

GERMAN INSTITUTE OF FOOD TECHNOLOGIES

DIL - MISSION INNOVATION
BROCHURE

KNOWLEDGE
FOR SUPERIOR
FOODS



Pulsed Electric Fields – Applications and commercial experience

Martina Kießling, Stefan Töpfl, DIL e.V., Quakenbrück



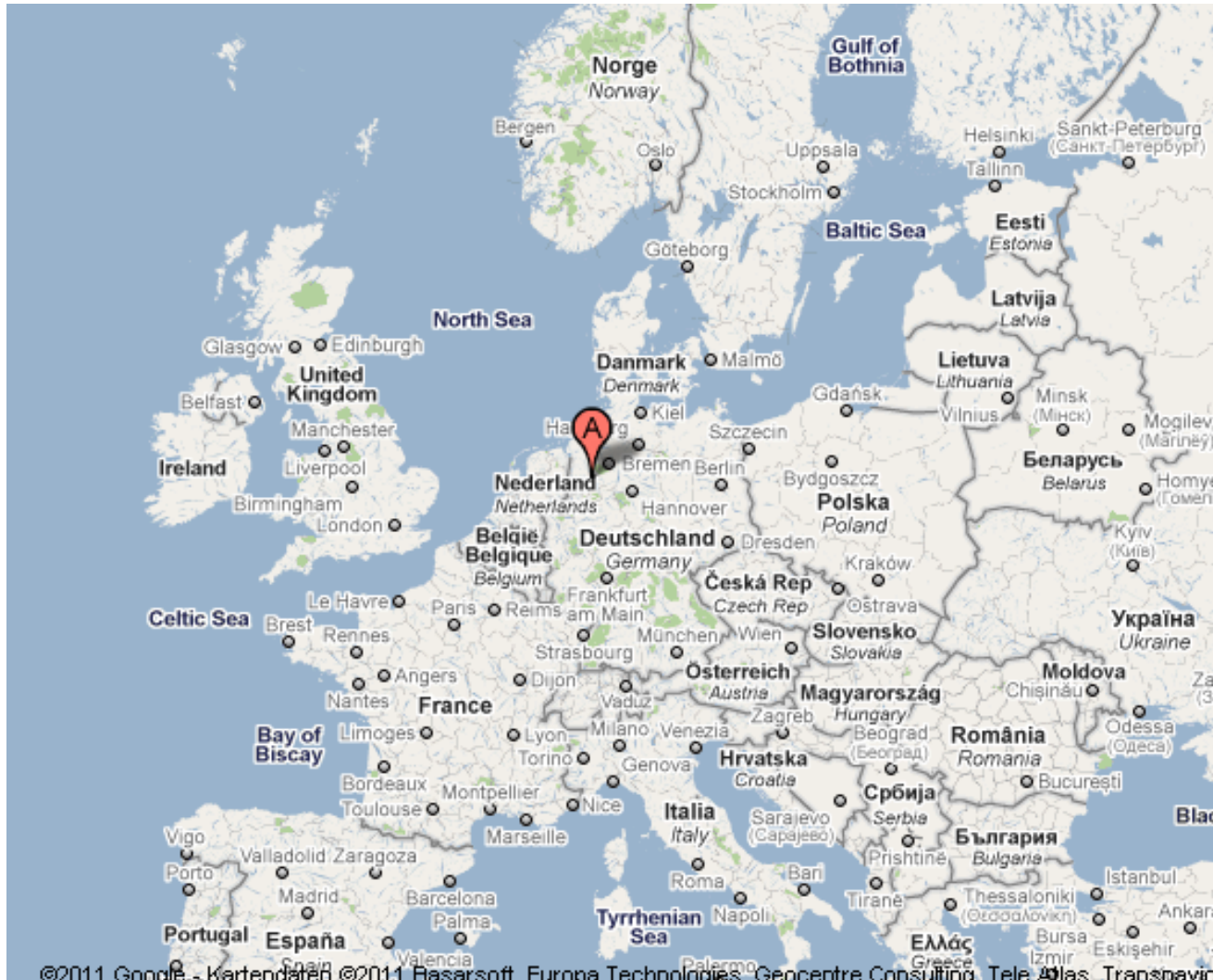
Pulsed Electric Fields – Applications and commercial experience

- DIL in Quakenbrück
- PEF – why, where and how?
- Equipment and process parameters
- Applications



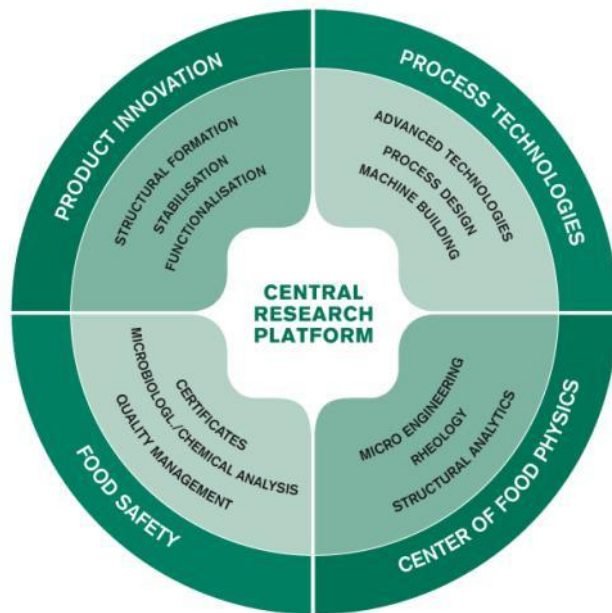
PEF

Institute / location



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wagrAlim, 20.10.2011



DIL BUSINESS FIELDS.
Providing services for the industry on behalf of direct clients.



The divisions of the research platform:

- STRUCTURE AND FUNCTIONALITY
- BIOTECHNOLOGY
- ROBOTICS
- NETWORKS

DIL RESEARCH PLATFORM.

Determination of scientific findings, independently for industrial clients.

Development of innovative approaches with the ambition to implement them into attractive products and efficient processes for industry.

PEF Institute / Extension



Labor Routine
750 qm

Labor Forschung
500 qm

Technikum
3.000 qm

Maschinenbau
1.000 qm

Seminar- und Büroräume 750 qm

Gesamt: 6.000 qm zusätzliche Nutzfläche



why

- microbial inactivation
- Cell desintegration
- improvement of mass transfer

where

- Foodtechnology and
- Biotechnology



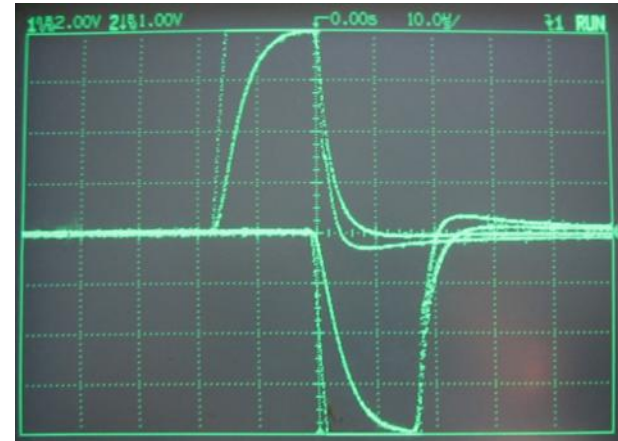
PEF

why, where and how?

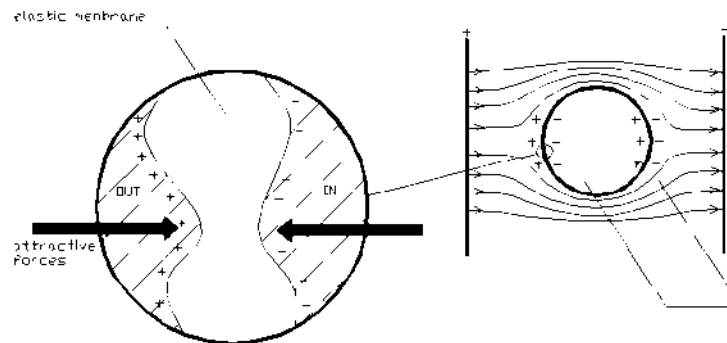


how

- *physical:*
electric pulse (μs),
high field strength and intensity
- *mechanism:*
cell membrane (Zimmermann, 1986).



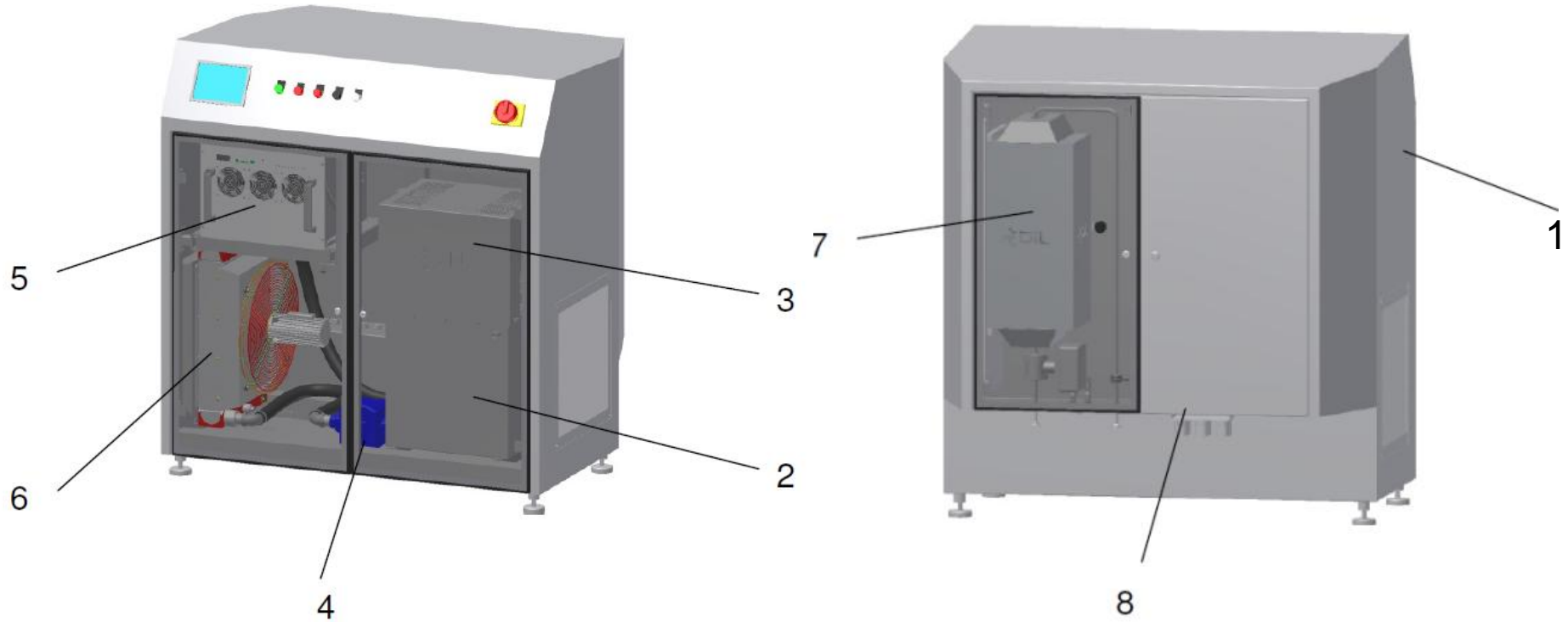
but



PEF Equipment



30 kW system

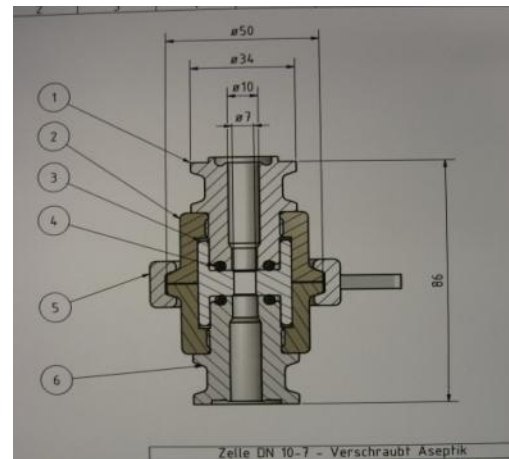


- 1 cabinet
- 2 transformer
- 3 capacitor bank
- 4 oil pump

- 5 capacitor charger
- 6 fan
- 7 treatment area
- 8 connectors

Design preconditions
Turnkey system
CE-Compliance
CIP/SIP suitability

PEF Equipment

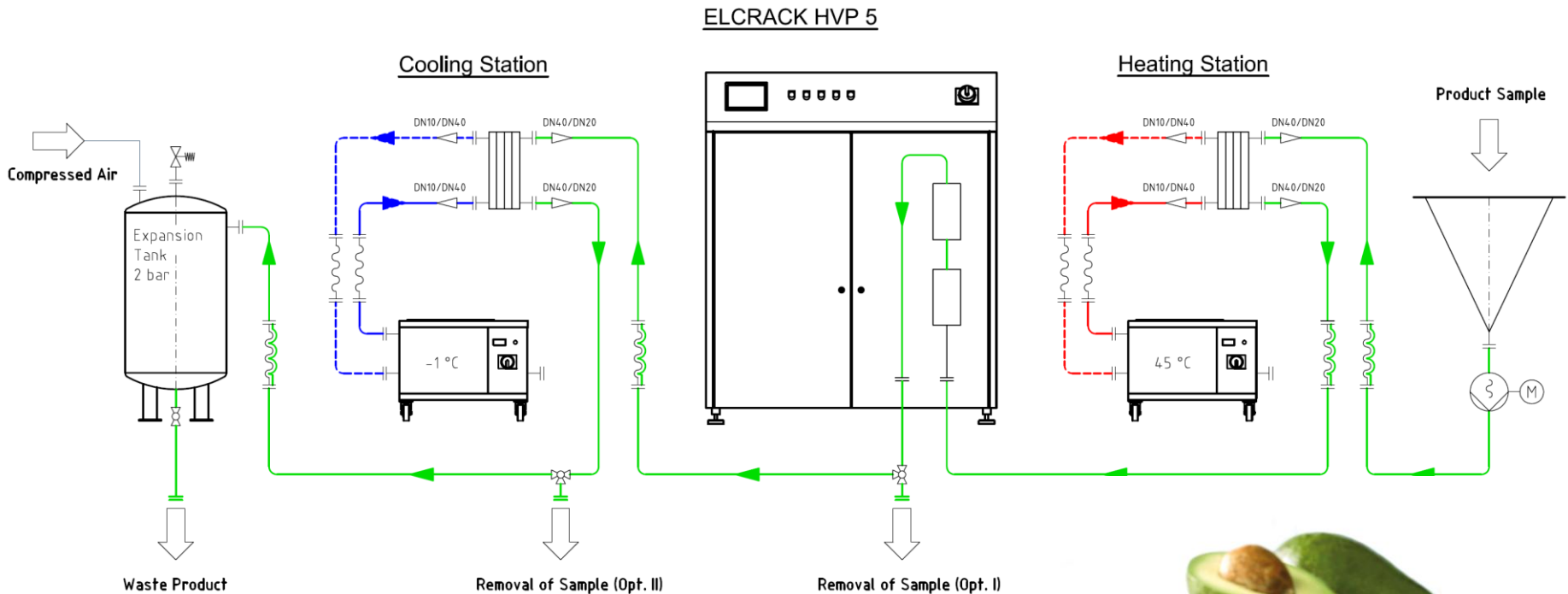


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Equipment



Preservation of heat sensitive liquids as fruit juices, preparations, beer, cocktail premixes, salsas or plasma



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Equipment, Pilot hall



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parameters

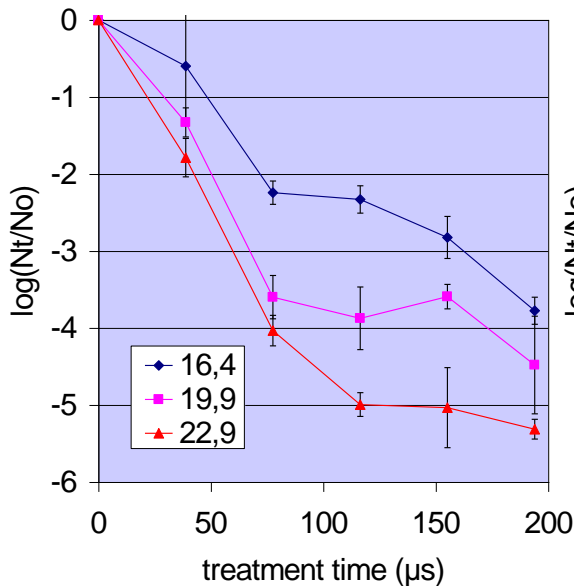


process factors	microorganisms	productinfluence
field strength	period of growth	conductivity
treatment time	cell size	ph
specific energy input	cell shape	water activity
temperature		particle
frequency		airbubble
pulse shape		

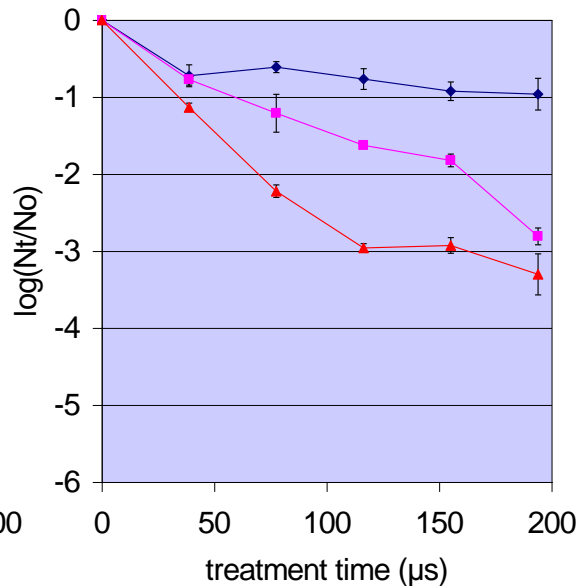


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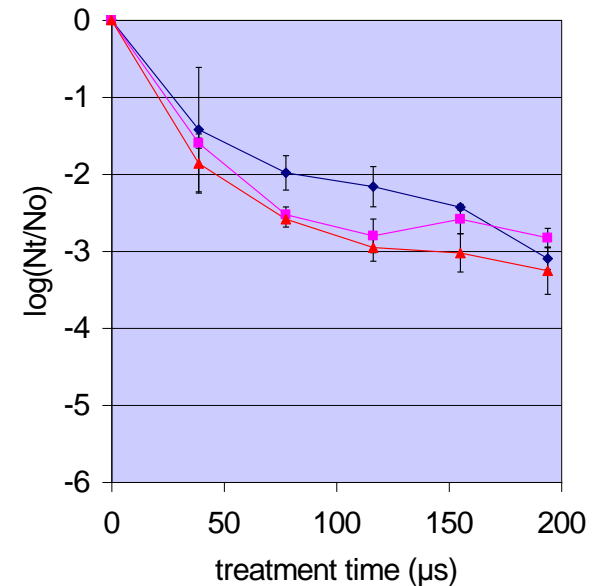
Orange juice



E. coli 35218, N0: $7,5 \times 10^6$ KBE/ml



L. innocua 320649, N0: $3,95 \times 10^6$ KBE/ml



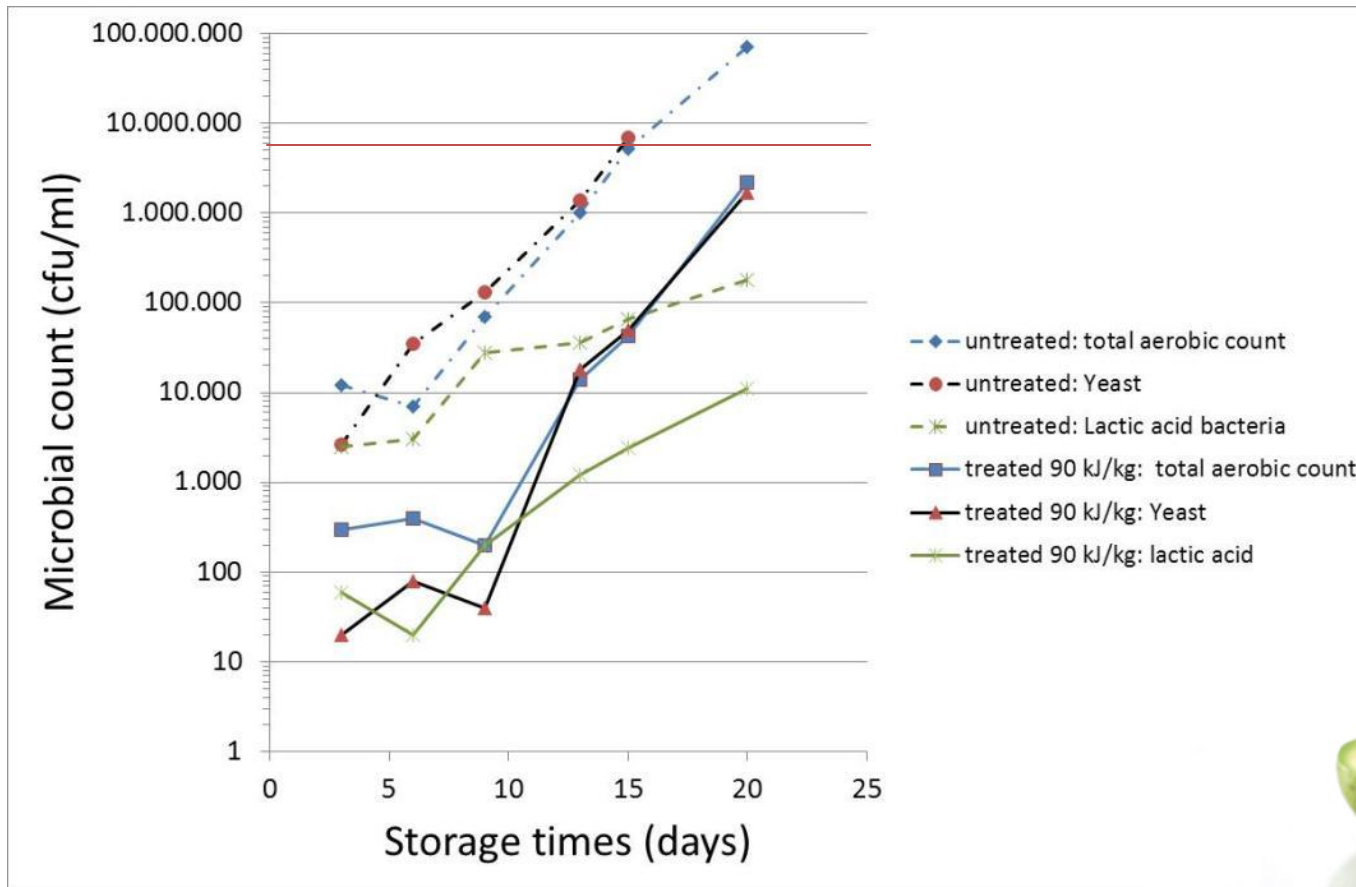
S. cerevisiae 1333, N0: $1,8 \times 10^5$ KBE/ml

conductivity 2,87 mS/cm, pH 3,25 , Brix°11,4
2 collinear treatment chambers DIN 10-7, different field strength(kV/cm)



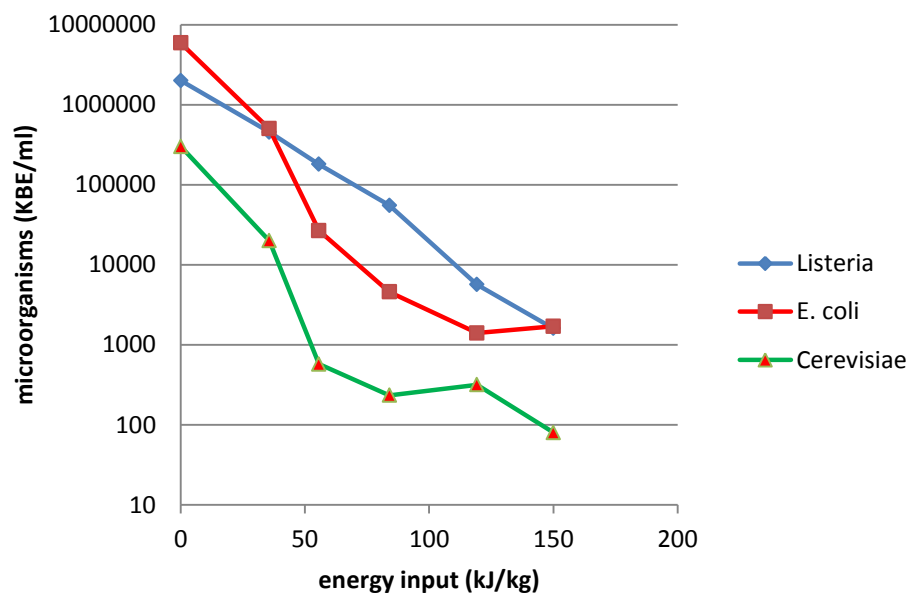
PEF

Smoothie



PEF

Mango



Processparameter

Energy input kJ/kg	T in °C	T out °C
0		
36	28	37
56	28	42
84	28	49
119	28	58
150	28	65

E. coli, NO: $5,9 \times 10^6$ KBE/ml
S. cerevisiae, NO: 3×10^5 KBE/ml
L. innocua, NO: $2,00 \times 10^6$ KBE/ml

conductivity 2,57 mS/cm, pH 3,74, Brix 12,81, 2 collinear treatment chamber DIN 10-7



PEF

Mango pulp – with a difference

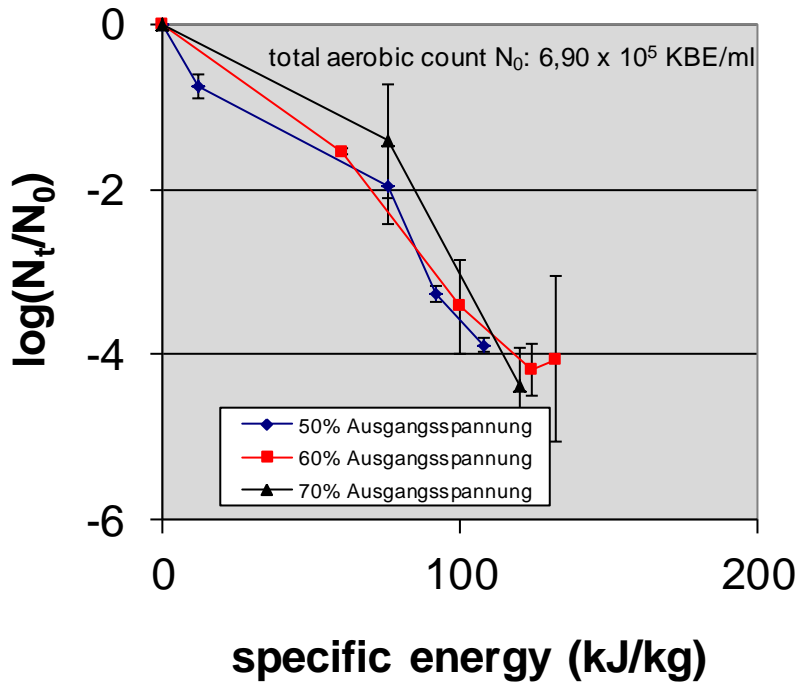
Energy input and different inlet temperatures

Energy input kJ/kg	T in °C	T out °C	L*(D65)	a*(D65)	b*(D65)	Viscosity Pas	Microbial count (cfu/ml)
0			51	13	46	3,8	350000
103	27	53	50	12	52	5,0	95
80	48	68	49	12	51	-	60
67	65	81	48	12	41	4,1	< 10

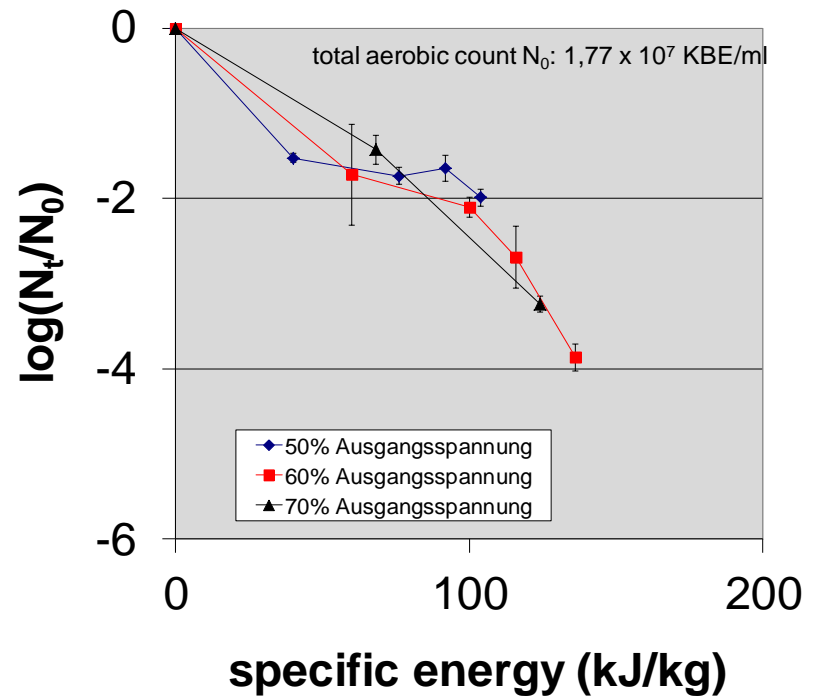
Goal: long shelf life with the best possible quality

conductivity 3,71 mS/cm, pH 4,15, Brix 28,5, 2
2 collinear treatment chambers DIN 10-7





Plasma 16.03.2010
 conductivity 11 mS/cm
 (before treatment ca. 3 h at 30°C)

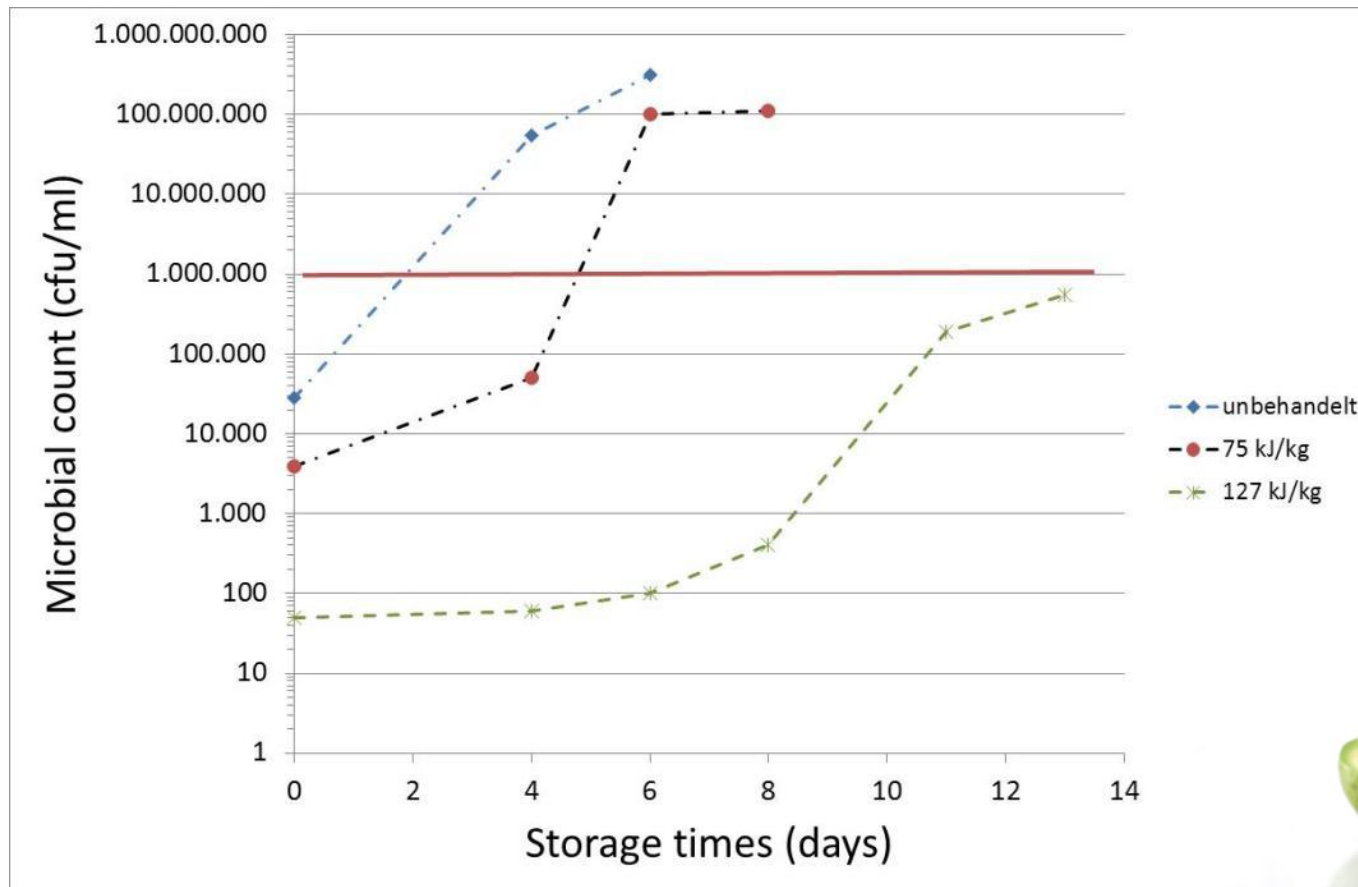


Plasma 29.03.2010
 conductivity 10,3 mS/cm
 (before treatment ca. 3 h at 30°C)



PEF

application plasma



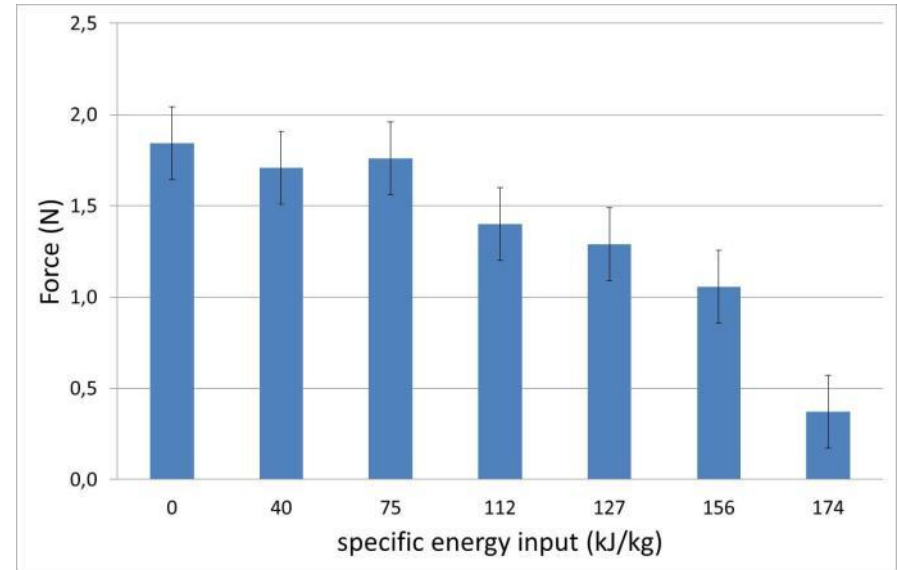
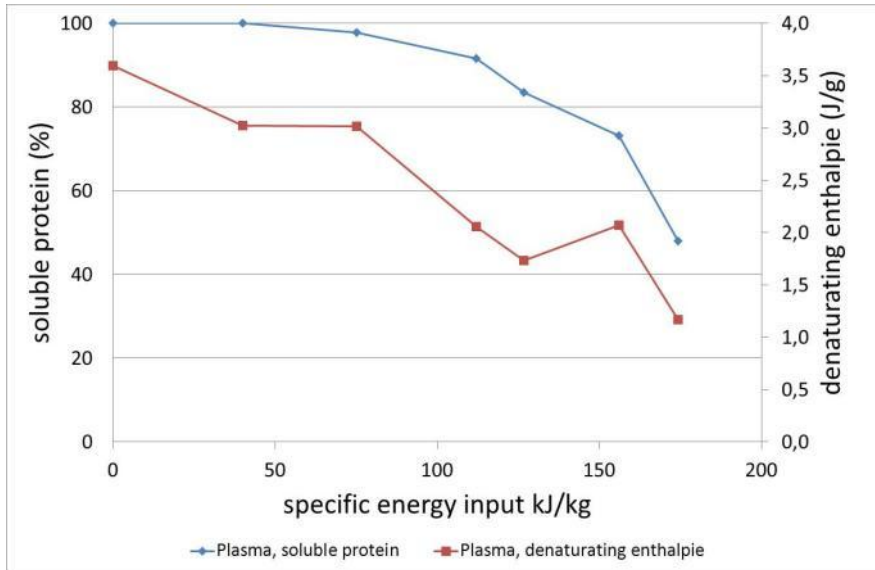
Shelf life of fresh untreated and fresh PEF treated blood plasma

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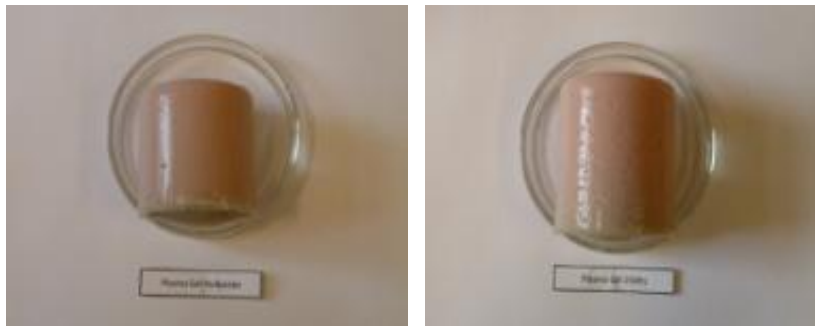


PEF

Plasma application



Protein characteristics



Thermally induced gelation



PEF

tomatos



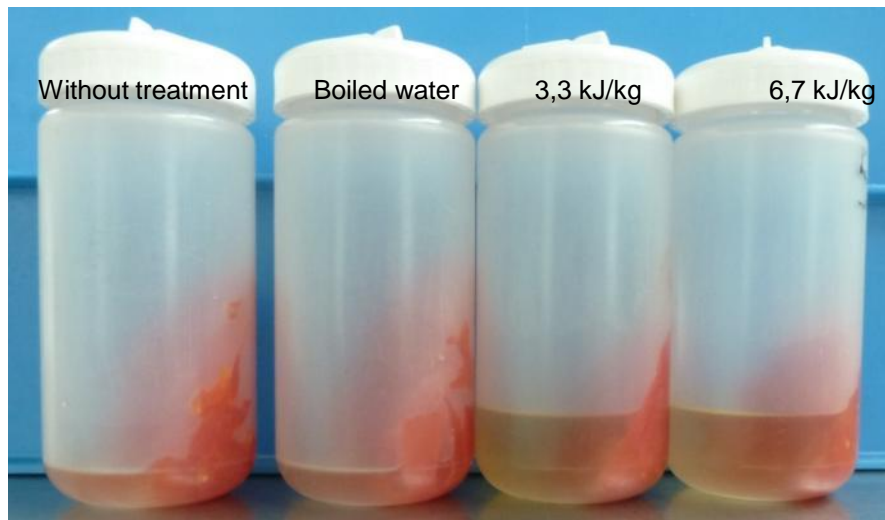
2 kJ/kg

control

7 kJ/kg

PEF influence

- Skin peeling
- cutting
- juice



Without treatment

Boiled water

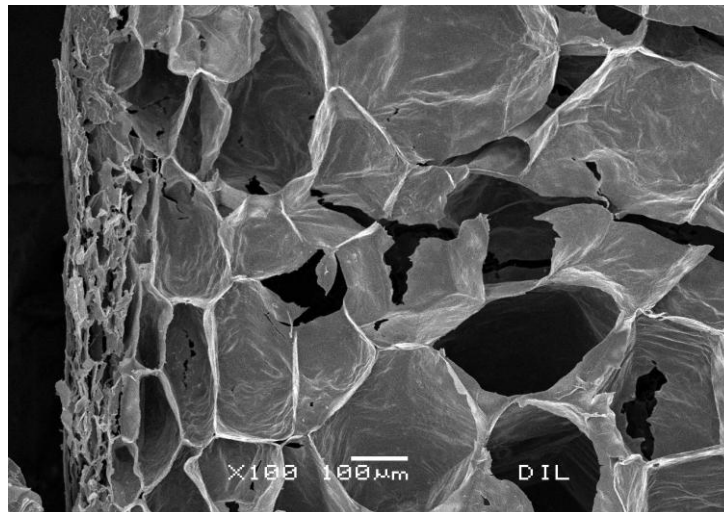
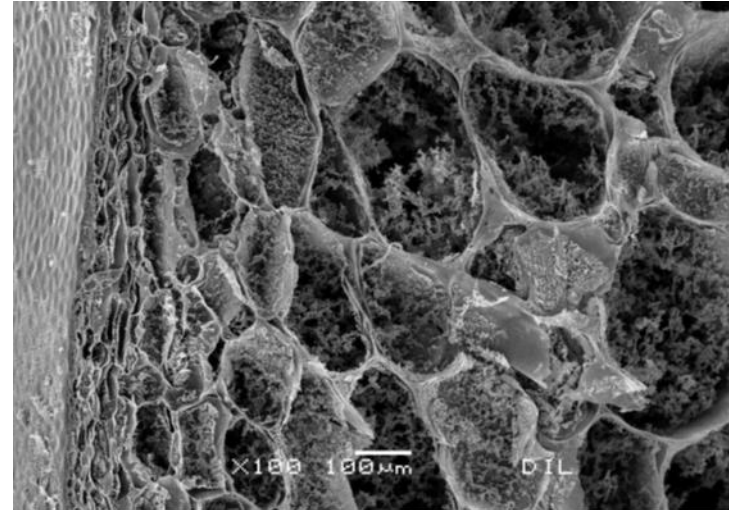
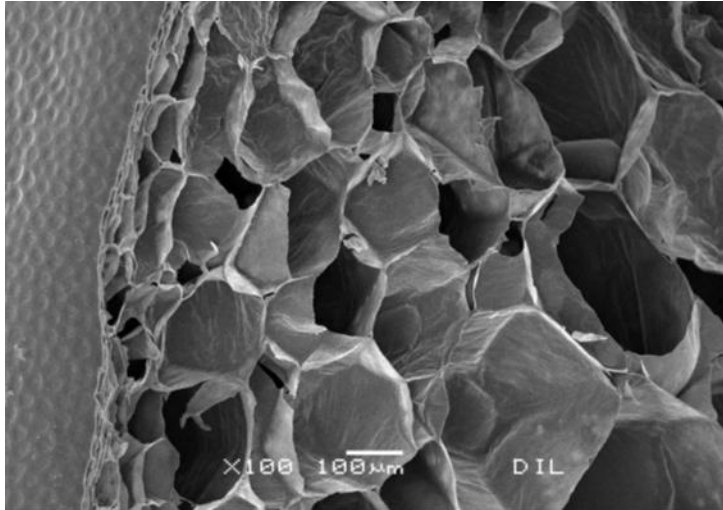
3,3 kJ/kg

6,7 kJ/kg



PEF

tomato

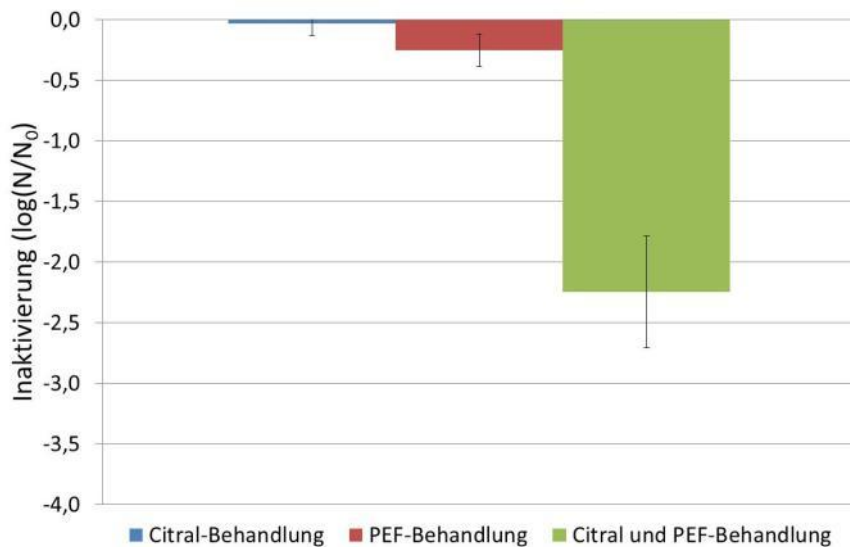


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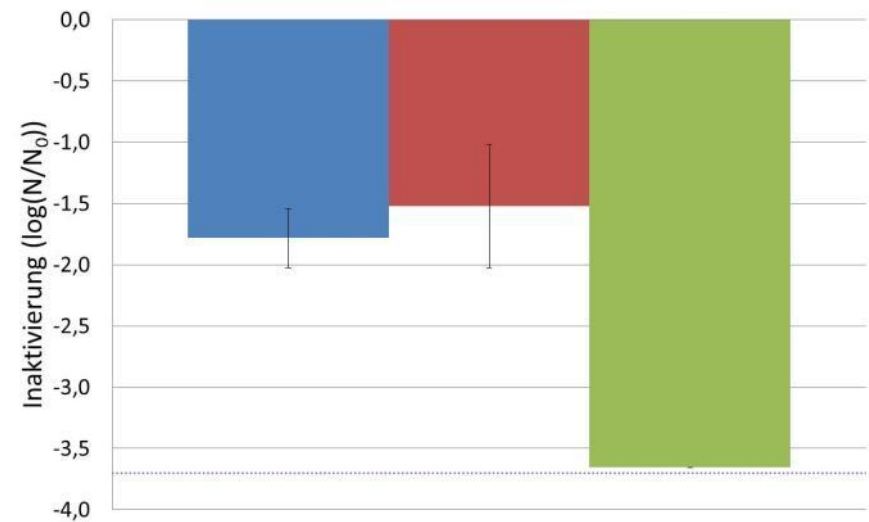
PEF combination



E. coli



L. plantarum

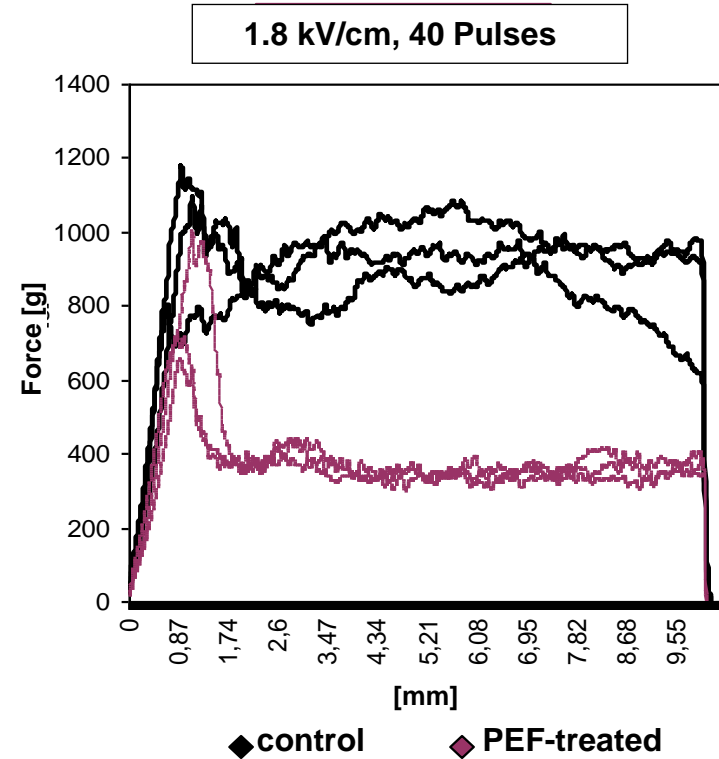
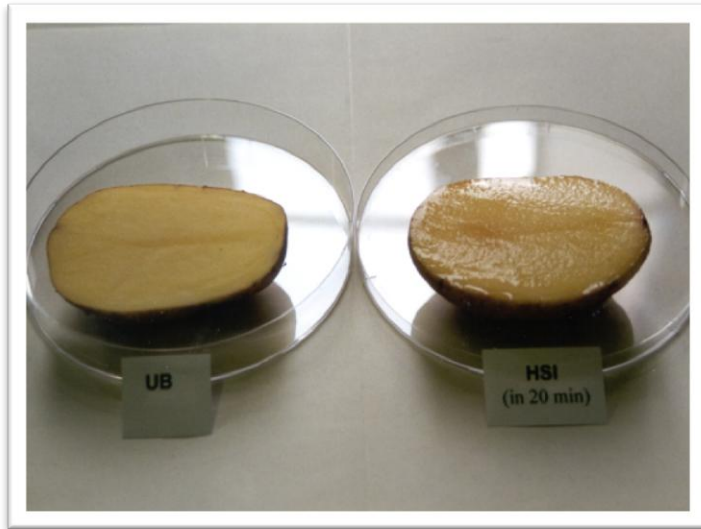


Orange juice, combination PEF and Citral (1000 ppm),

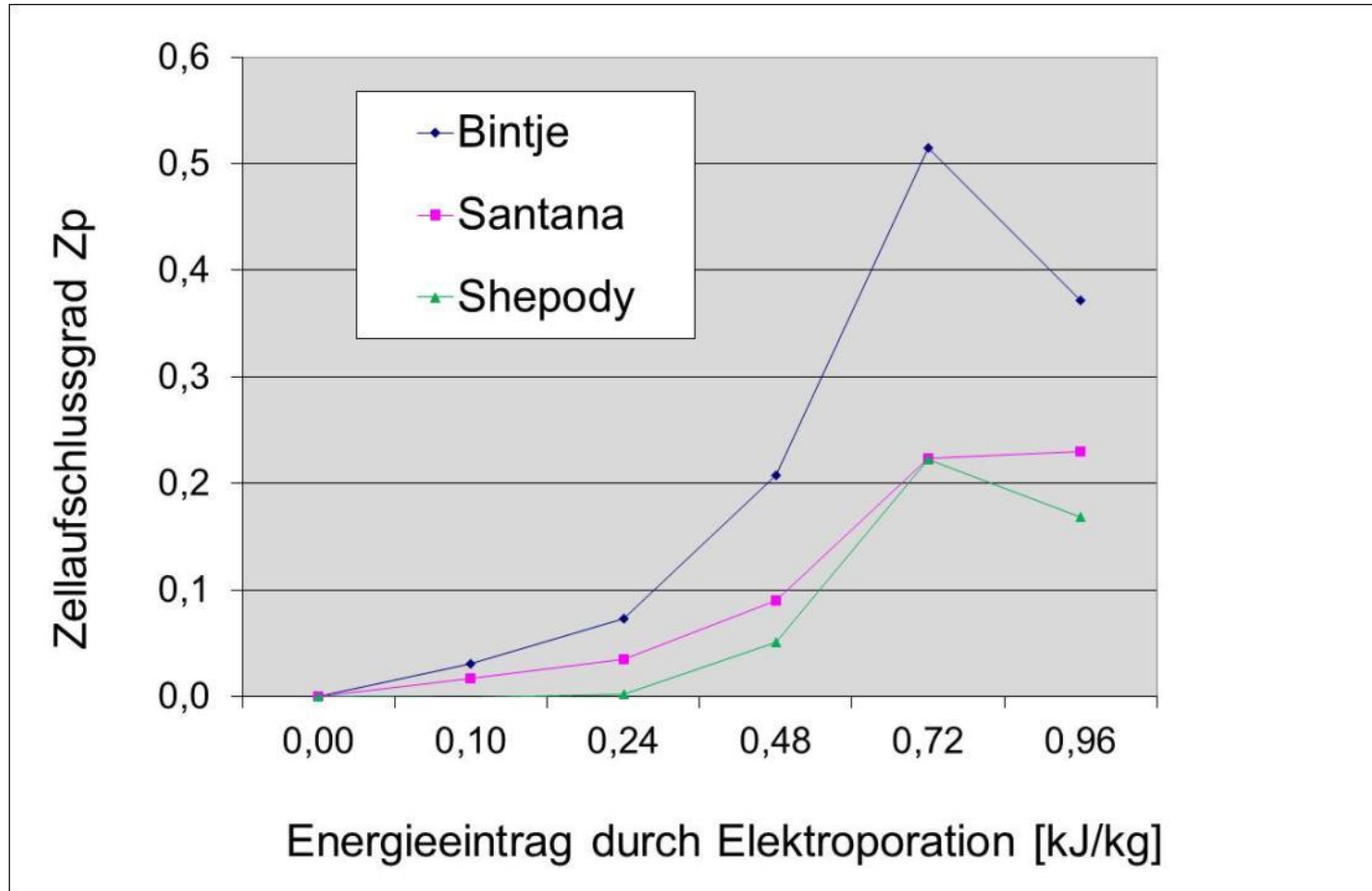


PEF

potatoes

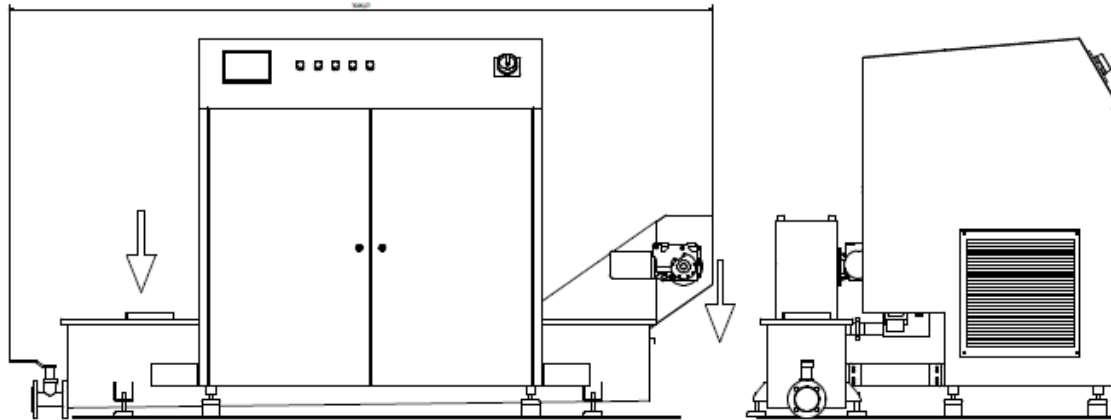
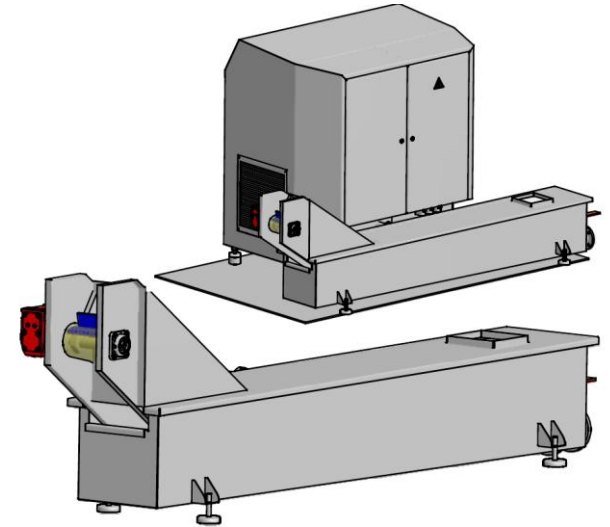


Influence on texture and processing characteristics



PEF

potatoes



Capacity Juices:
500 – 1.000 kg/h

(Belt system treatment of
fruits/vegetables
Capacity: 50 t/h)

Average and peak power	Scale	Typology	Specification	Capacity cell disintegration	Capacity microbial inactivation	Units realized
5 kW 6 MW _p	Laboratory scale	Transformer	DN 10 to 30 mm 30 kV max voltage 200 A max current 1.000 Hz max rep rate 1500x1150x1600 mm 3 x 400 V, 32 A	1.500 kg/h	200 l/h	20 Germany, Spain, Ireland, USA, Switzerland, Mexico, India, New Zealand, Korea
30 kW 20 MW _p	Technical / semi- industrial scale	Transformer	DN 20 to 40 mm 30 kV max voltage 700 A max current 500 Hz max rep 1500x1150x1600 mm 3 x 400 V, 80 A	10.000 kg/h	1.200 l/h	7 UK, Vietnam, Germany, The Netherlands, France, Canada
80 kW 300 MW _p (Multiple 160 kW 240 kW)	Industrial scale	Semi- conductor- based Marx Generator	DN 40 to 100 mm 60 kV max voltage 5.000 A max current 300 Hz max rep rate 5.000x1.300x2.500 mm 3 x 400 V, 160 A	30.000 kg/h	5.000 l/h	2 Germany, France

Cost effective, short-time cell disintegration technique, improvement of mass transfer processes, microbial inactivation
Equipment available at DIL, worldwide a dozen systems operational.

Contact:

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<http://www.elea-technology.eu>

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***We like to work with you
to implement your ideas.***