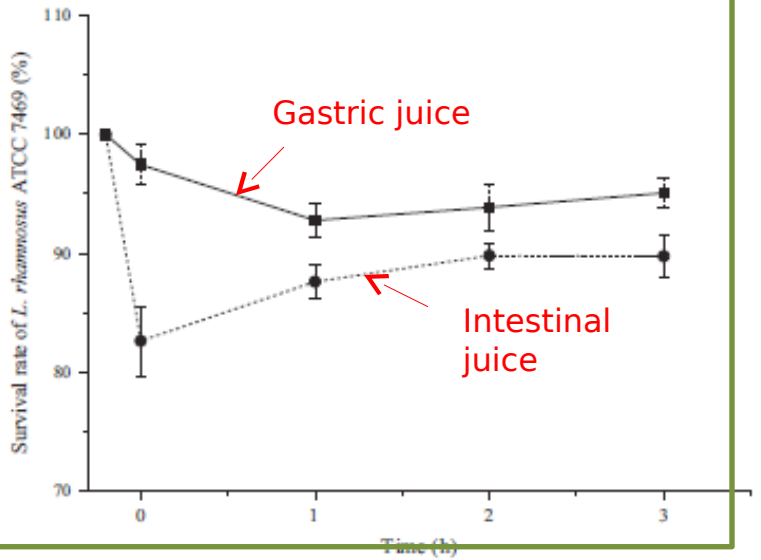


Suseptibility to:
- *Erytomycin*
- *Tetracycline*
- *Chloramphenicol*
- *Penicillin G*
- *Ampicilin*



- **Resistance to gastrointestinal stress** (low pH, pepsin, pancreatin, bile salts)

L. rhamnosus



Antioxidant activity of

–

- **intact cells**
- **intracellular cell free extracts**

Lactic acid fermentation

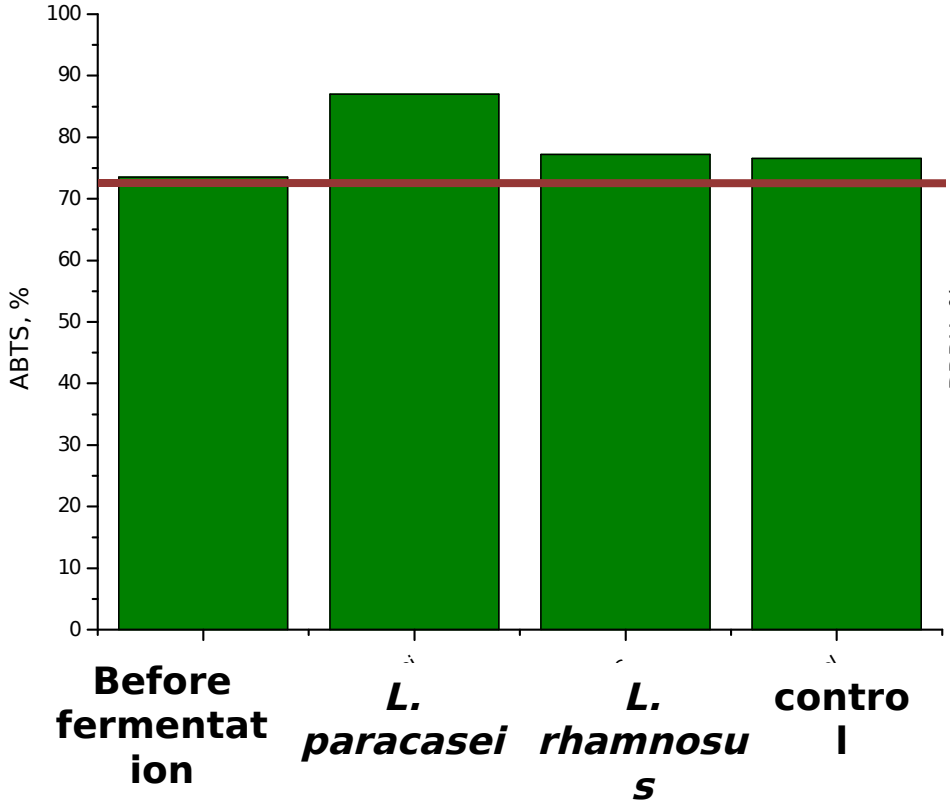
- Batch open fermentation – avoiding thermal treatment
- 37 ˚C, 24h, 100 rpm
- 5% (v/v) inoculum concentration
- ~30 g/L initial sugar concentration

Strain	LA concentration	LA yield	LA productivity	Stereoselectivity
L. rhamnosus	**24.24 g/L**	**85%**	**1.01 g/Lh**	**> 97% L-lactic acid**
L. paracasei	**27.3 g/L**	**91%**	**1.14 g/Lh**	**> 97% L-lactic acid**

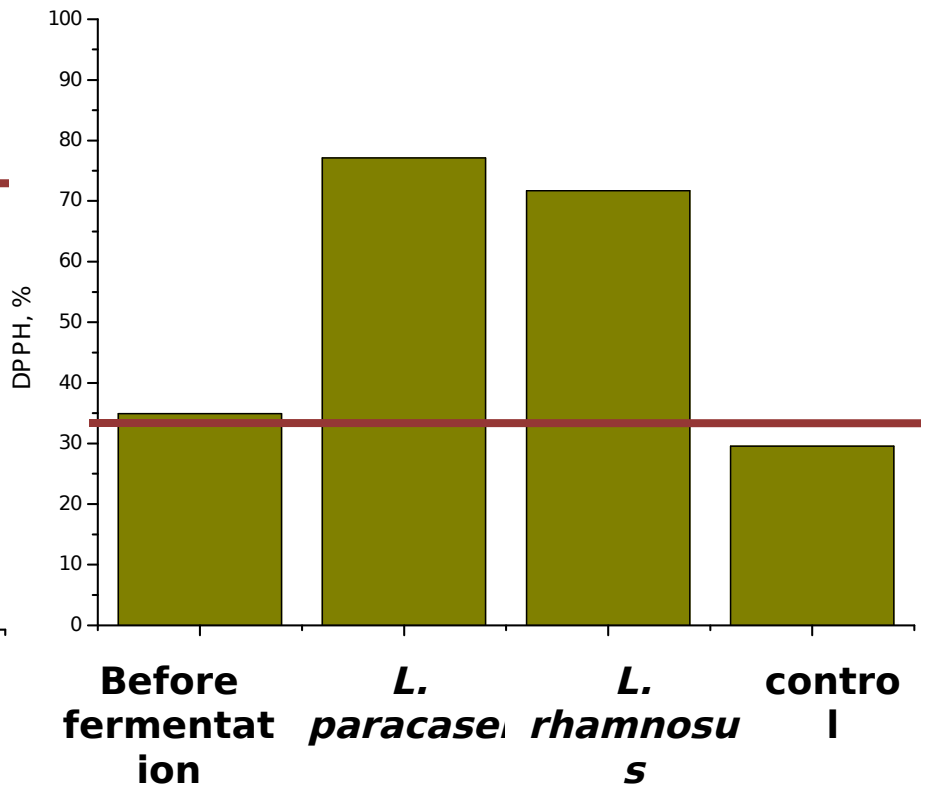
Not significant changes were observed in free amino nitrogen concentration!

Antioxidant activity

ABTS



DPPH



Revalorisation of PEF obtained extracts

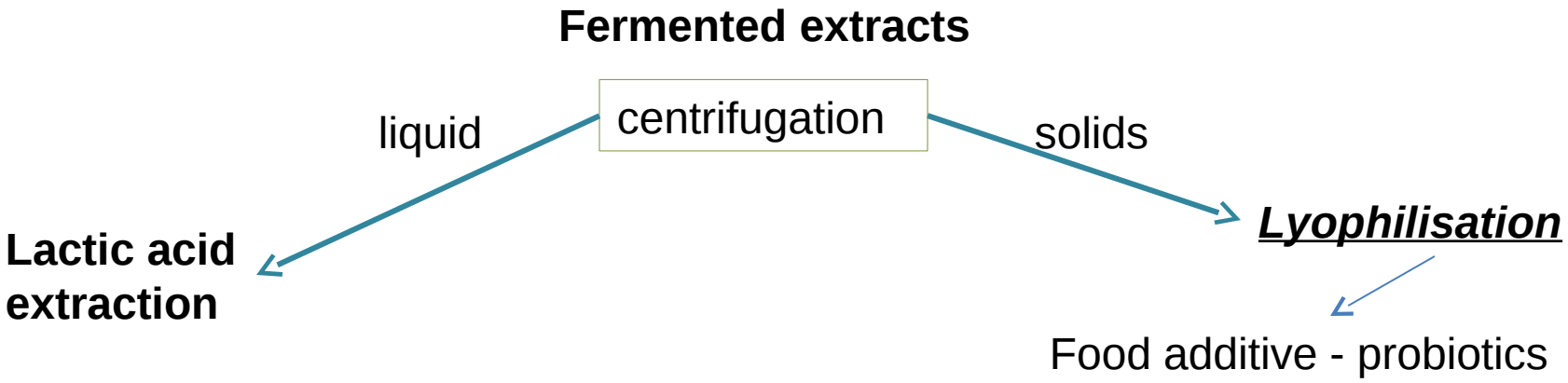
Chlorella vulgaris – **FDA approved for human nutrition**

L. rhamnosus
L. paracasei – **GRAS status**

✓Can be performed in open fermentation mode – avoiding thermal sterilisation or filtration

✓But… changes in colour, oxidation, temperature, pH …

✓After the LA fermentation high antioxidant activity in fermented extracts



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DAAD
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German Academic Exchange Service

Thank you for your attention!

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