IGE Innovationszentrum Technologien für Gesundheit & Ernährung

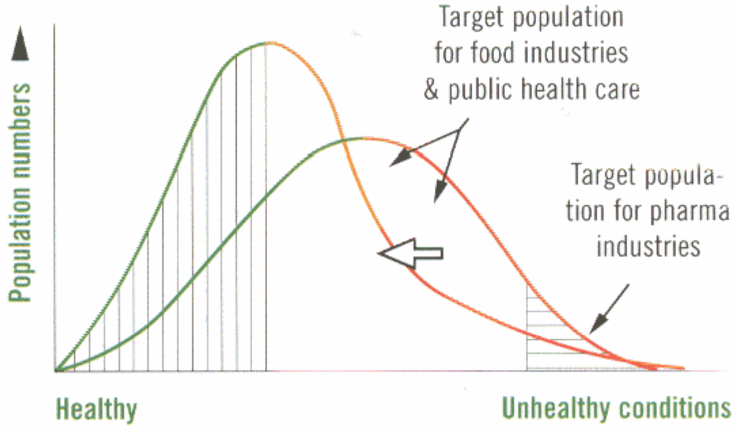
Technologien für Gesundheit und Ernährung – Impulse für die Ernährungswirtschaft

Prof. Dipl.-Ing. Dr. Dietrich Knorr

„European Technology Platform"

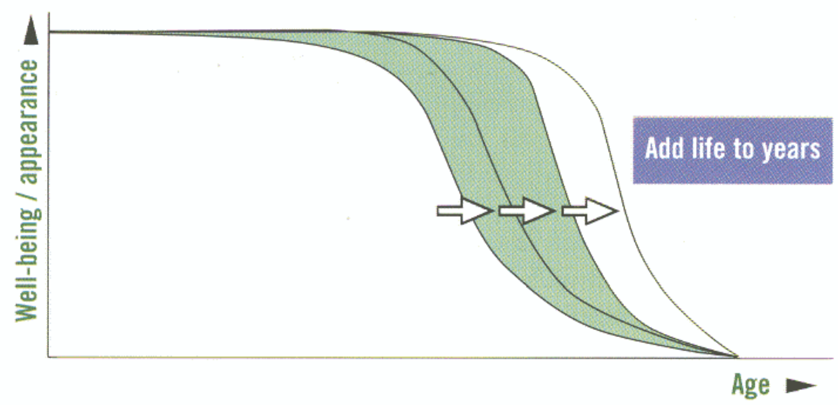
Vision

Figure 6. A schematic presentation of improving population health - Target areas of the food and pharma industries in public health

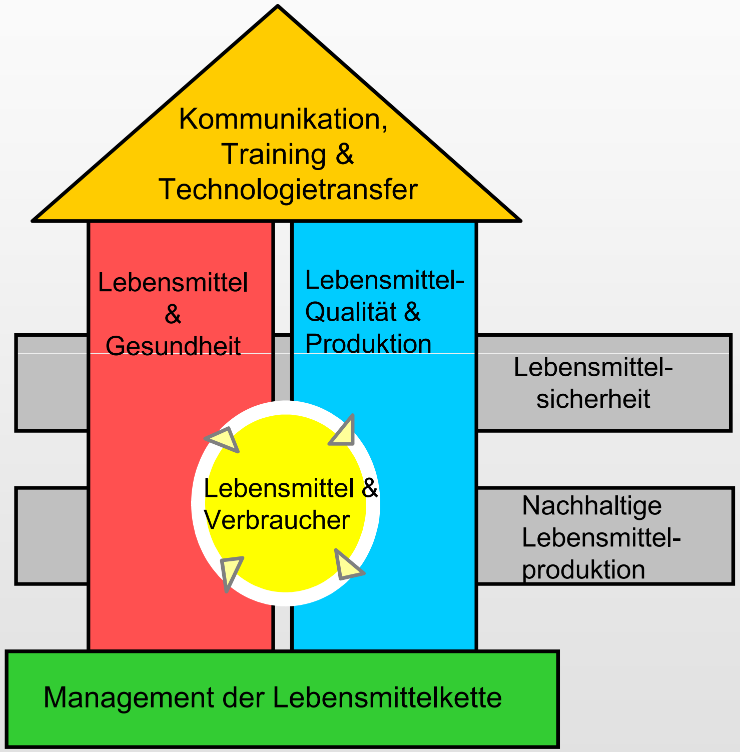


Source: Green MR and van der Ouderaa F, Nature Pharmacogenomics, 2003

Figure 5. Healthy Ageing



„European Technology Platform“



- Gewährleistung, dass die gesunde Wahl auch die einfache Wahl für alle Verbraucher wird
- Bereitstellung einer gesunden Ernährung
- Bereitstellung von Lebensmitteln mit hoher Qualität
- Entwicklung sicherer Lebensmittel, denen Verbraucher vertrauen können
- Erreichung einer nachhaltigen Lebensmittelproduktion
- Management der Lebensmittelkette

Struktur des IGE

ZiG Zentrum für innovative Gesundheitstechnologien

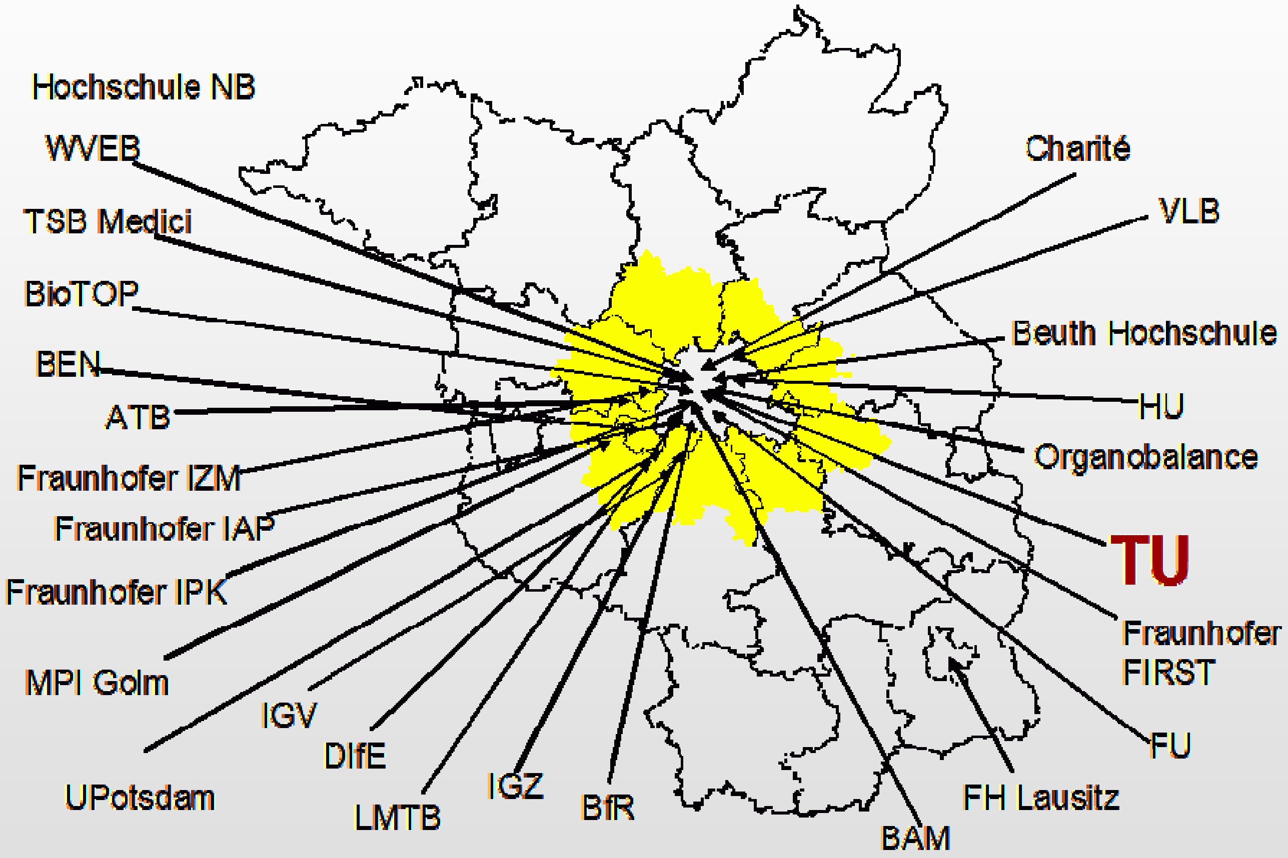
CPF Center for Preventive Foods

Zusammenschluss von zwei starken TU-Zentren zum Innovationszentrum

Mitglieder: 52 FG der TU Berlin
24 Partner von anderen Universitäten und außeruniversitären Forschungsinstituten

Im Jahr 2009 wurden 20 Projekte mit einem Volumen von 9,5 Mio Euro eingeworben.

Kooperationspartner des IGE

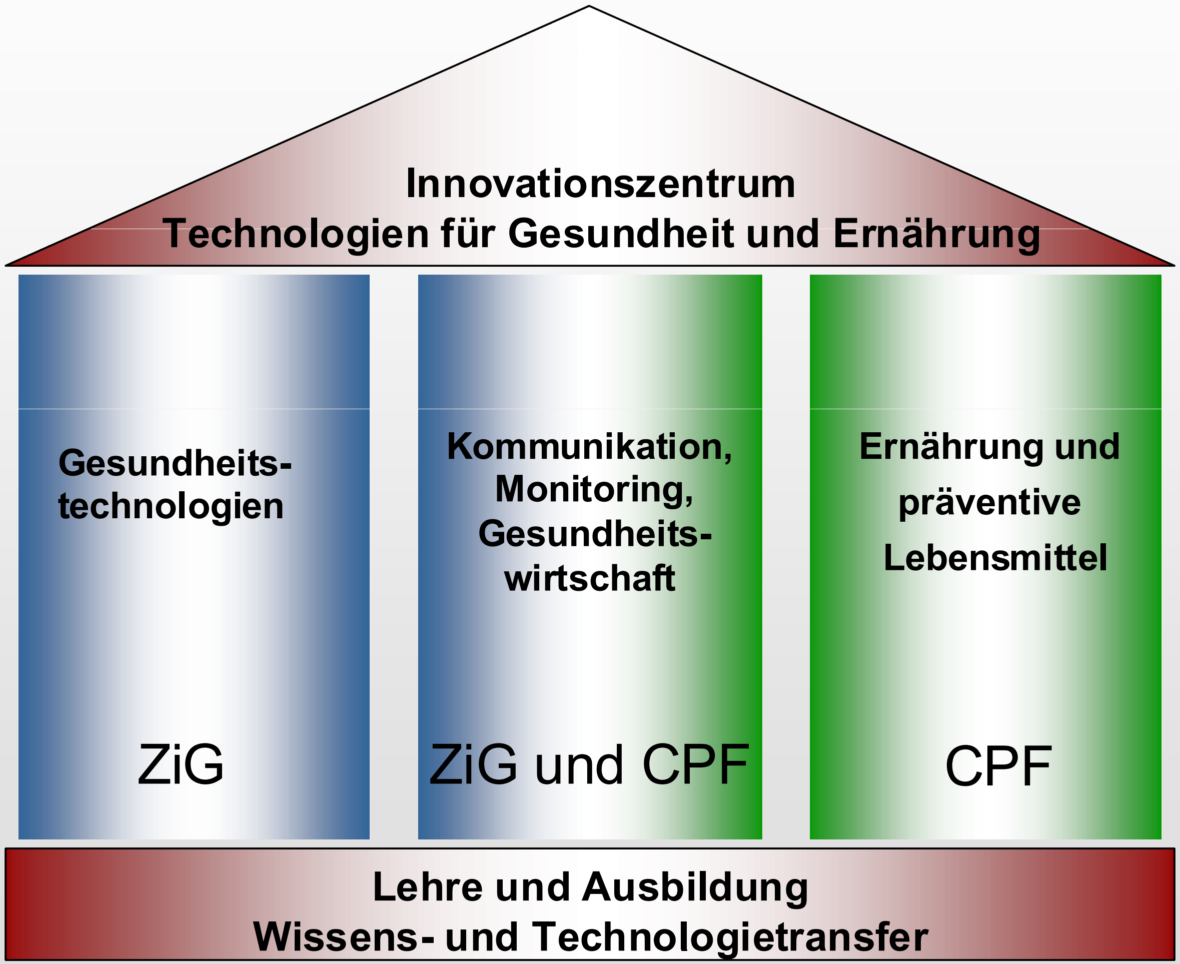


Ziele des IGE

- Bündelung der Kompetenzen
- Integration von Wissenschaft, Industrie und Politik
- Wissens- und Technologietransfer

Entwicklung der Region Berlin-Brandenburg zur Modellregion für Gesundheit und Ernährung

Forschungsschwerpunkte des IGE



Impulse für die Ernährungswirtschaft

In welchen Bereichen liegen die Schwerpunkte der Forschungsaktivitäten?

- Funktionelle Lebensmittel
- Maßgeschneiderte Lebensmittel
- Lebensmittelsicherheit

Funktionelle Lebensmittel

- Darmgesundheit
- Gewichtskontrolle
- Gesundheitsfördernde Wirkung

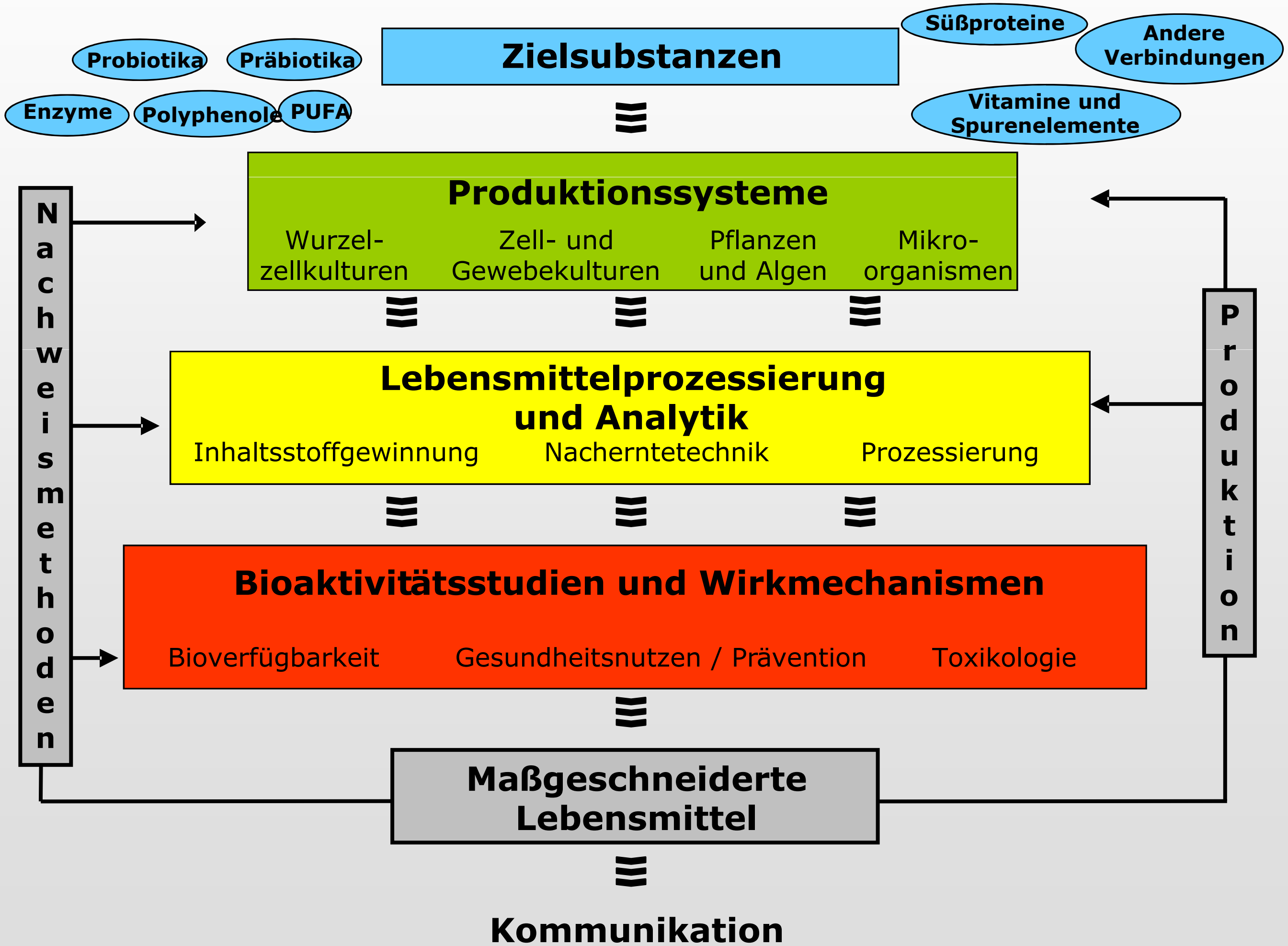
Maßgeschneiderte Lebensmittel

- gegen den Alterungsprozess
- für Personengruppen z.B. Kinder
- die Denkleistung steigernd
- die Schönheit fördernd
- Gluten-frei / Allergen-frei
- Zuckerfrei / Fettreduziert

Lebensmittelsicherheit

- Bereitstellung von Lebensmitteln mit hoher Qualität
- Entwicklung sicherer Lebensmittel, denen Verbraucher vertrauen können
- Schonende Verarbeitung bei maximaler Sicherheit

Forschung des CPF entlang der Wertschöpfungskette



Ausgewählte Themenschwerpunkte

- Nachhaltigkeit der Produktion und schonende Verarbeitung von Lebensmitteln
- Analyse von Lebensmittelinhaltsstoffen entlang der Wertschöpfungskette
- Entwicklung und Herstellung von maßgeschneiderten Lebensmitteln

Glucosinolate

- Anreicherung in Pflanzen und Wurzelkulturen
- Optimierung des Glucosinolatprofils
- Aufklärung molekularer Mechanismen zu Bioverfügbarkeit und Bioaktivierung

Funktionelle Getränke

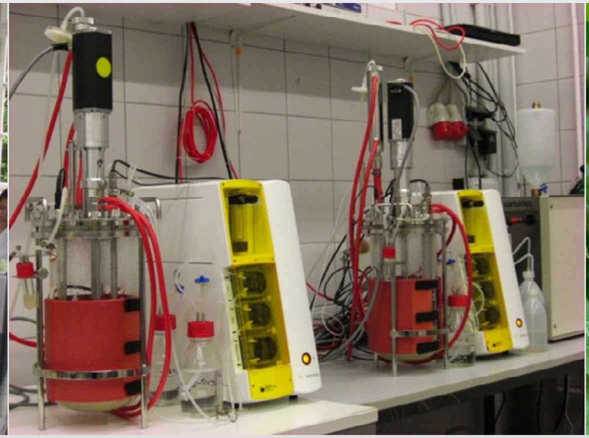
- Entwicklung von innovativen Gärgetränken auf Würzebasis
- Anreicherung des Getränkes mit gesundheitsfördernden Substanzen durch das Verfahren der Mischfermentation
- Einsatz alternativer Rohstoffe wie z.B. exotischen Getreidesorten mit hohem Polyphenolanteil

Leguminosen als Basis für maßgeschneiderte Lebensmittel

- Charakterisierung von sekundären Pflanzeninhaltsstoffen wie z.B. Flavonoiden, Saponinen und Glucosinolaten zur ganzheitlichen Nutzung

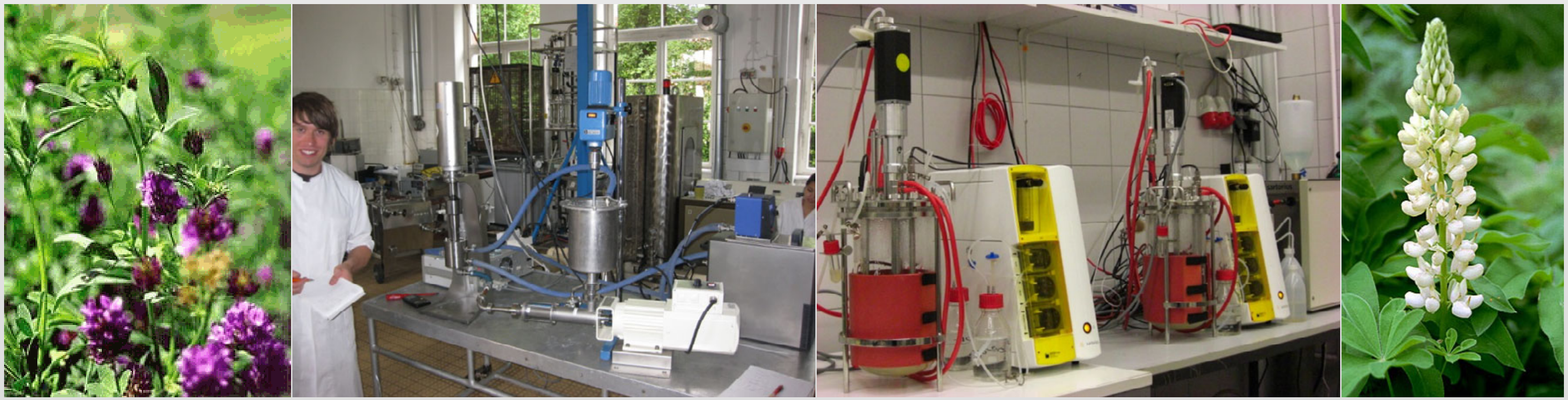
- Prozessbedingte Beeinflussung physikochemischer und ernährungsphysiologischer Faktoren





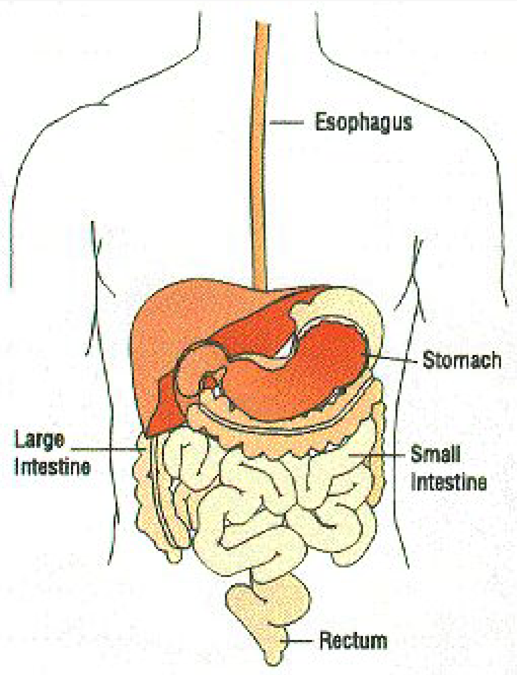

Leguminosen als Basis für maßgeschneiderte Lebensmittel

- Untersuchungen zur Bioaktivität und Bioverfügbarkeit
- Reststoffverwertung – Nachhaltigkeit
- Ökologische und ökonomische Evaluierung

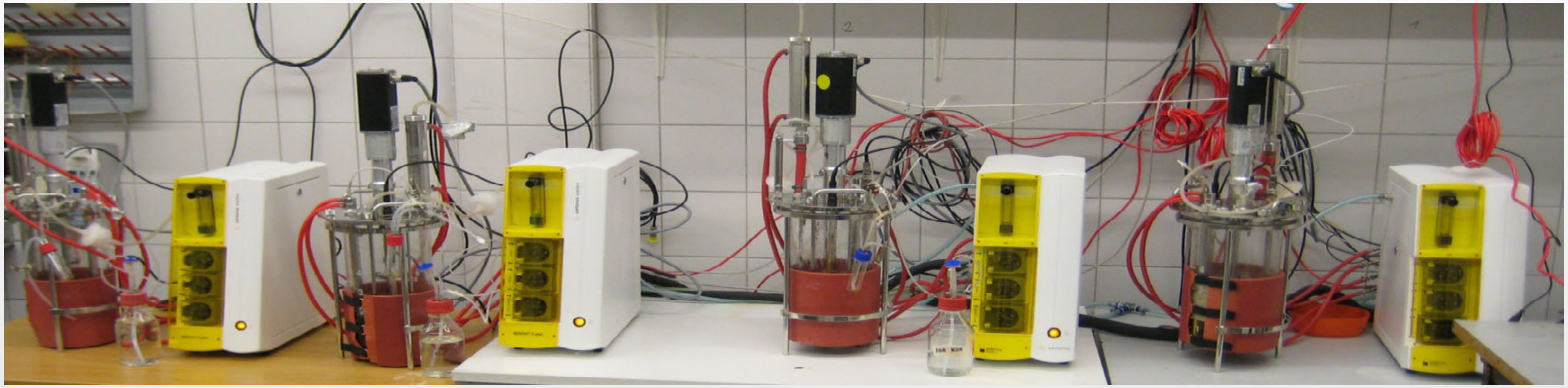


Darmmodell und funktionelle Lebensmittel

- Entwicklung eines Bioreaktor-basierten Darmmodells
- Funktionalität von pflanzlichen und mikrobiellen Lebensmittelinhaltsstoffen
- Bewertung funktioneller Lebensmittel in Bezug auf die Entstehung bioaktiver Wirkstoffe im Darm



Darmmodell und funktionelle Lebensmittel



Magen

- Säurehydrolyse

Dünndarm

- pH-Neutralisierung
- enzymatische Aufspaltung der Nahrung in kleine Bestandteile

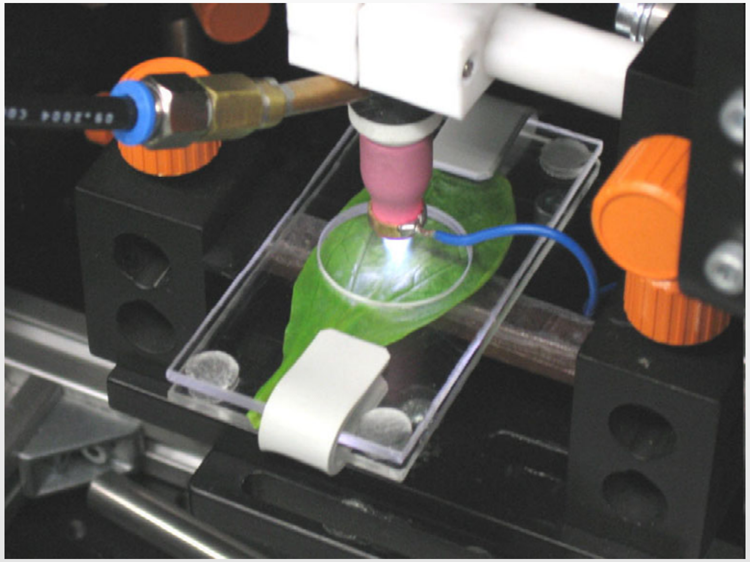
Dickdarmbereiche

- mikrobiologische Fermentation

FriPlas-Projekt

Anwendung von Plasmaverfahren zur schonenden Haltbarmachung am Beispiel verderblicher Lebensmittelprodukte in der Nachernte (FriPlas)

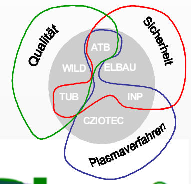
Plasma: elektrisch leitendes Gas, das aus freien Ladungsträgern (Ionen oder Elektronen) besteht

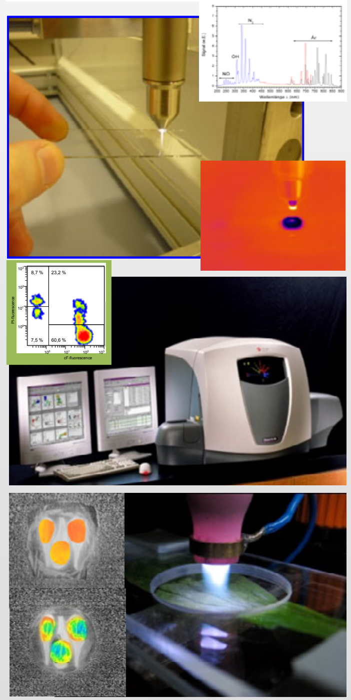


FriPlas-Projekt

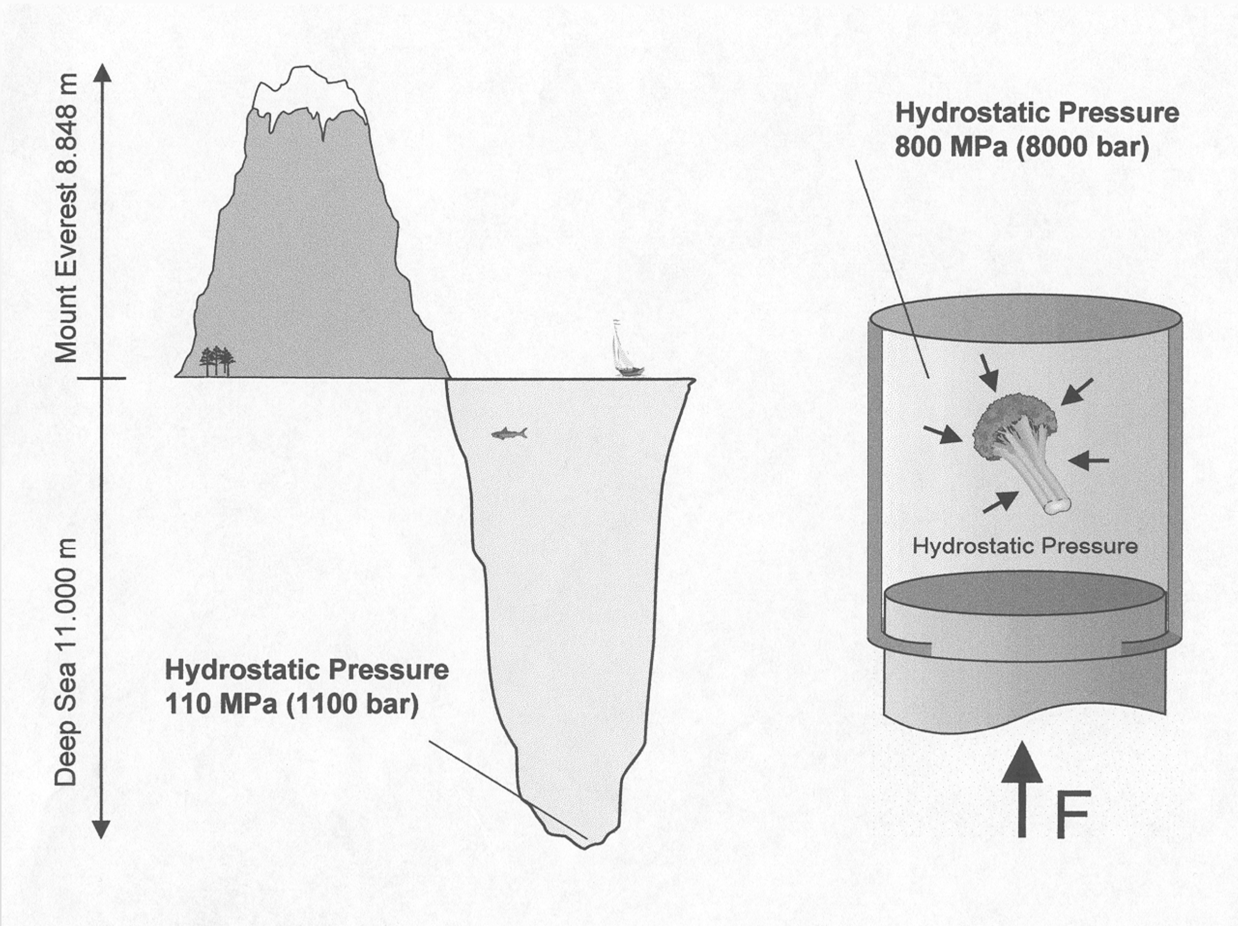
Ziele:

- Schonende Haltbarmachung leicht verderblicher Lebensmittel
- Untersuchung der antimikrobiellen Wirkung von nichtthermischen Plasmen (NTP)
- Einfluss auf Qualitätsparameter pflanzlicher Lebensmittelsysteme
- Monitoringsysteme zur Prozess- und Qualitäts-überwachung
- Längere Haltbarkeit frischer Lebensmittel und verbesserte Sicherheit



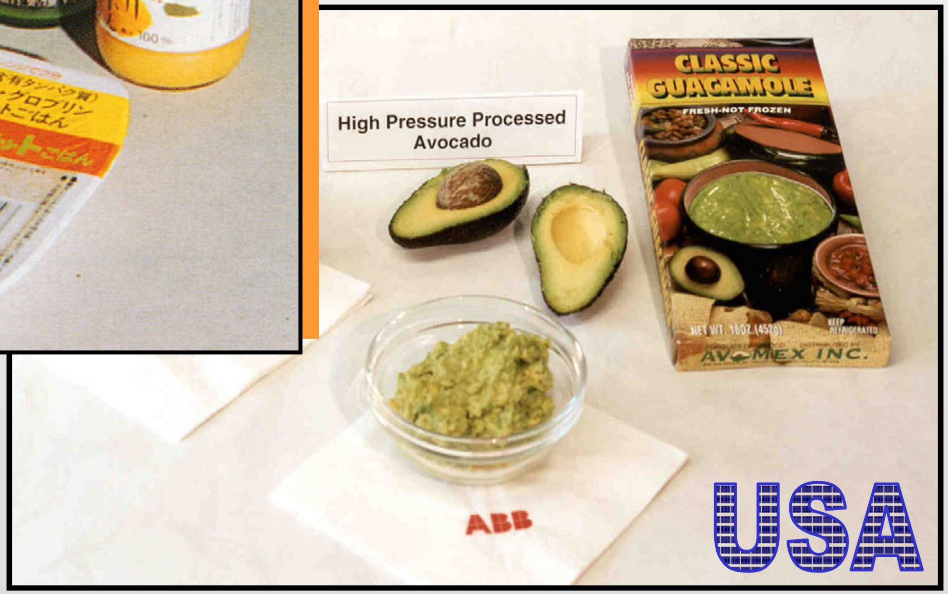


High Pressure – Scale an Principle



Products

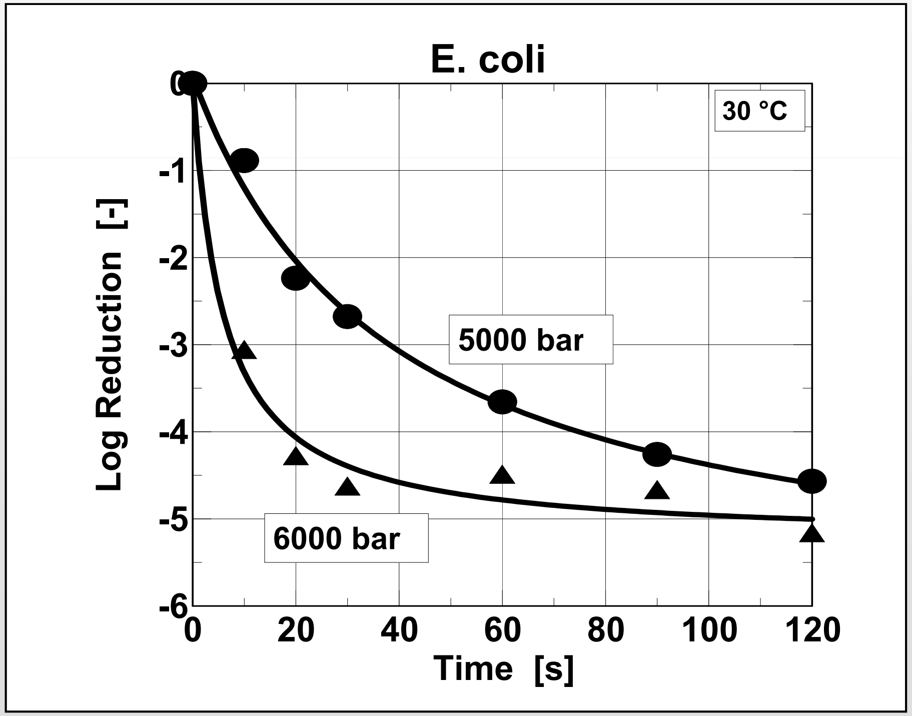

Japan
Sun Pokka
High Pressure'S
FRUIT JELLY
SAUCE

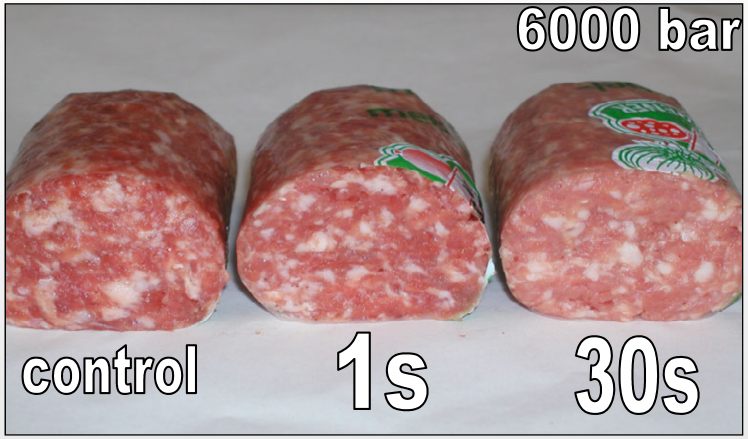

High Pressure Processed
Avocado
CLASSIC GUACAMOLE
FRESH-NOT FROZEN
AVOMEX INC.
ABB
USA

Pathogens

Kinetics

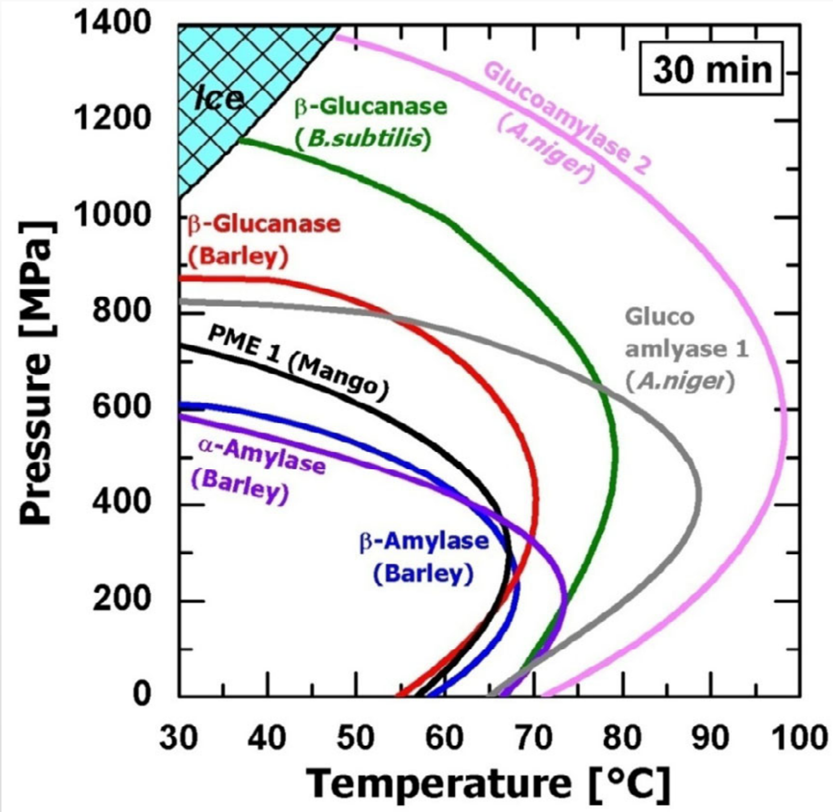
Of *E. Coli* in Raw Sausage





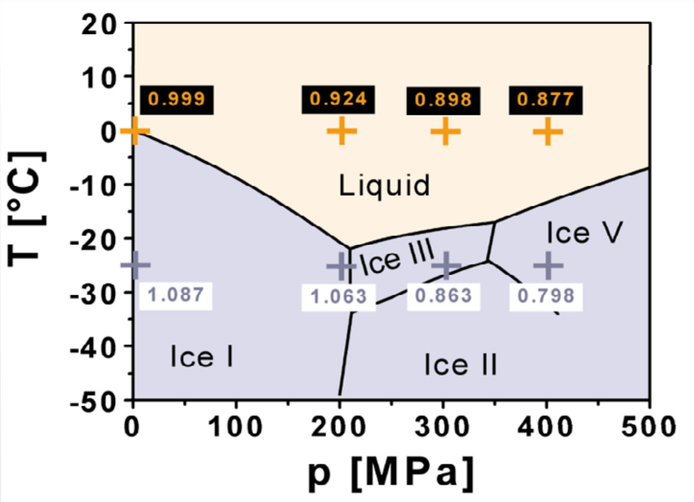
Thermo stability of enzymes under pressure

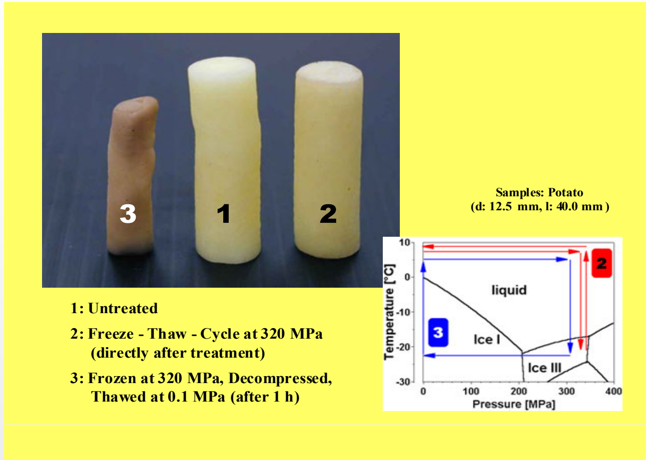
- Pressure and temperature have a strong influence on enzyme activity
- Temperature stabilization in a specific pressure range
- possible optimization and acceleration of enzyme catalyzed reaction under optimal p-T conditions

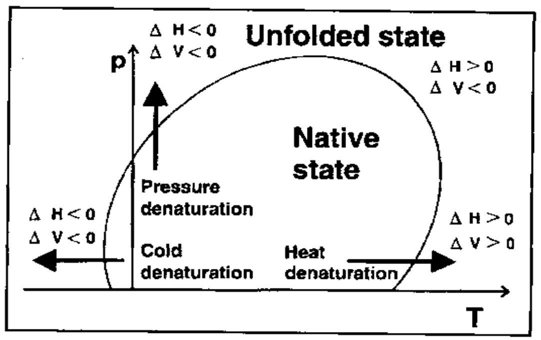


P-T plot for 95 % inactivation of different enzymes after 30 min treatment time

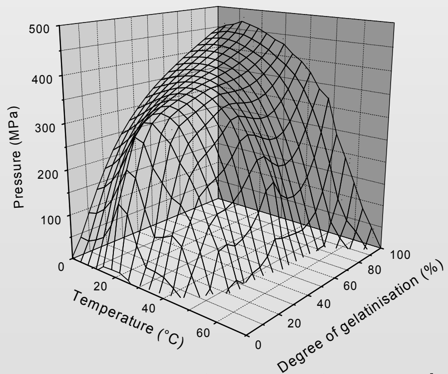
STRUCTURE ENGINEERING







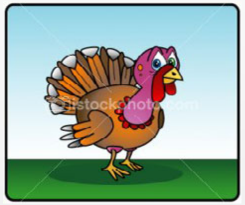
The relation between heat, cold and pressure denaturation of proteins

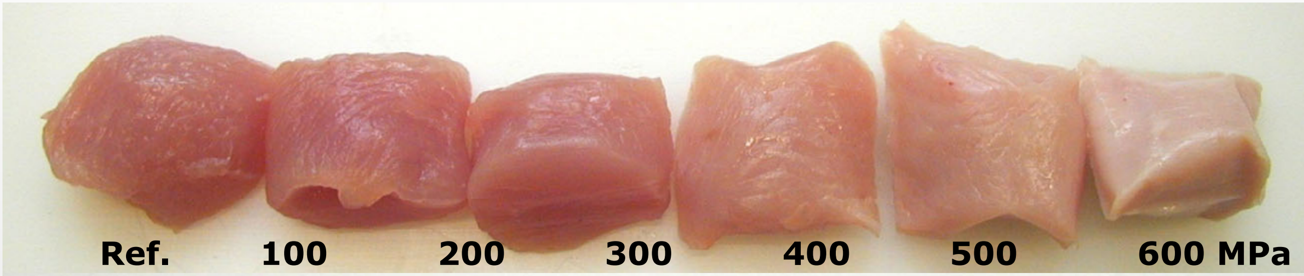


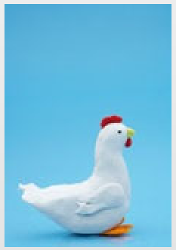
Relation between pressure, temperature and degree of gelatinisation of wheat starch suspensions (5% w/w) treated for 15 min.

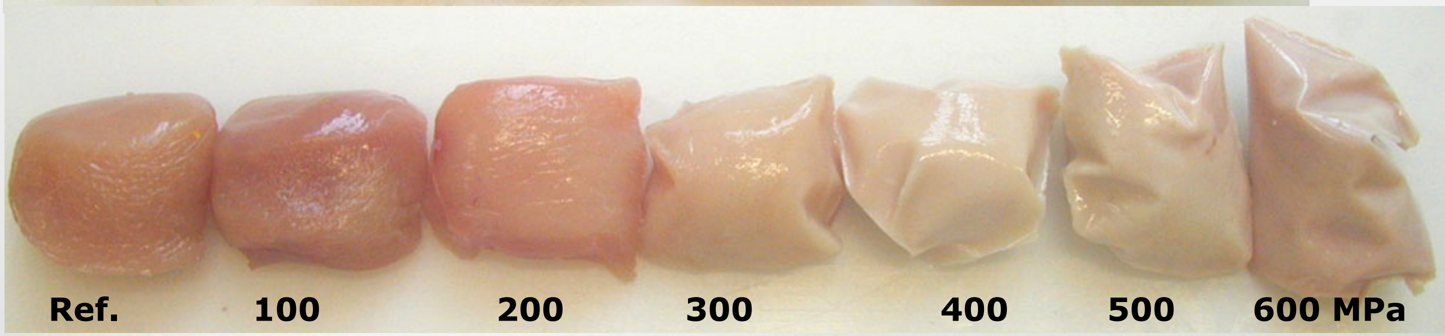
High Pressure

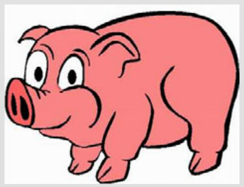
Change of meat after 1 min at 0.1-600 MPa and 25°C

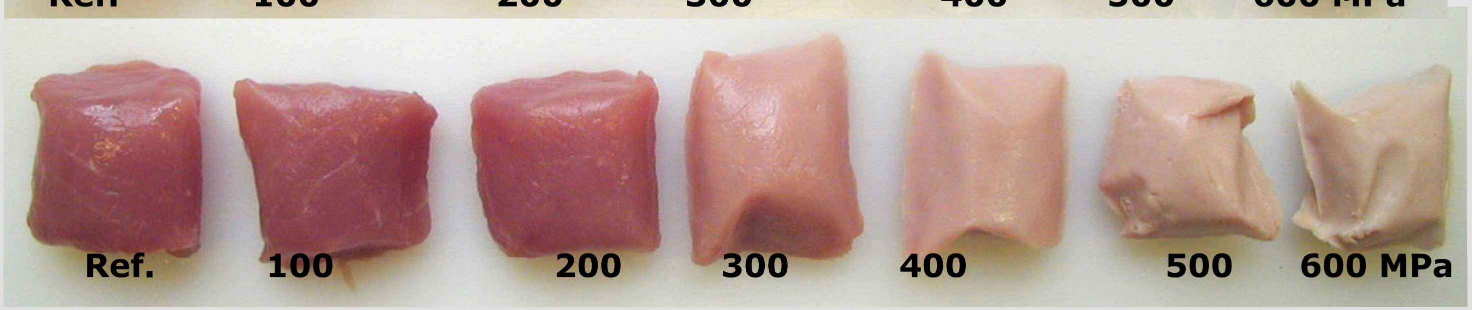












High Pressure

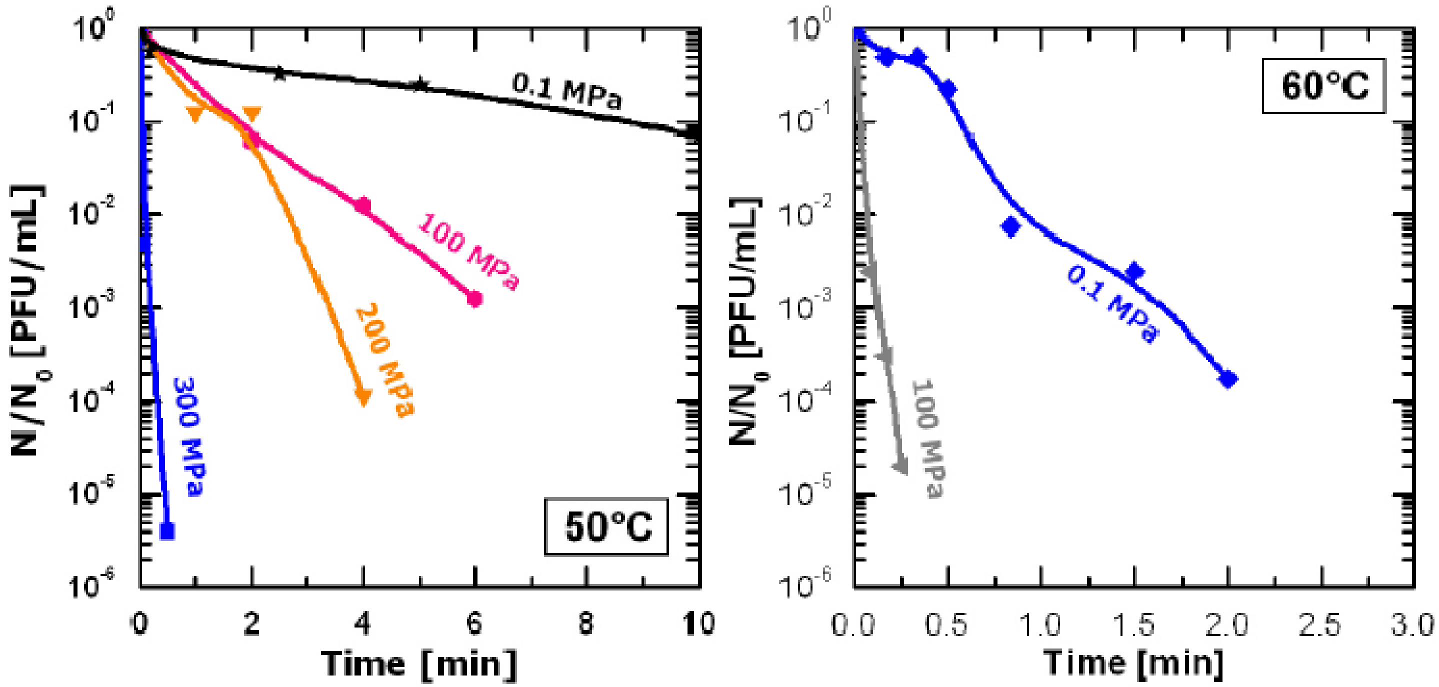
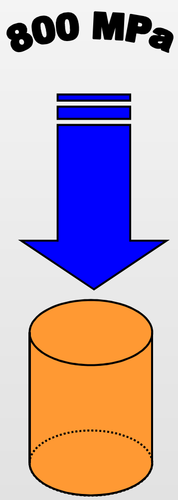
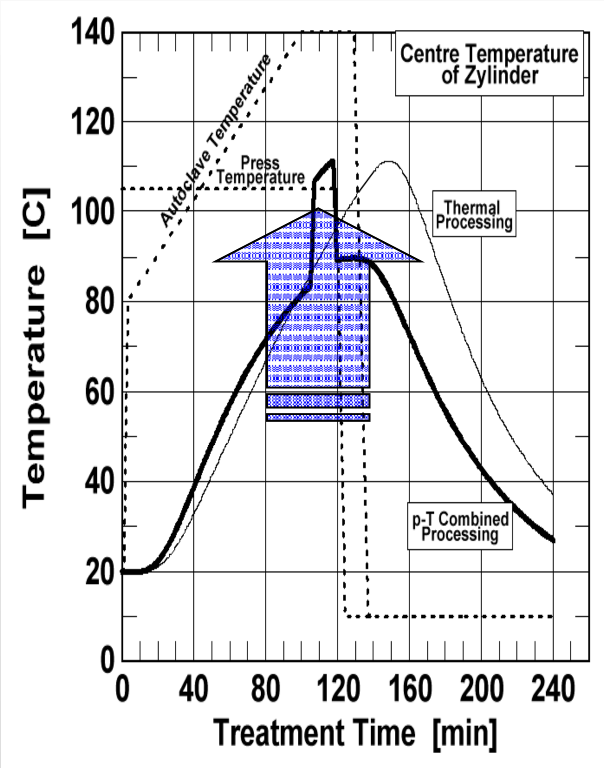


Abb.7: 1.1 Ordnung Inaktivierungskinetiken von Avian Influenza Virus (H7N7) in Hühnerfleisch bei 50°C (links) und 60°C (rechts) und verschiedenen Drücken.

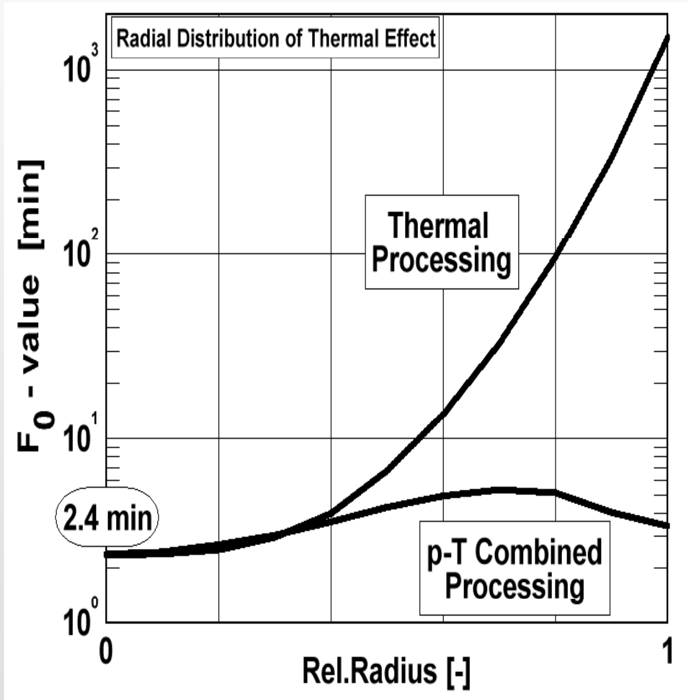
Pressure Assisted STERILISATION

Centre Temperature in Cylindrical Package (10 cm Diameter)

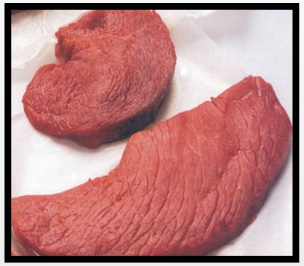


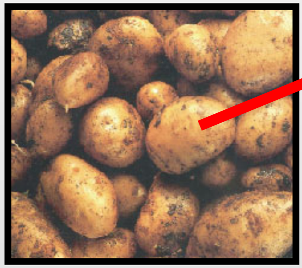


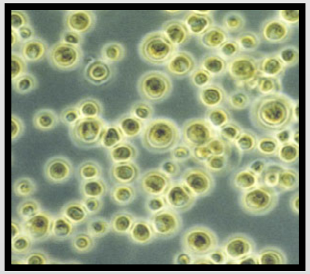
$$F = \int 10^{\frac{T(t)-T_{Ref}}{z}} dt$$

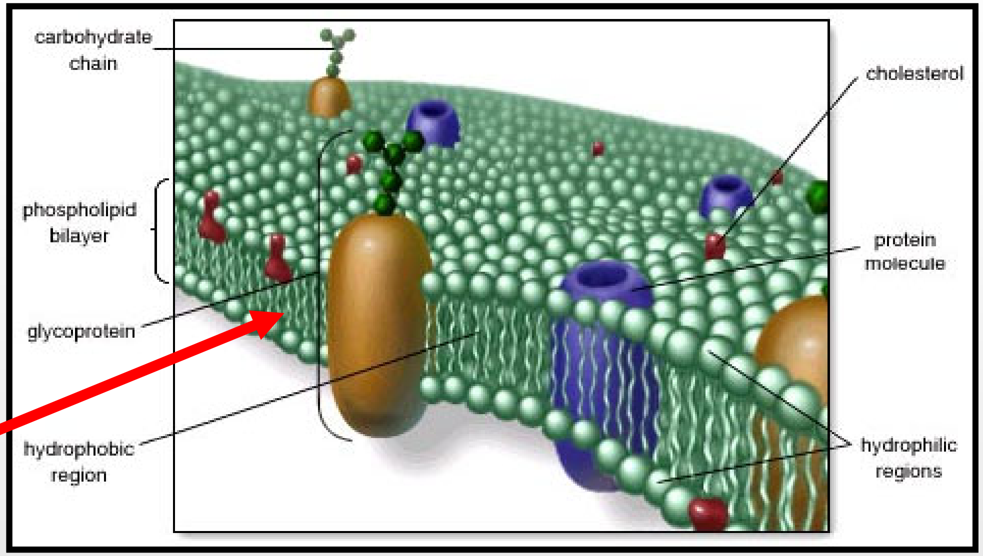


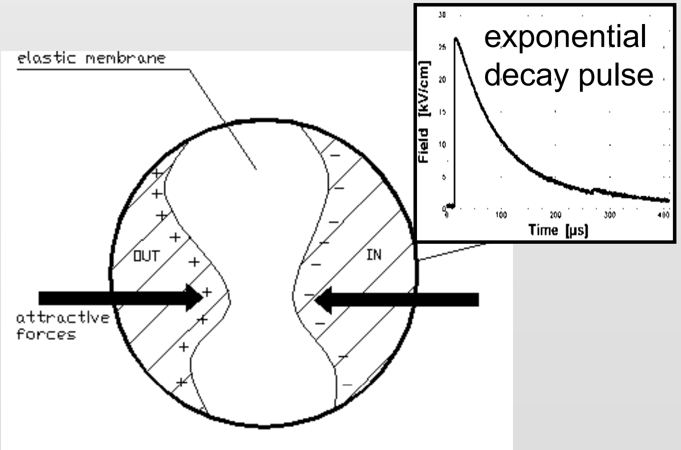
Mechanism of Electroporation





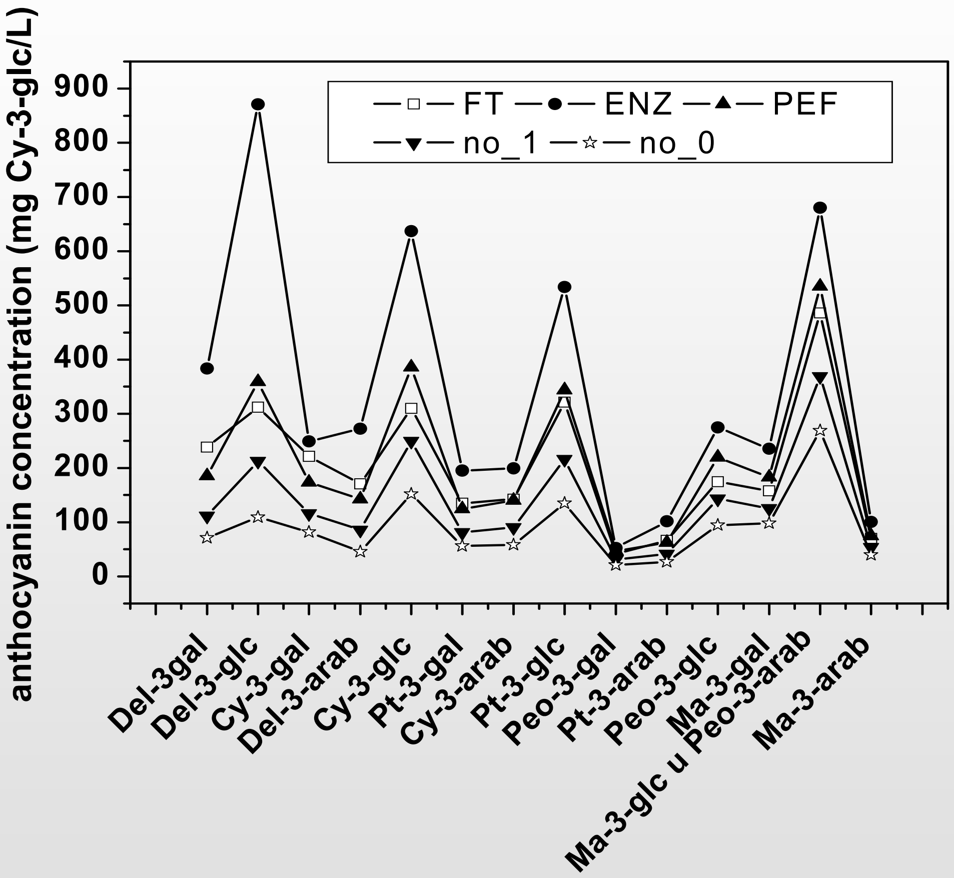


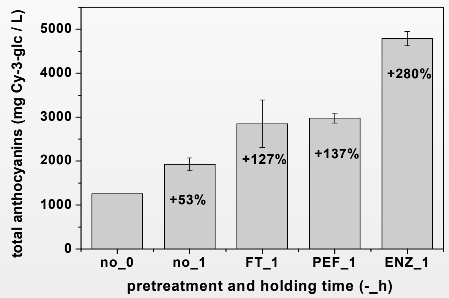




- Electric field induces charges
- compression and deformation
- pore formation occurs
- loss of physiological control systems leading to cell death

Einfluss der Maische-vorbehandlung auf das Anthocyanprofil im Saft





Gehalt einzelner Anthocyane im Presssaft von Heidelbeeren nach verschiedenen Maischebehandlungen

PEF Aufschluss von Apfelmaische – Charakterisierung des Pektin

	Control	PEF
AIS (g/100 g)	13.40[a] ± 0.11 x	13.37 ± 0.09 x
Starch (g/100 g)	3.41[b] ± 0.03 x	3.58 ± 0.09 x
AIS_{Scorr} (g/100 g)	12.07 ± 0.11	11.93 ± 0.10
DE (%)	79.89[b] ± 0.48 x	79.99 ± 0.57 x
Galacturonic acid (g/100 g)	76.88[b] ± 2.54 x	76.49 ± 1.76 x
Rhamnose (g/100 g)	1.40[c] ± 0.151 x	1.62 ± 0.083 x
Fucose (g/100 g)	0.11[c] ± 0.001 y	0.13 ± 0.001 x
Ribose (g/100 g)	0.04[c] ± 0.001 x	0.04 ± 0.002 x
Xylose (g/100 g)	1.45[c] ± 0.012 x	1.47 ± 0.015 x
Mannose (g/100 g)	0.21[c] ± 0.006 x	0.20 ± 0.004 x
Arabinose (g/100 g)	10.65[c] ± 0.074 x	10.12 ± 0.067 y
Galactose (g/100 g)	6.92[c] ± 0.021 x	7.01 ± 0.026 x
Glucose (g/100 g)	5.48[c] ± 0.012 y	5.63 ± 0.022 x
Intrinsic viscosity (dL/g)	5.34[d] ± 0.10 y	5.78 ± 0.09 x
Gelling units (GU)	3,814[c] ± 58 x	3,635 ± 111 x

Characterization of pectin extracted from pomace of unprocessed (control) and PEF-treated apple mash.

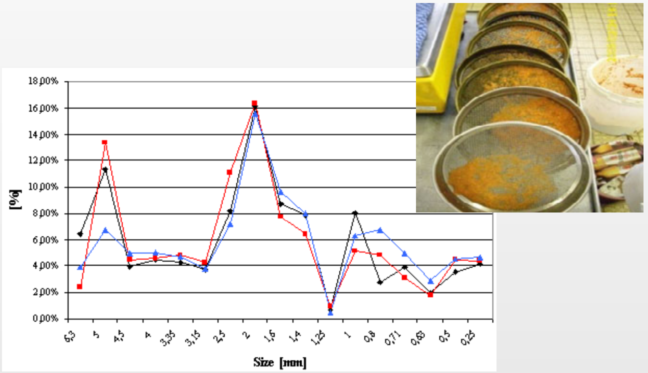
PEF and juice production – adaptation of processing steps

Apples

Carrots

Apples → Mechanical disintegration

Carrots → Mechanical disintegration



Mechanical disintegration → PEF

PEF → Packing press | Belt press | Bucher hydraulic press | Decanter

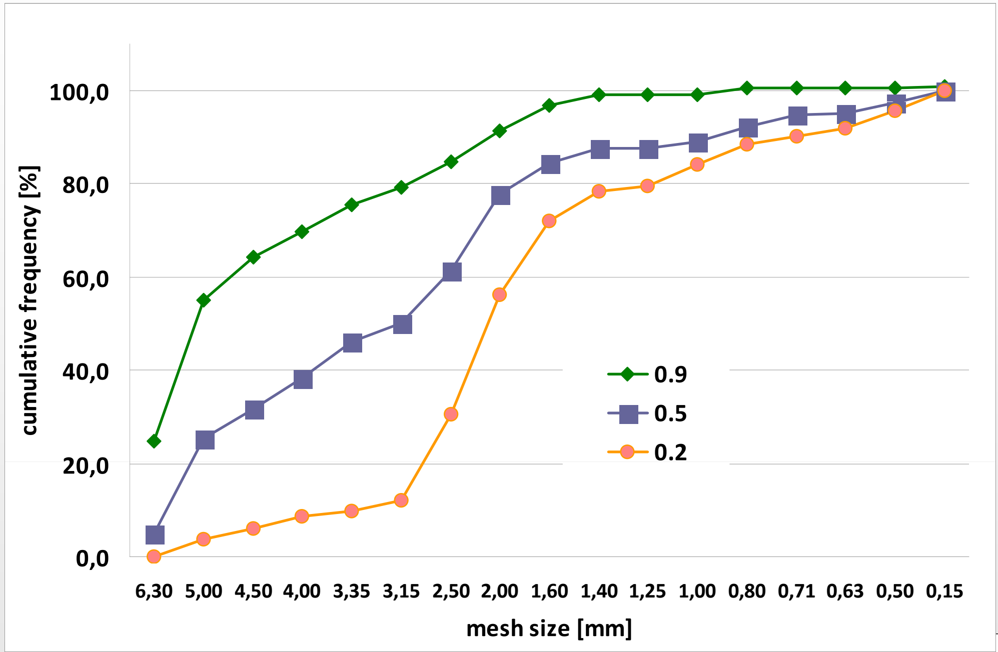
Packing press

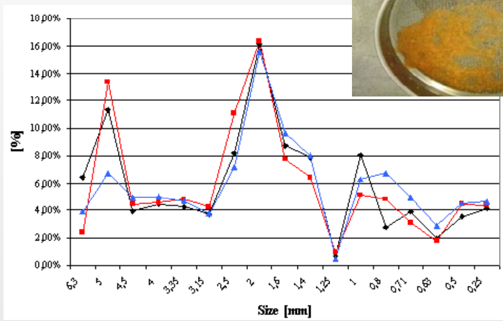
Belt press

Bucher hydraulic press

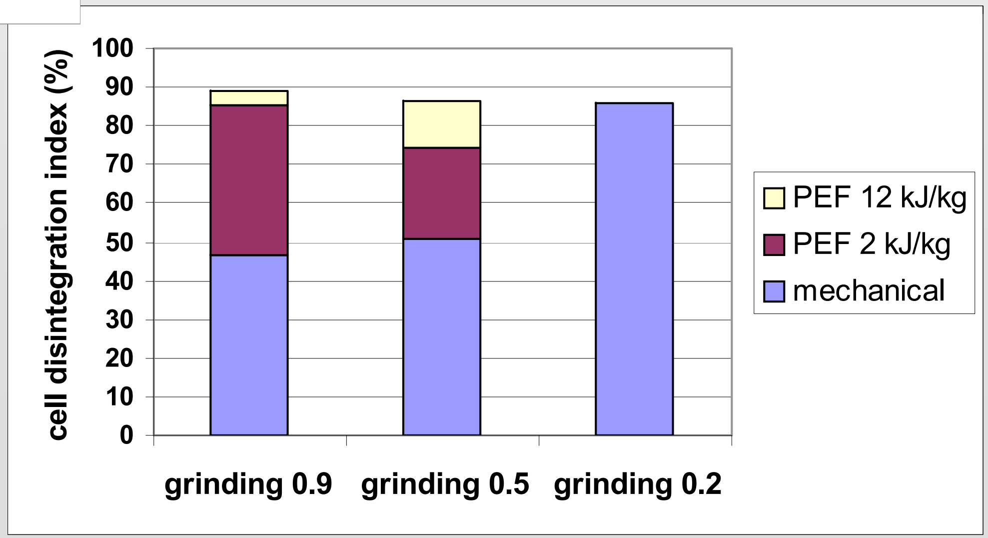
Decanter

Particle size and cell disintegration index

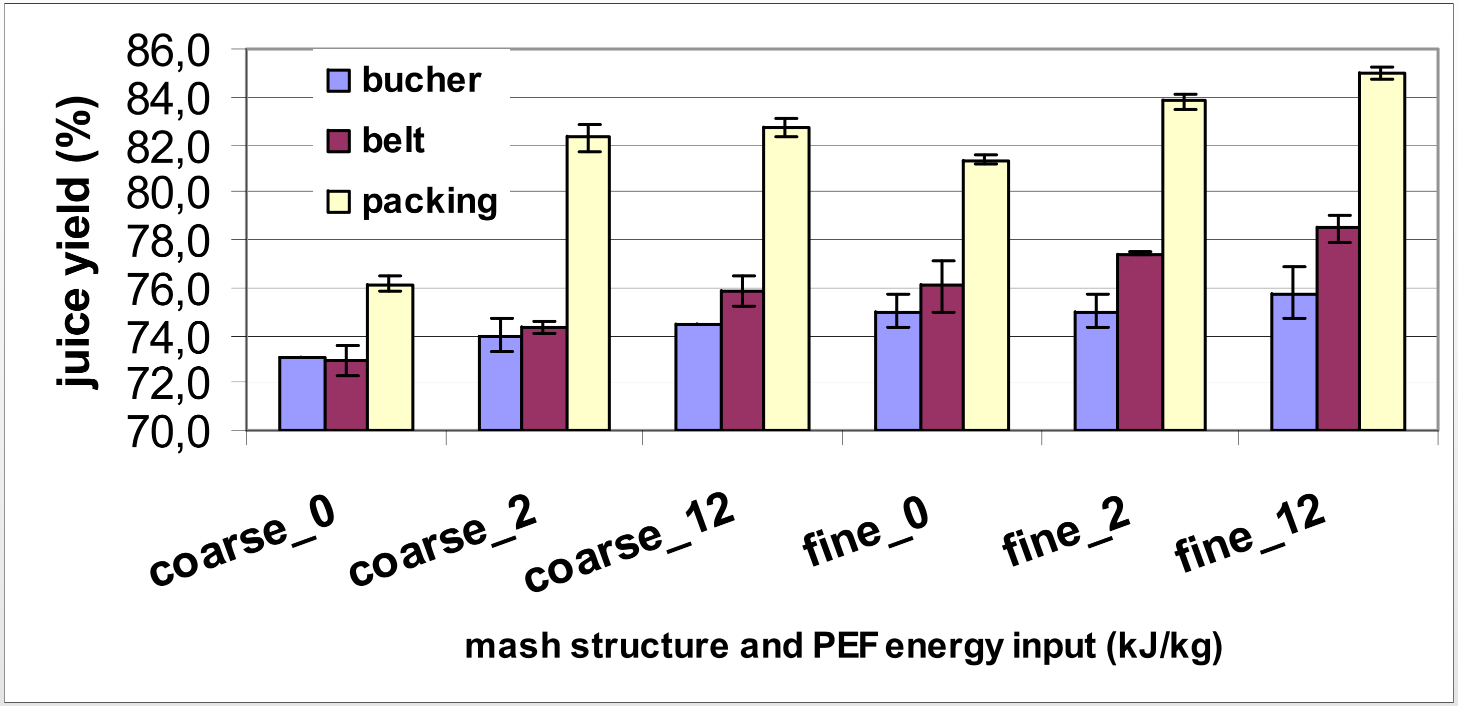


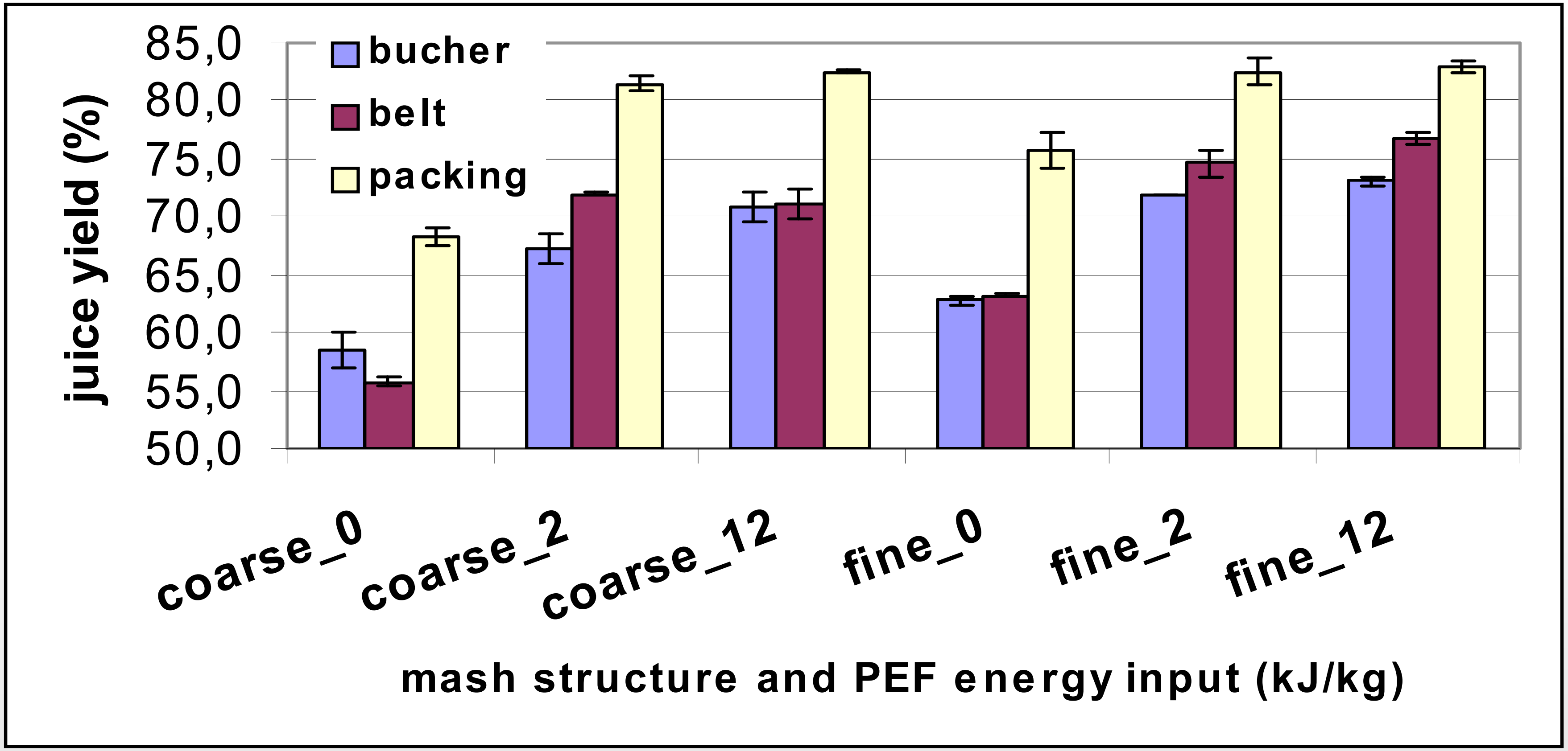


Particle size distribution
depending on grinding technology



Juice yield (apple juice)

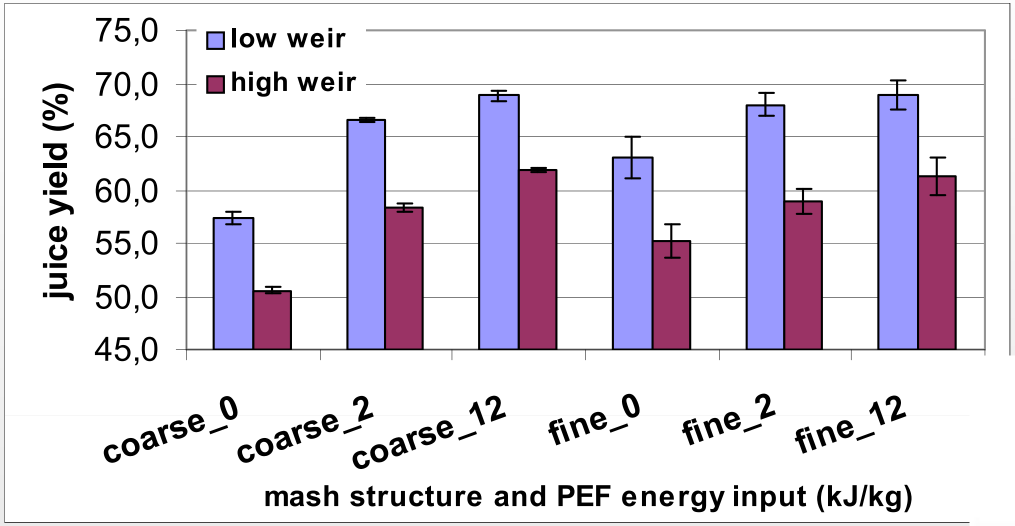




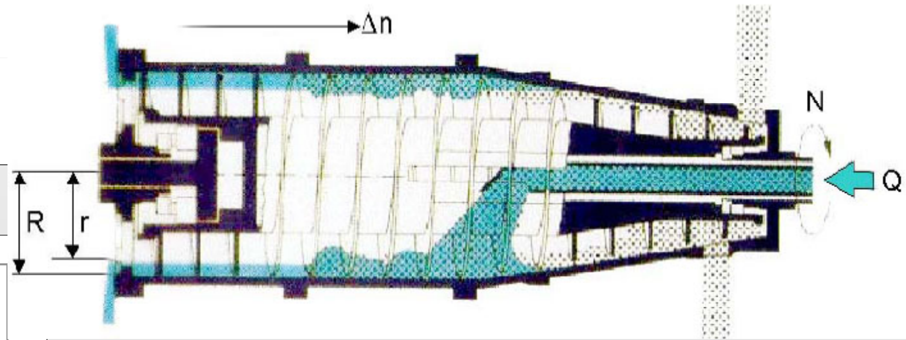
juice yield (%)
85,0
80,0
75,0
70,0
65,0
60,0
55,0
50,0
bucher
belt
packing
coarse_0
coarse_2
coarse_12
fine_0
fine_2
fine_12
mash structure and PEF energy input (kJ/kg)

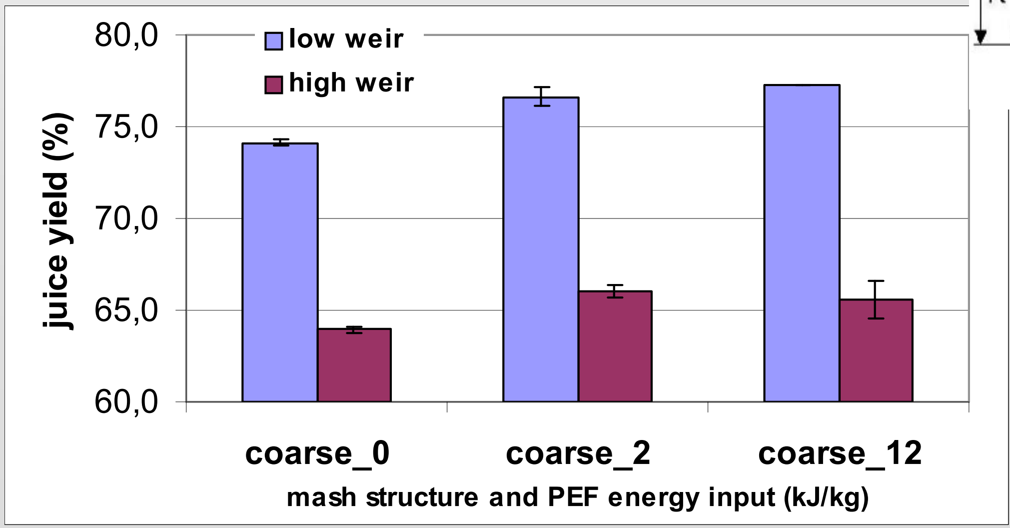
voran

Decanter processing conditions



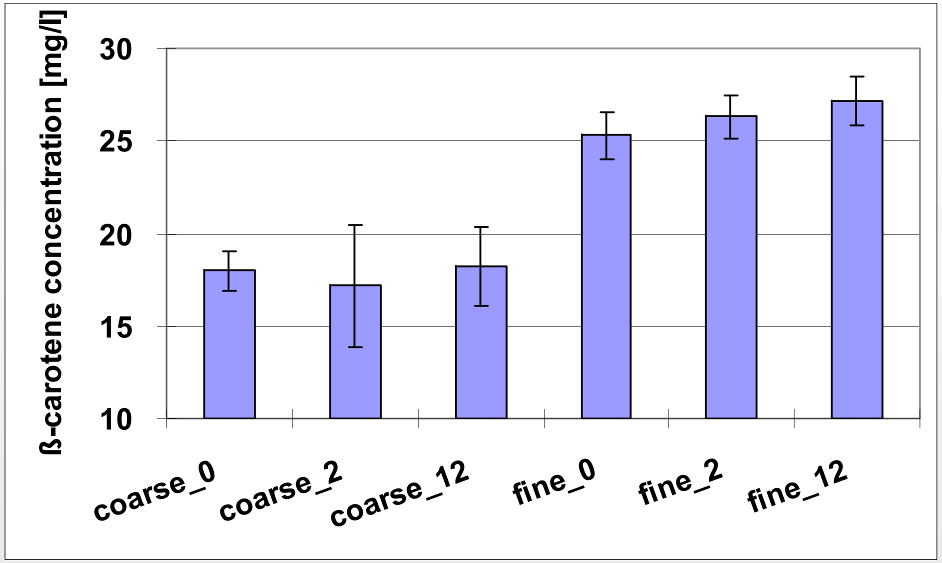
Carrot juice





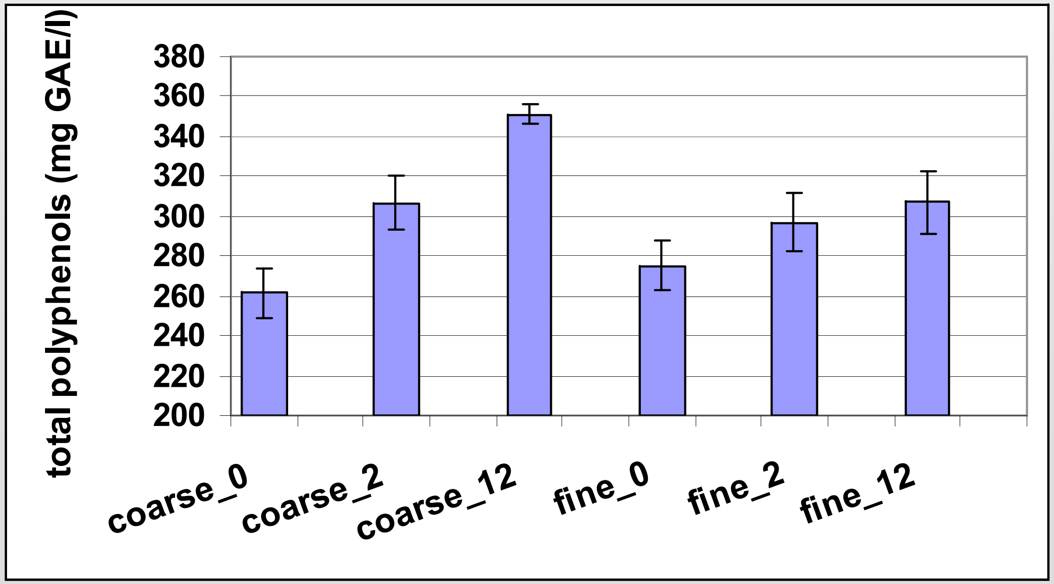
Apple juice

Juice composition



carrot juice
(belt press)
ß-carotene

apple juice
(packing press)
total polyphenols



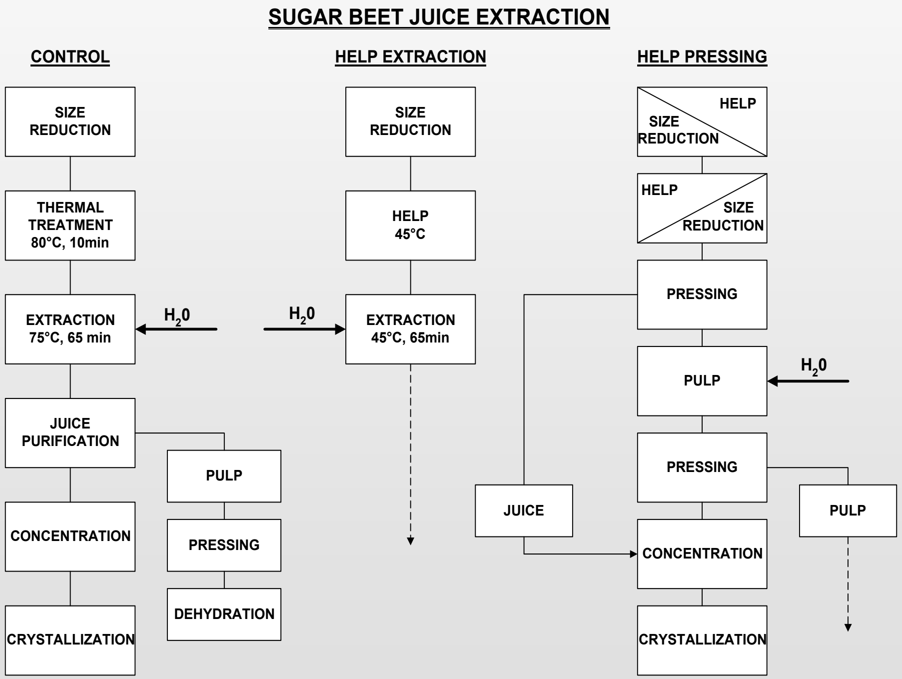
Tresternutzung

- Höhere Trestertrockenmasse
- Erhalt nativer Pektinqualtiät nach PEF-Behandlung
- Höhere Ausbeute bei der Pektinextraktion

	Unbeh	PEF
TS(%)	**23,7**	**26,4**
AIS (%)	13,9	16,1
Stärke(%)	0,41	0,83
AIS-Stärke(%)	**13,8**	**16**
Lüers 0,20%	364	442
Lüers 0,25%	564	618
Lüers 0,30%	**664**	**811**
GE 0,2-0,25%	3741	4651
GE 0,25-0,3%	**3878**	**4606**
AIS n.Ent. (%)	75,3	80,5
VE (%)	**79,0**	**78,2**
Gal (%)	**78,9**	**79,1**
Meth (%)	10,2	9,9
VE° (HPLC)(%)	75,1	74,9

Sugar Beet Processing

„COLD“ EXTRACTION OF SUGAR BEETS

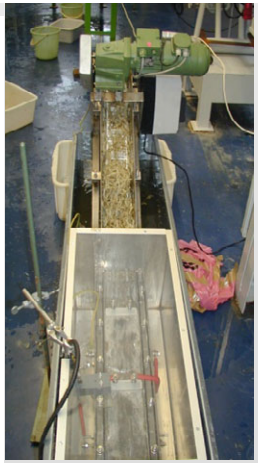


Conventional Extraction (untreated) at 70°C

- HELP + Extraction at 60°C
- HELP + Extraction at 50°C
- HELP + Extraction

1.1 tons os sugar beets

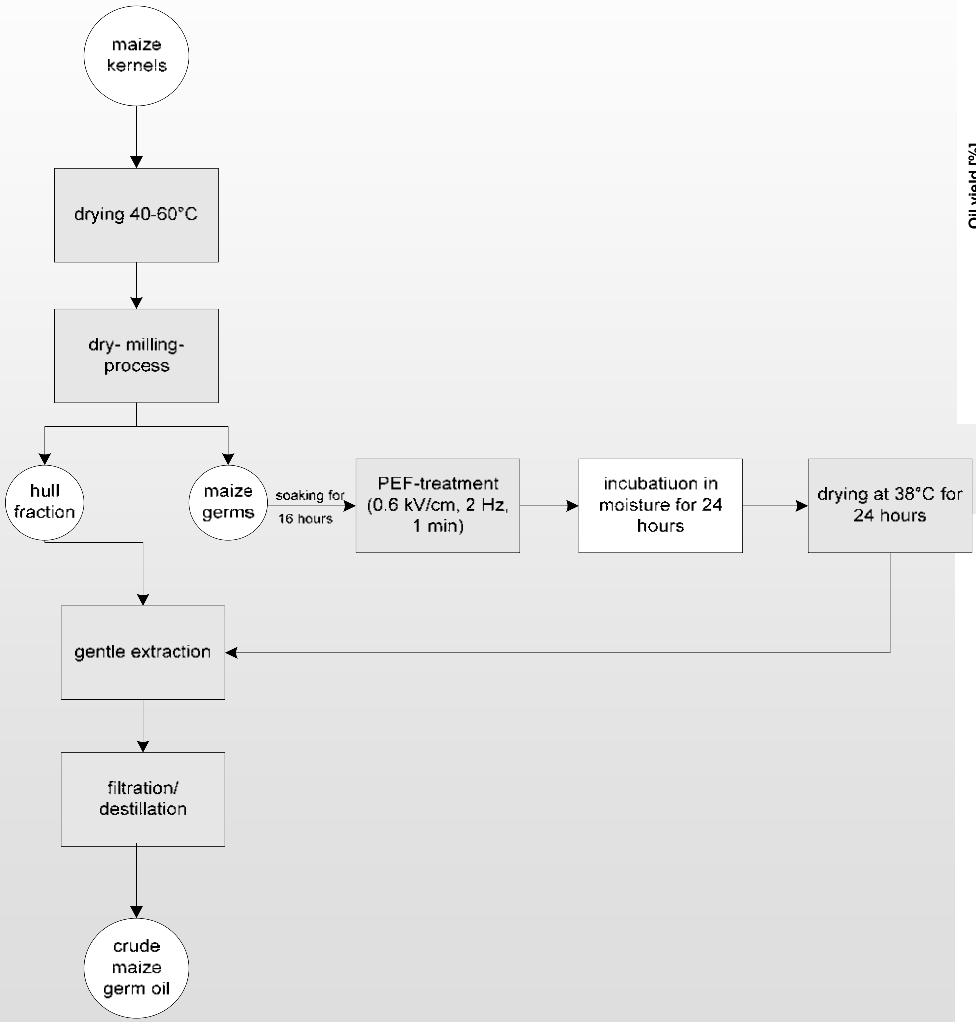
- Continuous HELP treatment, 120-130 kg/ h

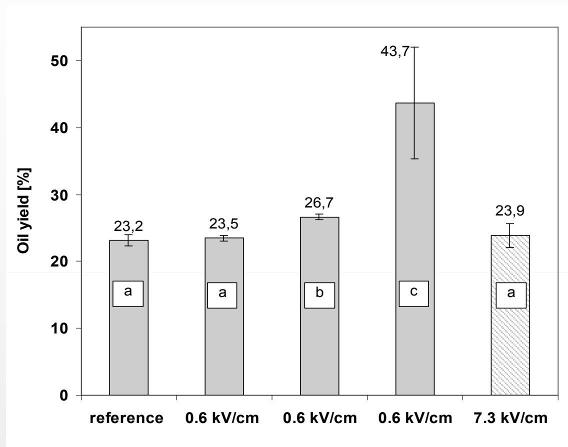


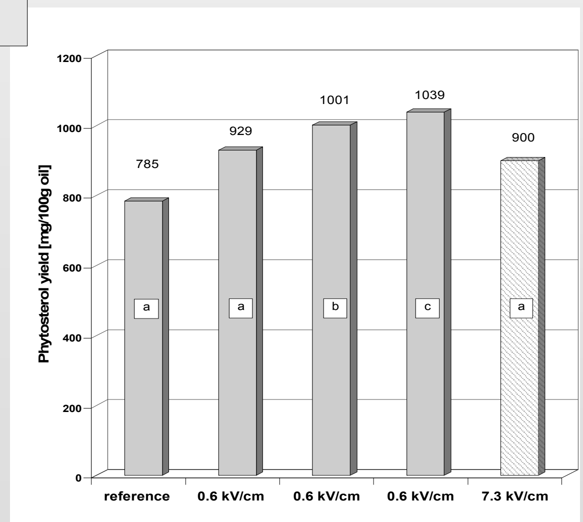
Key Results

- good extraction at HELP+ 30°C (residual suger 1.9 - 2.4 %)
- dry matter of HELP extracted cochettes substantially higher after pressing than control
- few low molecular weight substances in juice after HELP *
- * approx 100% increase of extractor capacity after
- HELP

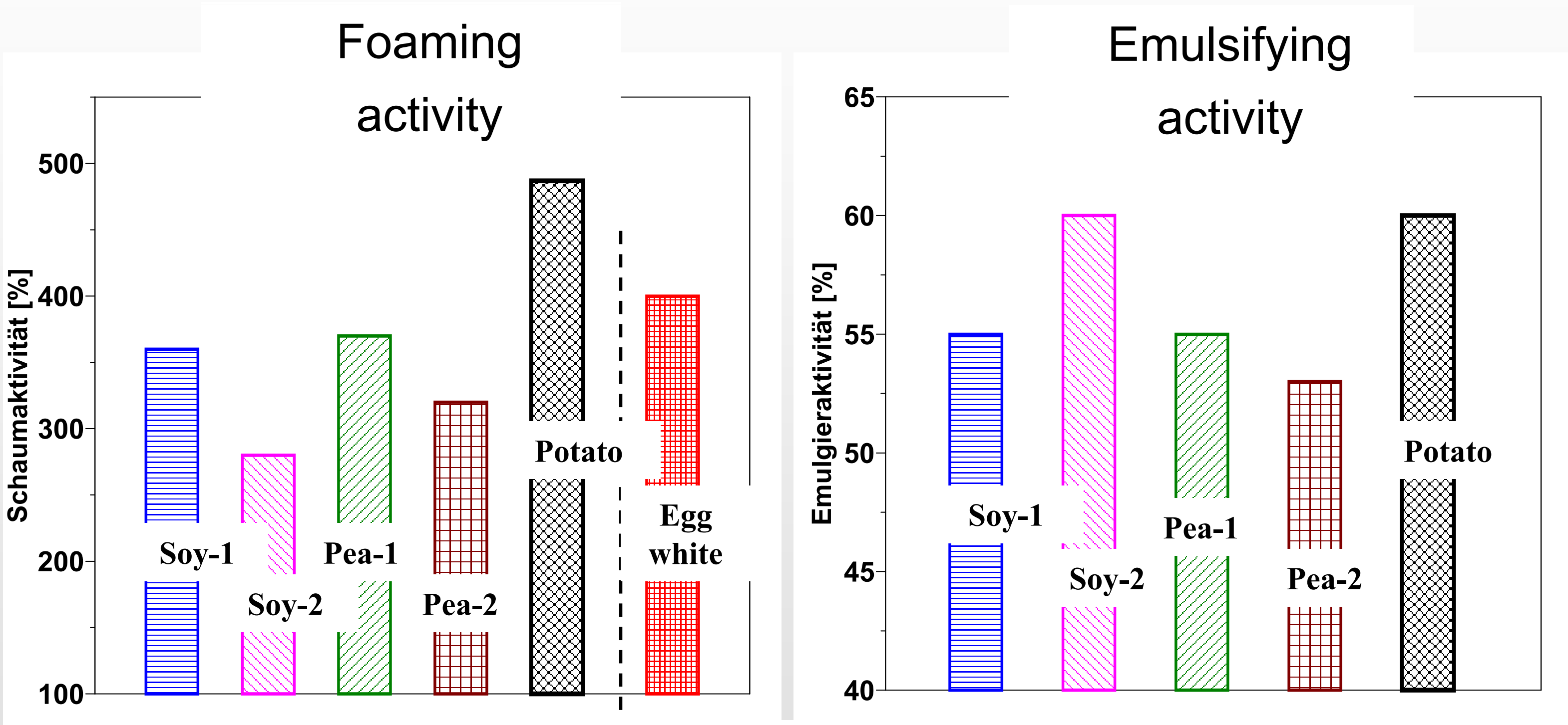
Sugar Beet Processing







Surface properties of vegetable proteins



Soy-1: Soy isolate „Supro 1711“ (Fa. Protein Technologies International, Belgian)

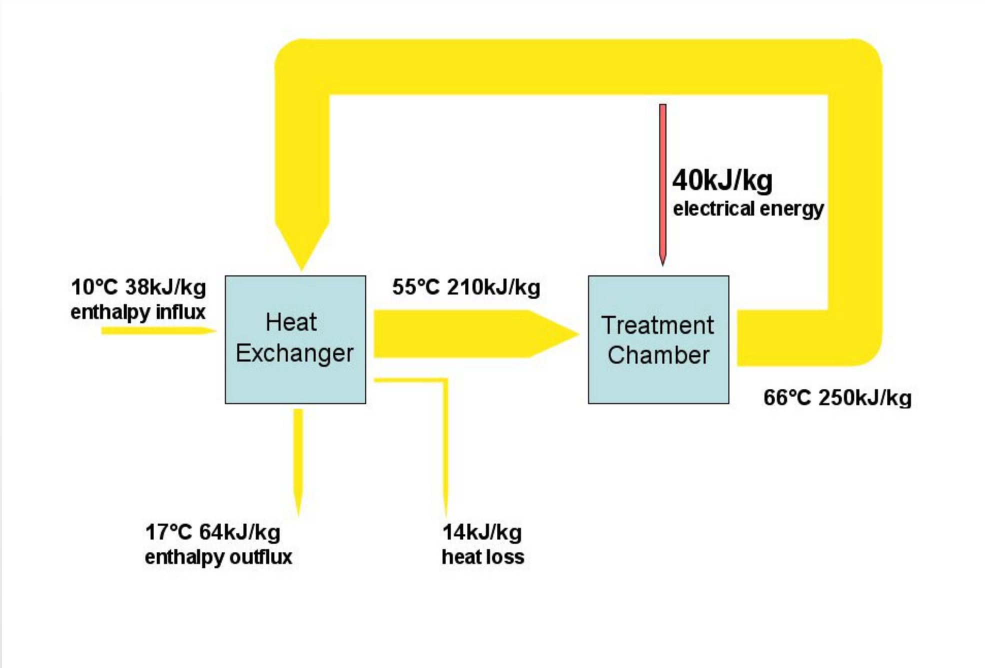
Soy-2: Soy isolate „Supro 661“ (Fa. Protein Technologies International, Belgian)

Pea-1: pea isolate „Pisane“ (Fa. Cosucra, Belgian)

Pea-2: pea isolate „Pisella HV“, (Fa. DENA, Düsseldorf)

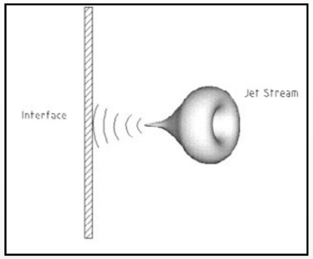
Results provided by Alexander Angersbach

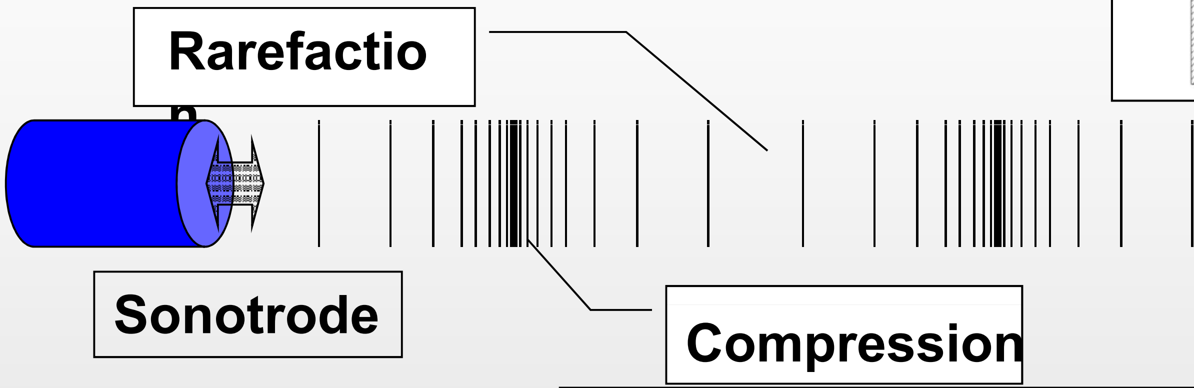
PEF-treatment of Apple Juice

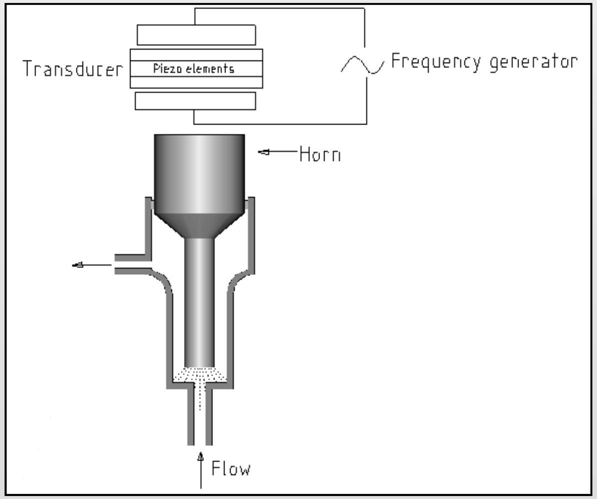


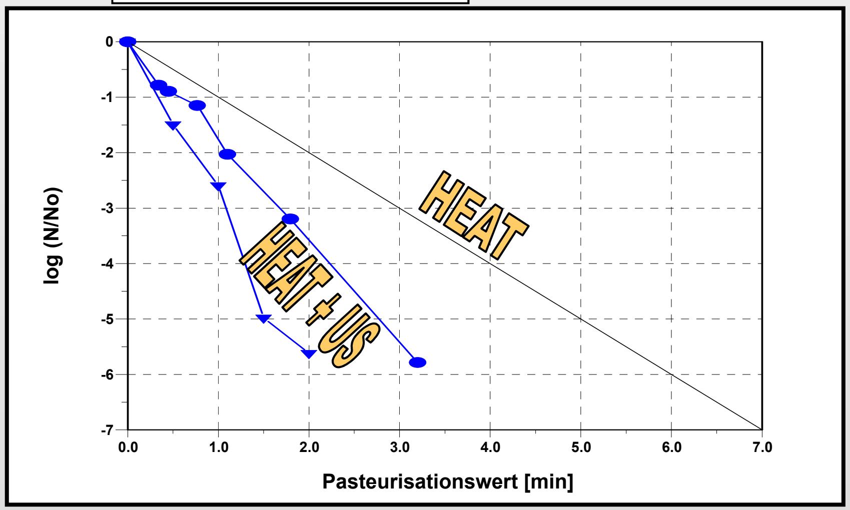
Enthalpy of a PEF-treatment of Apple Juice with an inlet temperature of 55°C and a specific energy input of 40kJ/kg. As specific heat capacity 3,8 $kJ \cdot kg^{-1} \cdot K^{-1}$ was used, the heat loss in the heat exchanger was estimated with 5%.

Ultrasonics

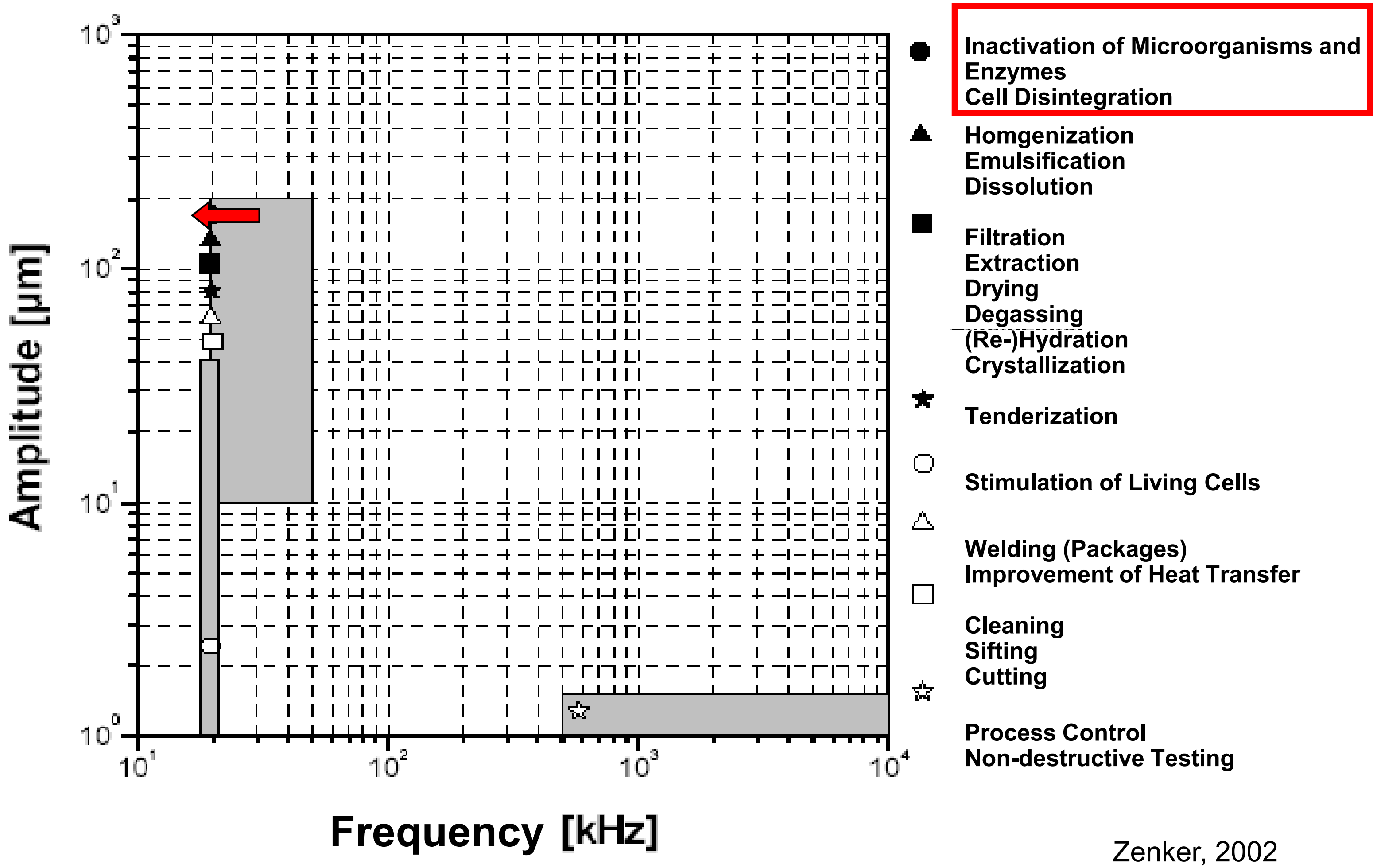








Ultrasound in Food Processing



Zenker, 2002

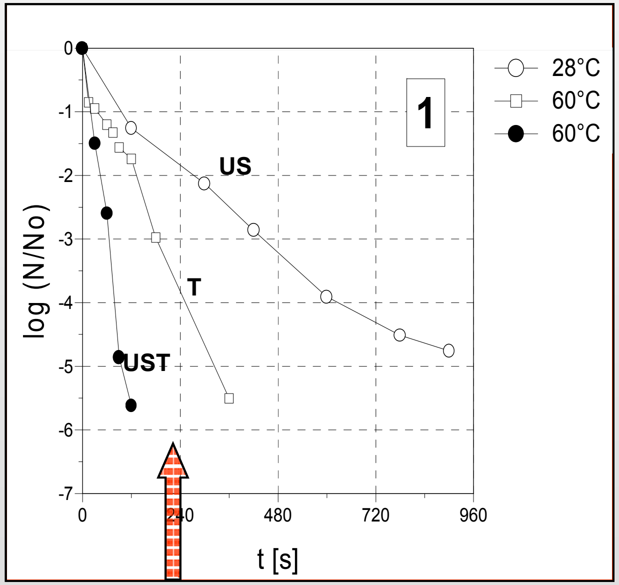
Inactivation of microorganisms

Ultrasound + Heat → Thermosonication (TS)

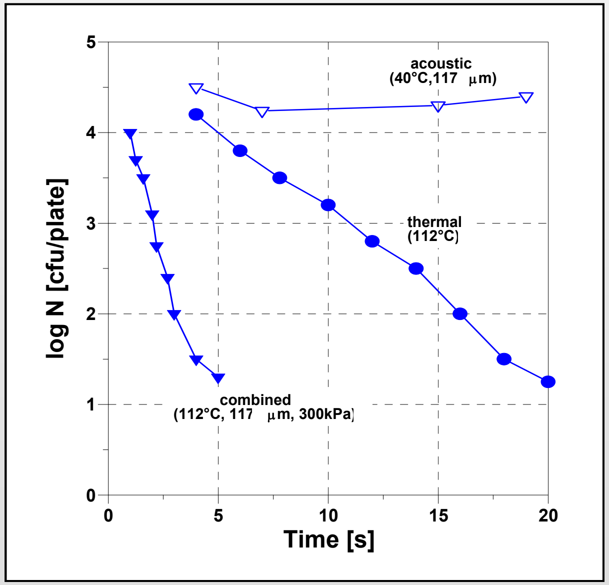
Ultrasound + Pressure → Manosonication (MS)

Ultrasound + Heat + Pressure → Manothermosonication (MTS)

TS *E. coli K12 DH 5 α* *(Zenker et al., 2004)*

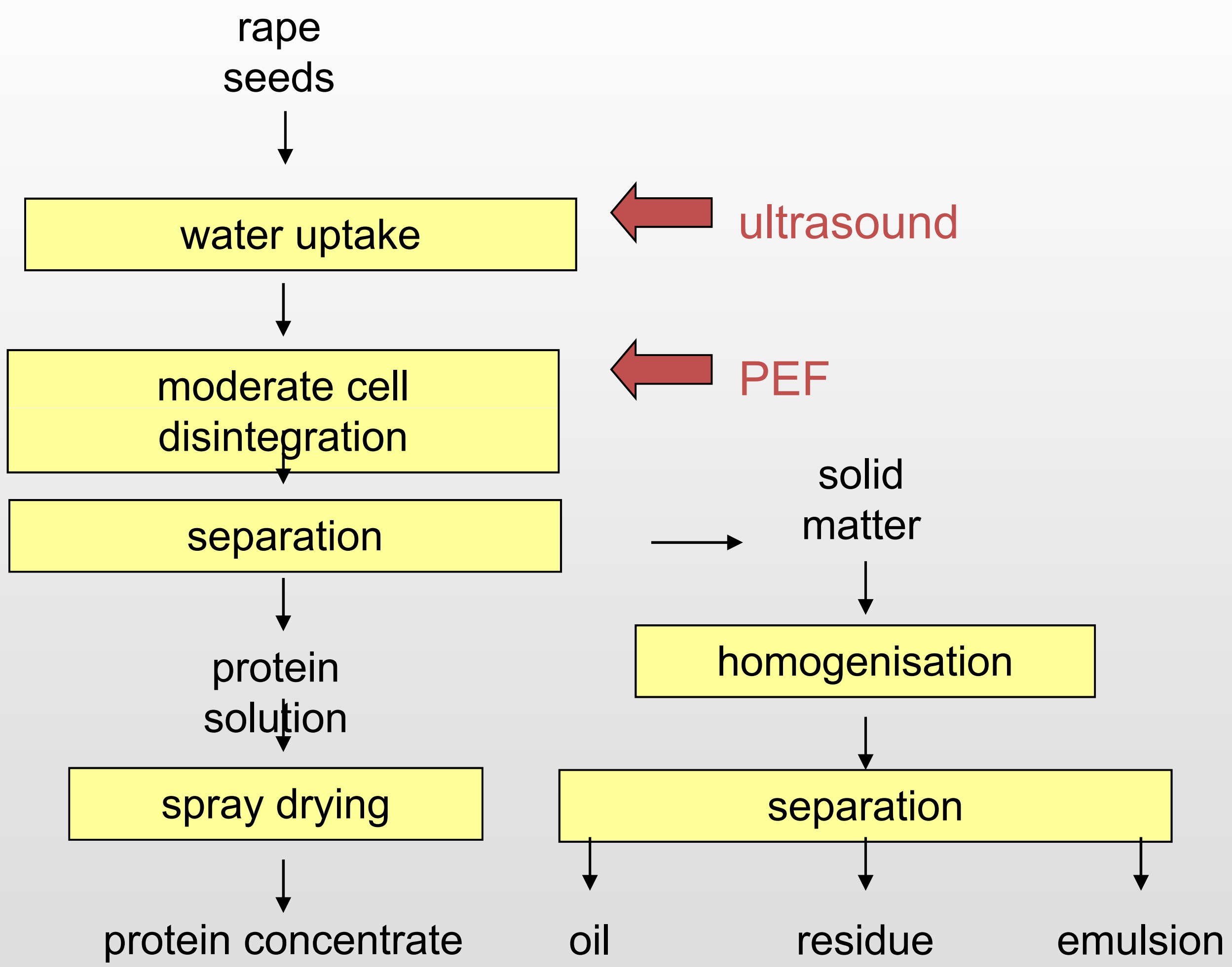


MTS ***Bacillus subtilis spores*** *(Raso et al., 1995)*

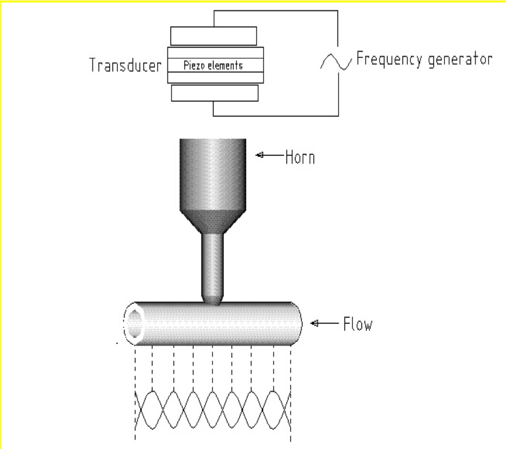


- Reduction of temperature and / or process time
- lower energy requirement, improved food quality

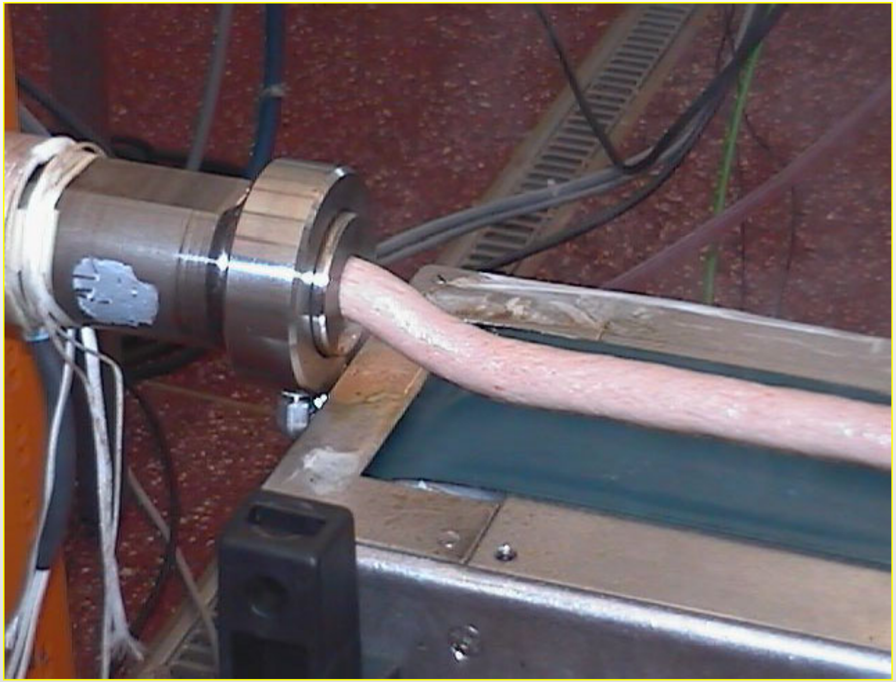
Pre-extraction of rape seed protein



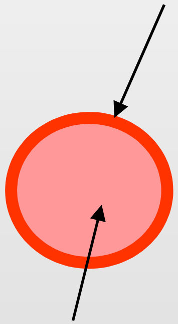
Example: Production of skinless sausage (Frankfurter type)



Heated tubular sonotrode



Skin formed by denatured proteins



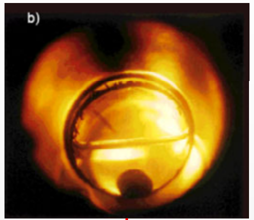
Raw emulsion

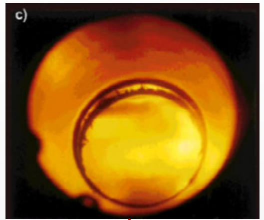
Advantage:

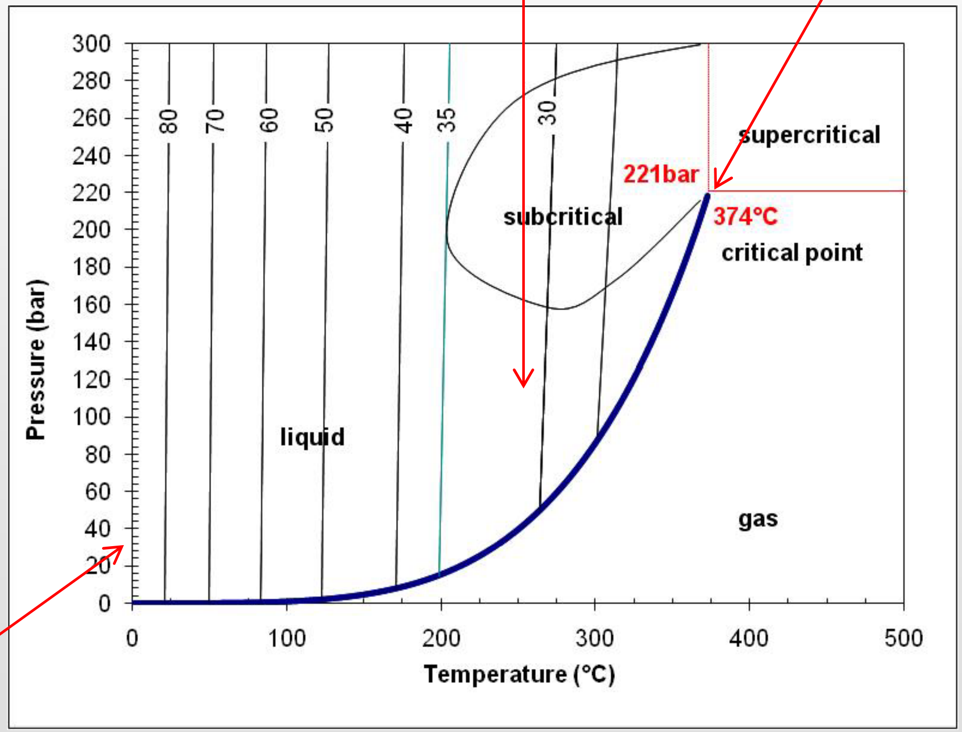
- Structure formation and pasteurization in one step
- No drip losses
- No casings

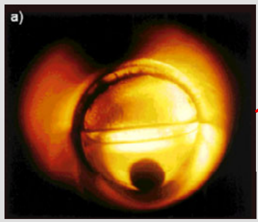
Critical point of water

- Temperature 374°C; Pressure 22.1 MPa
- Hot compressed water above 150°C







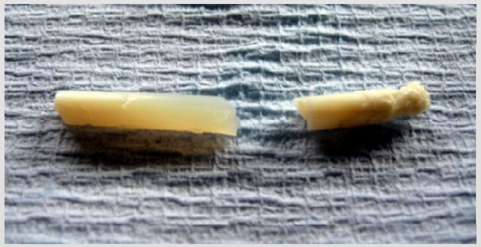


a) 25°C; b) 250°C; d) 374°C (Bröll, 2008)

Protein-Based Plastic

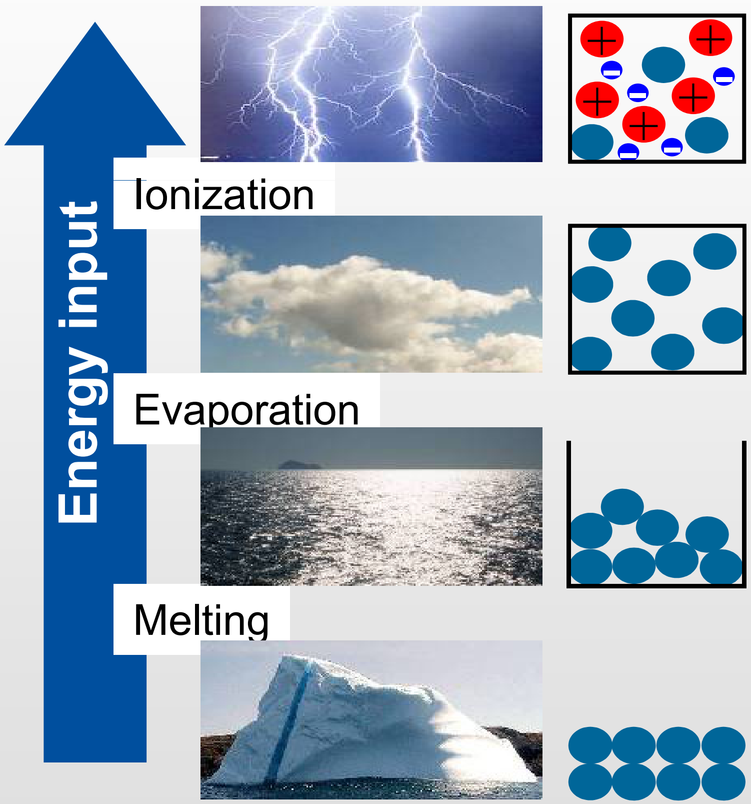
- biodegradable plastic
  synthesized from BSA
- T 250°C; t< 60s
- strong protein network
  by formation of disulfide bonds
- brittle plastic with a
  high tensile strength
- blending 10% glycerin
  increased elasticity

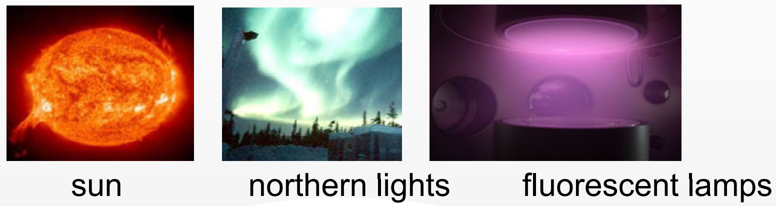
(Abdelmoez, 2007)

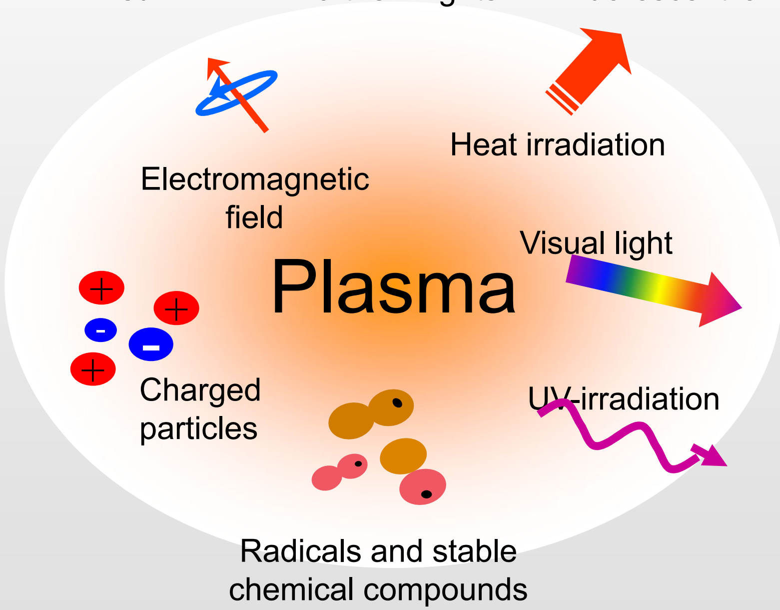


(Reineke, 2008)

Plasma - Introduction

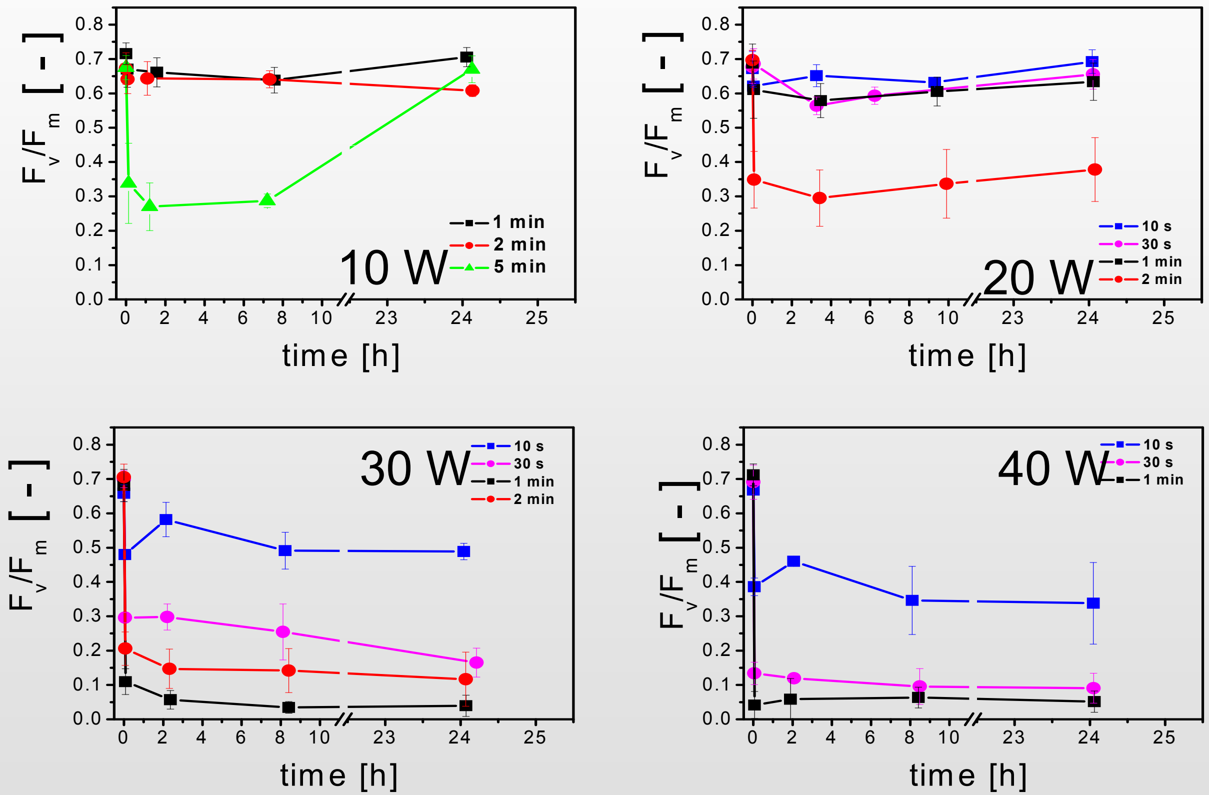




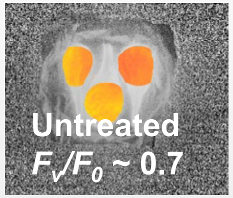


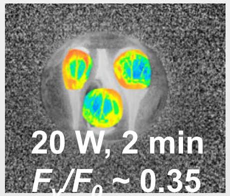
Plasma effects on perishables

Stress response indicated by F_v/F_0



Sample: Lamb's





F_v/F_m : maximum photochemical efficiency

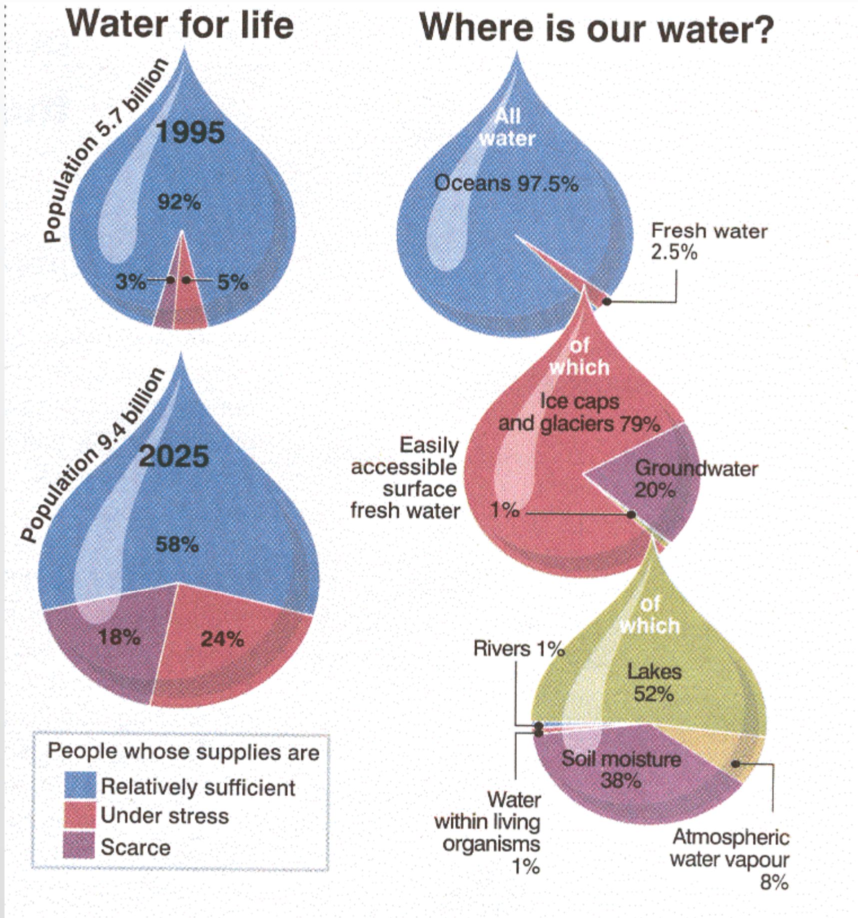
Aufbau einer Industrieplattform

- Serviceleistungen für Unternehmen
- Wissens- und Technologietransfer
- Förderung von Kooperationen
- Markt- und bedarfsorientierte Aus- und Weiterbildung

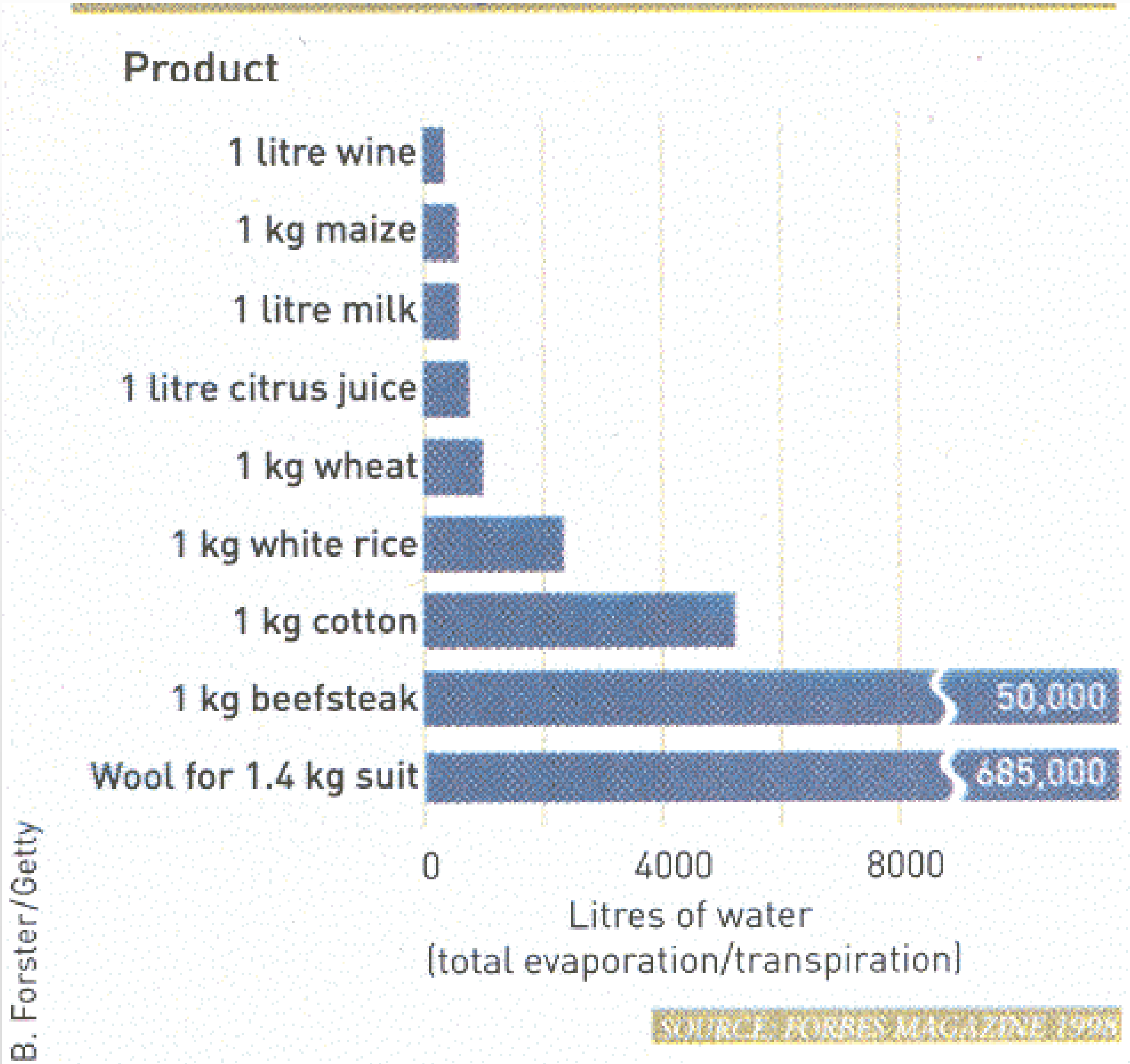
Ausblick

- Konzepte zur Herstellung präventiver Lebensmittel
- Beitrag zur Prävention ernährungsabhängiger Krankheiten
- Technologien für Gesundheit und Ernährung als Innovationstreiber für die Region
- Einbindung weiterer Partner aus Forschung und Industrie

Water for life



Water use in agriculture



Veranstaltungen

www.DLG.org/freshcut

IGE-Konferenz

Ernährungswissenschaften
in Berlin und Brandenburg
-
Innovationspotentiale für
Lebensmittel und Tierernährung

16. September 2010

TU Berlin, Hauptgebäude

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