국가 식품 클러스터 지원센터

주소 : 경기도 과천시 새술막길 10-13
홈페이지 : www.foodpolis.kr

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식품과 과학기술의 융합

제5회 국제식품클러스터포럼

The 5th International Food Cluster Forum

2015.11.17(화) 10:30-17:00 더 K호텔 크리스탈 볼룸

주최 농림축산식품부 전라북도 익산시

주관 FOODPOLIS 국가식품클러스터 지원센터

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CONTENTS

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■ 프로그램

시 간	소요시간	내 용	비 고
09:30~10:30	60’	참석자 등록	일반참가자
10:30~10:33	3’	개회 및 VIP소개	
10:33~10:35	2’	개회선언 및 개회사	조직위원장
10:35~10:37	2’	환영사	지원센터장
10:37~10:50	13’	축 사	농식품부 및 각 국가 대사
10:50~11:00	10’	농식품부 장관상 표창 및 기념촬영	수상자(5명)
11:00~11:30	30’	**[기조연설]** 식품 산업에서 제품과 가공기술의 혁신을 위한 성공요소	호르스트 크리스티안 랑고프스키
11:30~12:10	40’	**[품질안전 - Part 1]** 식품식품 포장재의 살균 방법 및 무균 충진 공정 검증	캐롤린 하우저
12:10~13:20	70’	중 식	중식제공
13:20~14:00	40’	**[기능성 - Part 1]** 혁신 가공기술이 적용된 최상의 기호도를 가진 건강 편의식 개발	크리스티안 차켈
14:00~14:40	40’	**[패키징 - Part 1]** 식품 포장재 안전성 평가 기술 (나노물질, 이취, 법적동등성) 등	롤란드 프란츠
14:40~15:00	20’	Coffee break	
15:00~15:40	40’	**[품질안전 - Part 2]** 식품의 품질개선 및 유통기한 연장	캐롤린 하우저
15:40~16:20	40’	**[기능성 - Part 2]** 식품 맞춤형 기능성 물질 (천연 물질의 추출, 분리, 개량기술)	크리스티안 차켈
16:20~17:00	40’	**[패키징 - Part 2]** 포장을 통한 제품의 가치 향상	클라우스 놀러
17:00		폐회	
17:00~18:00	60’	기업맞춤형 1대1 기술면담	사전신청

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Program

Time	Lead Time	Content	Host
09:30~10:30	60’	Registration	
10:30~10:33	3’	Opening & VIP introduce	
10:33~10:35	2’	Opening Remark	Chairman of organizer
10:35~10:37	2’	Welcome Remark	CEO of AnFc
10:37~10:40	13’	Congratulatory Remark	Minister of MAFRA, Ambassadors
10:50~11:00	10’	Minister’s Commendation	Minister
11:00~11:30	30’	**[Keynote Speech]** Success Factors for Product and Process Innovations in the Food Sector	Dr. Horst-Christian Langowski
11:30~12:10	40’	**[Quality and Safety - Part 1]** Decontamination methods for food / food packaging and aseptic filling validation	Dr. Carolin Hauser
12:10~13:20	70’	Chinese Cuisine	Lunch
13:20~14:00	40’	**[Functional Foods - Part 1]** Development of healthy and convenient food products with innovative technological processes, optimized for maximal taste	Christian Zacherl
14:00~14:40	40’	**[Food Packaging - Part 1]** Food content materials(FCM) – chemical migration, compliance and safety assessment	Dr. Roland Franz
14:40~15:00	20’	Coffee Break	
15:00~15:40	40’	**[Quality and Safety - Part 2]** Quality enhancement and shelf-life prolongation of food	Dr. Carolin Hauser
15:40~16:20	40’	**[Functional Foods - Part 2]** Tailor-made functional ingredients for foods – extraction, fractionation and modification	Christian Zacherl
16:20~17:00	40’	**[Food Packaging - Part 2]** Enhanced product protection – active packaging functions for improved product protection	Dr. Klaus Noller
17:00		Closing	
17:00~18:00	60’	Tailored technical consulting with participants	Fraunfoher IVV

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■ 연사 소개

호르스트 크리스티안 랑고프스키 박사

강연	기조강연
분야	식품전반[포장]

주제 식품산업에서 제품 및 가공기술의 혁신을 위한 성공요소

이력 사항

1973 – 1980
독일, 핸노버 대학에서 물리학 전공

1981 – 1991
필립스 그룹에서 광정보저장기기 분야의 개발 기술자 와 프로젝트 매니저로서 일을 했었습니다.

1985 – 1989
동시에 – 독일 핸노버 대학에서 박사 학위 논문
학위 : 이학박사

1991
프라운호퍼 기관의 과학자

1992
프라운호퍼 기관의 부서의 부장

2003
뮌헨공과대학교에서 교수직, 식품 포장 기술의 의장

2004
프라운호퍼 기관의 실장 대행

2006
양조업과 식품 기술 학장

2007
프라운호퍼 기관의 실장

추가 내용

1. EMA(The European Metallizers Association)집행위원
2. The Bavarian State Brewery Weihenstephan의 위원
   압축기술(독일 기술자 협회(VDI)와 성형 기술) 자문위원회의 일원

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■ Introduce A Lecture

Dr. Horst-Christian Langowski

Lecture	KeyNote Speech
Area	Overall Food [Packaging]

Theme 1 Success Factors for Product and Process Innovations in the Food Sector

Curriculum Vitae

1973 – 1980
Studies of Physics at the University of Hannover, Germany

1981 – 1991
Development engineer and project manager in the sector of
optical data storage (CD, CD-ROM, CD-R) for a company of the Philips Group

1985 – 1989
Parallel: Doctoral Thesis at the University of Hannover, Germany
Degree: Dr. rer. nat.

1991
Scientist at the Fraunhofer-Institute for Process Engineering and Packaging IVV, Freising

1992
Head of Department at the Fraunhofer-Institute for Process Engineering and Packaging IVV, Freising

2003
Professor at the TU Munich, Chair of Food Packaging Technology

2004
Acting Director of the Fraunhofer-Institute for Process Engineering and Packaging IVV, Freising

2006
Study Dean of the school of Brewing and Food Technology

2007
Director of the Fraunhofer-Institute for Process Engineering and Packaging IVV, Freising

Additional Functions

Executive Committee of the European Metallizers Association
Board member of the Bavarian State Brewery Weihenstephan
Member of the advisory committee Extrusion Technology
within the VDI, group plastics technology

■ 연사 소개

캐롤린 하우저 박사

강연	기술강연
분야	식품 품질 안전

주제 1 식품/식품 포장에 대한 오염 제거 방법 및 무균 충진의 유효성
- 식품 – 예) 광선, 고주파 가열
- 포장 – 예) 플라즈마, H202
- 무균 충진 확인

주제 2 식품의 품질 강화와 유통기한 연장
- 물리적 품질 – 예) 먹을 수 있는 코팅, 초코렛을 위한 기술들
- 화학적 품질 – 예) 산화 작용, 빛의 영향
- 생물학적 품질 – 예) 천연 항균재, 항균 포장

이력 사항

개인정보
1982년 8월 4일 뉘른베르크, 독일

이력
2008년 1월 ~ 2012년 12월 프라운 홉퍼기관
식품 화학 대표 헨리에트-슈미트-버크하트
프리드리히 알렉산더 대학교 에를랑겐-뉘른베르크, 에를랑겐, 독일, 박사 학위(학점: 우등)
주제 : 기본 소르브산 그리고 식품의 응용할, 원활한 향균성의 포장 산업
2006년12월 ~ 2007년11월 건강 과 식품 안전을 위한 바이에른 국가 사무소,
에를랑겐, 독일 실무수습 식품 화학자를 위한 2번의 국가 검토 (점수: 우수)
2002년10월 ~ 2006년10월 프리드리히- 알렉산더 대학교 에를랑겐-뉘른베르크
에를랑겐, 독일 식품화학 과정 “약국 과 식품화학을 위한 기관”
식품 화학자를 위해 첫째 국가 검토 (점수: 매우 우수)
1993년 9월 ~ 2002년7월 하인리히-슐리만 중고등학교 퓌르트,
독일 고등과정: 라틴어, 생물학

현재와 최근위치
2015년10월 ~ 2016년 3월 TU 드레스덴, 프로세싱 기계들 그리고 프로세싱 기술의 대표,
드레스덴, 독일 엘리노어-트래프츠 초빙 교수 “세정 작용으로 인한 생물막 제거의 영향”
2014년1월 ~ 2014년5월 과학 및 식품 기술 학과, 라벤 포장 연구소 – 칠레,샌티아고 대학의 박사,
CO2 임계 초과의 포장 자재 수정
2008년1월 부터 프라운 호퍼 기관, 독일과학자, 식품 품질 유지 부서
2011년7월 ~ 2011년12월 뮌헨 공과대학교, 식품 포장 기술 학과장, 프라이징 – 바이 흔 슈테판,
독일과학자, 프로젝트 지도자 그리고 행동낙농 제품을 위한 향균성 포장 뚜껑
2010년9월 ~ 2011년1월 뮌헨 공과대학교, 식품 포장 기술 학과장, 그리고 프라이징 바이 흔
슈테판, 독일 과학자, 프로젝트 지도자 그리고 행동
2009년7월 ~ 2009년12월 투명한 포장을 최대한 이용해 치즈 표면의 품질을 유지

이력 사항

인턴쉽

2006년12월 ~ 2007년5월 건강과 식품 안전을 위한 바이에른 국가 사무소, 에를랑겐, 독일
2006년5월 ~ 2006년6월 헨켈, 뒤셀도르프, 독일 연구 인턴쉽, R&D 재료 기술
2005년2월 ~ 건강과 식품보호를 위한 바이에른 국가 사무소, 에를랑겐, 독일

국제 경험

2012년3월 ~ 2012년7월 과학및 식품 기술학과, 라벤 포장 연구소 –칠레 산디에고 대학교
바이에른 연구제단의 연구 지원 “칠레 식물의 향균물질 체출 그리고 그들의 통합된 활성화 포장
2014년1월 ~ 2014년5월 과학및 식품 기술학과, 라벤 포장 연구소
–칠레 산디에고 대학교박사직위, CO2 임계 초과의 포장 자재 수정

인증

2014 국제 관계 설립을 인정 받음 DFG(Deutsche Forschungsgemeinschaft), 독일 연구 협회
2013 프라운호퍼 능수 프로그램 선정 프라운 호퍼 협회
2013 과학 커뮤니케이션 워크샵에 클라우스 치라 재단으로 부터 초청 받았음.
2012 바이에른 연구제단으로부터 칠레에서의 연구를 인정 받음
2012 독일 화학 학회로 부터 재정 지원을 선행연구를 위해 승인 받았음
“입증된 프로젝트 매니저 사업과 화학 (독일 화학 학회)”
2012 줄리아스 메기 연구 어워드 2012에서 유럽 연병국가 식품 화학 공학 그리고 유럽 연병국가 식품 과학 그리고 기술 부분에서 지명을 받았음
2010-2011 프라운호퍼 멘토링 프로그램에서 선택 받았음

위원회 활동

2014년7월부터 기회 균등 책임, 프라운호퍼 기관의 공정공학 그리고 IVV포장
2008년11월부터 오염물질의 고성능액체크로마토그래피, 가스 크로마토그래피,
긴급요소부호 분석 내부감사인 프라운호퍼 기관의 공정공학 그리고 IVV 포장
전문적 그리고 지속적인 교육

- 화학자들을 위한 경영학 : 혁신관리, 제품관리, 화학 산업의 사업전략, 화학 산업의 경제력 분석; 증명서 독일 화학 학회, 프로젝트 관리자 경영 및 화학으로 부터 증명 받음
- 프로젝트 관리자 / 과학 커뮤니케이션 시각화 / 인사관리 긴급요소부호 지도자 / 습득 / 부하직원 지도 / 내부검사

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■ Introduce A Lecture

Carolin Hauser, Dr. rer. nat.

Lecture	Technology Lecture
Area	Food Quality and Safety

Theme 1

Quality enhancement and shelf-life prolongation of food
- physical quality: e.g. edible coating, technologies for chocolate
- chemical quality: e.g. oxidation, light influence
- microbiological: e.g. natural antimicrobials, antimicrobial packaging

Theme 2

Decontamination methods for food/food Packaging and aseptic filling validation
- Food: e.g. pulsed light, high frequency heating
- Packaging: e.g. plasma, H2O2
- Aseptic filling validation

Curriculum Vitae

Personal data:
Place of birth: 04.08.1982 in Nuremberg, Germany
Scientific career
01/2008 – 12/2012 Fraunhofer Institute for Process Engineering and Packaging (IVV), Freising, Henriette-Schmidt-Burkhardt Chair of Food Chemistry, Friedrich- Alexander-University Erlangen-Nuremberg Erlangen, Germany PhD (grade: magna cum laude)
Topic: Antimicrobial active packaging films on sorbic acid basic and its application on food12/2006 – 11/2007 Bavarian State Office for Health and Food Safety, Erlangen, Germany Practical training Second State Examination for Food Chemists (grade: good)
10/2002 – 10/2006 Friedrich- Alexander-University Erlangen-Nuremberg Erlangen, Germany Course of studies „Food Chemistry“ Institute for Pharmacy and Food Chemistry First State Examination for Food Chemists (grade: very good)
09/1993 – 07/2002 Heinrich-Schliemann Secondary School, Fürth, Germany Advanced course: latin, biology
Present and recent positions
10/2015 – 03/2016 TU Dresden, Chair of Processing Machines and Processing Technology, Dresden, Germany Eleonore-Trefftz Visiting Professor “Influence of cleaning processes on the removal of biofilms”
01/2014 – 05/2014 Departamento de Ciencia y Tecnología de los Alimentos, Laboratorio de Envases LABEN-Chile, Universidad de Santiago de Chile Postdoc-Position „ Supercritical CO2 Impregnation of packaging materials“
since 01/2008 Fraunhofer Institute for Process Engineering and Packaging IVV,Freising,Germany Scientist, Retention of Food Quality Department
07/2011 – 12/2011 Technical University Munich TU München, Chair of Food Packaging Technology, Freising-Weihenstephan, Germany

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■ Introduce A Lecture

Curriculum Vitae

Scientist, Project leader and performance„Antimicrobial packaging lids for dairy products“
09/2010 – 01/2011 Technical University Munich TU München, Chair of Food Packaging Technology, and Freising Weihenstephan, Germany Scientist, Project leader and performance
07/2009 – 12/2009 Quality maintenance of cheese surfaces with optimized transparent packaging“

Internships/Secondary employment

12/2006 – 05/2007 Bavarian State Office for Health and Food Safety, Erlangen, Germany
05/2006 – 06/2006 Henkel KGaA, Düsseldorf, Germany Research Internship, R&D Ingredients Technology
02/2005 Bavarian national office for health and food security, Erlangen, Germany International Experience
03/2012 – 07/2012 Departamento de Ciencia y Tecnología de los Alimentos, Laboratoria de Envases LABEN-Chile, Universidad de Santiago de Chile Santiago, Chile
Research Grant of „Bayerische Forschungsstiftung“Antimicrobial extracts of chilean plants and their incorporation in active packaging“
01/2014 – 05/2014 Departamento de Ciencia y Tecnología de los Alimentos, Laboratorio de Envases LABEN-Chile, Universidad de Santiago de Chile
Postdoc-Position „Supercritical CO2 Impregnation of packaging materials“Grants

2014 Grant for the establishment of international relations DFG, Deutsche Forschungsgemeinschaft
2013 Selection for Fraunhofer TALENTA program Fraunhofer Gesellschaft
2013 Invitation for the workshop “Scientific Communications” from Klaus-Tschira Foundation
2012 Research Grant for a research stay in Chile from Bayerische Forschungsstiftung
2012 Financial grant by „Gesellschaft Deutscher Chemiker e.V.“ (German Chemical Society) for advanced training „Certified Projectmanager Business and Chemistry GDCh“
2012 Nominated for „Julius Maggi Research Award 2012“ by Section on Food of the European Federation of Chemical Engineering (EFCE) and European Federation of Food Science and Technology (EFFoST)
2010 – 2011 Selected for „Fraunhofer-Mentoring-Program

Board activities

since 07/14 Equal Opportunities Officer Fraunhofer Institute for Process Engineering and Packaging IVV
since 11/08 Internal Auditor for HPLC, GC und analytics of contaminants Fraunhofer Institute for Process Engineering and Packaging IVV

Professional and continuous training

Business studies for chemists: Innovation-management,
Product-management,
Business strategies in chemical industries,
Competition analysis in chemical industries;
Certificate: „Certified Projectmanager Business and Chemistry GDCh“

- Project-management
- Data visualization in scientific communications
- Personnel-management und Leadership
- Acquisition
- Leadership for junior staff
- Internal Audits

Additional skills

Languages German[native speaker] / English fluent (spoken and written)
Spanish[working knowledge] / French[basic knowledge] / Italian[basic knowledge]
Software-skills MS Word, MS Excel, MS PowerPoint, MS Access, SigmaPlot, LaTeX
Hobbies Fitness (Spinning, Pilates), cycling, theatre and opera, travelling

■ 연사 소개

크리스티안 차켈

강연	기술강연
분야	식품 성분, 제품과 공정

주제 1 혁신적인 기술을 활용한 최상의 기호도를 가진 건강식품 및 간편 식품 개발
- 가공절차, 재료 배합, 식감간의 상호작용 연구
- 열처리, 건조, 식용 가능한 코팅

주제 2 추출, 분획, 변형을 통해 얻은 기능성 성분들

학력
2003년까지 뮌헨공과대학교에서 식품공학 전공
2003년 뮌헨공과대학교에서 “식물성 단백질과 트랜스글루타미나아제의 교차결합 효소”에 대한 학위 논문 작성
2003년~2005년 뮌헨공과대학교에서 식품의 기술과 생명공학 전공
2005년 뮌헨공과대학교에서 “열로 유도하여 식물성 단백질에서 젤 형성”에 대한 석사 학위 논문
현재 뮌헨공과대학교에서 “채소 식물성 단백질 그리고 섬유질의 생리활성 성질” 에 대한 박사 논문 작성 중

이력 사항

2006**년부터 프라운호퍼** IVV:
유럽연합 프로젝트 “BioProFibre” 프로젝트 코디네이터
“저지방 소시지” 프로젝트의 협력자
지방을 대신할 새로운 식물성 단백질을 위한 격리 기술 개발

2007**년**
프라운호퍼 상: 저지방 소시지 개발을 함으로서 “사람들을 위한 기술”을 수여받음
2009년 서부터 회사의 식품 현장 경영자

현재 지위
과학자, 회사의 식품 가공 및 제품 현장 경영자

연락처
프라운호퍼 공정공학 및 포장 연구소, 크리스티안 차켈[Giggenhauserstr.3585354 Freising]
전화 : +49 / 8161 491 – 426, 팩스 : +49 / 8161 491 – 444
이메일 : Christian.zacherl@ivv.fraunhofer.de

FOODPOLIS
KOREA NATIONAL FOOD CLUSTER

■ Introduce A Lecture

Dipl.-Ing. Christian Zacherl

Lecture	Technology Lecture
Area	Food Ingredients, products and processes

Theme 1

Development of healthy and convenient food products with innovative technological processes, optimized for maximal taste
- Foods with reduced fat or reduced sugar, convenience products, new textures and aroma
- technological processes for gentle processing of foods, e.g. drying, heating methods, extrusion
- Evaluation and optimization of product properties (sensory and technofunctional properties)

Theme 2

Tailor-made functional Ingredients for foods – extraction, fractionation and modification techniques applied on raw materials from sustainable resources
- Characterization of the composition and properties of plant based raw materials and recovered fractions
- Development, adaption, and optimization of fractionation processes

Curriculum Vitae

Education	Until 2003	Studies in Food Technology at TechnicalUniversityMunich-Weihenstephan
	2003	Dipl.-Ing Thesis on "enzymatically crosslincing of plant-proteins with Transglutaminase" at Technical University Munich
	2003-2005	Studies in Technology and Biotechnology of Foods at TechnicalUniversityMunich-Weihenstephan
	2005	Master´s Thesis on "heat induced gel forming of plant proteins" at Technical University Munich
	currently	PhD thesis on "bioactive properties of vegetable plant proteins and fibers" at Technical University Munich- Weihenstephan
Professional Experience	since 2006	Fraunhofer IVV:
	2007	- Projectcoordinatorof EU-Project"BioProFibre"
	Since 2009	- Project co-worker of project "low fat sausages"
		- Development of isolation technology for new plant protein as fat replacer
		Fraunhofer Award: "Technology for people" for development of low fat sausages
		Business field manager Food
Present Position		Scientist, Business field manager Food Processes and Products
Contact		Fraunhofer Institute for Process Engineering and Packaging Christian ZacherlGiggenhauserstr.35, 85354 Freising Phone: +49 / 8161 491- 426, Fax: +49 / 8161 491 -444 E-mail: Christian.zacherl@ivv.fraunhofer.de

■ 연사 소개

닥터 롤란드 프란츠

강연	기술강연
분야	식품 포장

주제

식품 접촉 물질 (FCM) - 화학적 마이그레이션, 규정 준수와 안전도 평가
- EU [유럽 연합] 제정법
- 선별 방법을 포함한 마이그레이션과 규정 준수 테스트
- FCM에 의도치 않게 첨가한 물질
- 마이그레이션 테스트 결과의 규정 준수와 안전도 평가
- 중합체 나노 복합 재료인 나노 입자의 마이그래이션
- 악취 및 냄새 제거의 분석 연구와 식별

이력 사항

- 닥터 로날드 프란즈는 독일 프라이징에 있는 공정 공학과 포장IVV을 위한 프라운호퍼 연구소의 '상품 안전과 화학 분석'의 부서장이다.
- 그는 독일 우즈버그 대학에서 유기 화학 박사 학위를 땄고, 1차 장애 발암 분야에서 실험적 독소학에 대한 post-doc연구가 잇따랐다.
- 그의 과학적인 연구의 주요 목표는 포장과 음식 사이의 상호 작용에 있다.
- 수많은 국가 및 국제 연구 활동, 또한 지지하는 제정법 전문가 집단과 음식의 안전 접촉 기사에 관련 되었었고 현재에도 관련되어 있다.
- 최근 조사 활동들은 발달시키기 위한 목적과 마이그래이션 모델을 입증 시키기 위한 곳이며 소비자 노출 판단을 지지 하여 식품으로 마이그래이션의 계산을 할 수 있게 하는 EU 프로젝트 "FACET" 내에 있다.
- 문제에 있었던, 현재에도 있는 또 다른 실제 조사 분야는 나노 입자들이 식품 접촉 물질로부터 이동 할 수 있는지의 대한 여부이다.
- 그는 140개가 넘는 과학출판물의 저자이다.
- 위험 평가를 위한 독일 연방 기관의 '소비자 제품을 위한 위원회', 베를린에 있는 BfR의 멤버 및 의장. 유럽 식품 안전청의(EFSA) 접촉 물질 연구단, 효소와 향료 (CEF). '식품 첨가물과 오염' 저널의 국제 편집 위원회 멤버와 '식품 포장과 유통 기한' 저널의 편집 조수.

■ Introduce A Lecture

Dr. Roland Franz

Lecture	Technology Lecture
Area	Food Packaging

Theme 1

Food Contact Materials (FCM) – Chemical Migration, Compliance and Safety Assessment
- Current state of legislation in the European Union (EU)
- Migration and compliance testing including screening methods
- Not intentionally added substances (NIAS) in FCM
- Compliance and safety assessment of migration test results
- Migration potential of nanoparticles in polymer nanocomposites
- Analysis and identification of off-odours and off-smells

Curriculum Vitae

Dr. Roland Franz is Head of the Department 'Product Safety and Chemical Analysis' of the Fraunhofer Institute for Process Engineering and Packaging IVV in Freising, Germany.
He made his Ph.D. in Organic Chemistry at the University of Würzburg, Germany, followed by a post-doc research in experimental toxicology in the area of carcinogenic primary lesions. Main focus of his scientific work is on interactions between packaging and food. He was and is involved in numerous national and international research activities as well as expert groups in support of legislation and safety of food contact articles.
Most recent research activities were within the EU project 'FACET' where the objective was to develop and substantiate a migration model which enables calculation of migration into foodstuffs in support of consumer exposure estimations. Another actual research area was and is on the question whether or not nano-particles can migrate from food contact materials. He is (co-)author of more than 140 scientific publications. Member and chair of the 'Committee for Consumer Products' of the German Federal Institute for Risk Assessment, BfR, in Berlin. Member of the European Food Safety Authority's (EFSA) Panel on Contact Materials, Enzymes and Flavourings (CEF). Member of the International Editorial Board of the Journal 'Food Additives and Contaminants' and assistant Editor of the Journal 'Food Packaging and Shelf Life' http://www.journals.elsevier.com/food-packaging-and-shelf-life/ . Furtherinformationcanbefoundunderhttp://www.ivv.fraunhofer.de.

■ 연사 소개

클라우스 놀러 박사

강연	기술강연
분야	식품 포장

주제

제품 보존 성능의 강화 : 제품 보존 성능의 향상을 위한 활성기능 포장들
- 산소 흡착기술[탈 산소제 이용]
- 흡습 능력 향상, 작용 메커니즘
- 항균 시스템
- 자외선 흡착

이력 사항

1986 – 화학과 수학을 튀빙겐 대학, 그리고 마인츠 대학에서 전공했고, 마지막 박사 학위를 공화학으로 끝냈음
11년의 필름과 종이를 특히 습식용액, 그리고 진공기술로 전환시키는 산업에서의 경험있음.
그 후로 R&D에 3년 동안 광텍제 생산 기업 기술 지원 그리고 안전 품질을 책임지는 책임자였음
2002년도 까지 공학과정과 프라이징 포장을 하는 프라운호퍼 기관에서 일을 했었고, 2003년 말까지 소재개발 부서를 도 맡아 이끄렀습니다. 소재개발부서는 포장소재, 필름 압축, 필름과 종이 전환을 맡고 있습니다. 주 분야는 극도록 높은 장벽의 필름을 가스와 증기를 침투를 못하도록 개발하는 것입니다. 또한 많은 산업과 정부 그리고 유럽에서 공적 기금으로 운영되는 프로젝트들에 협조하고 일을 했었습니다.

FOODPOLIS
KOREA NATIONAL FOOD CLUSTER

■ Introduce A Lecture

Dr. Klaus Noller

Lecture	Technology Lecture
Area	Food Packaging

Theme

Packaging – Enhanced Product
- Protection Oxygen scavengers
- Humidity regulation and absorption
- Antimicrobial systems
- UV- and light-absorption

Curriculum Vitae

He has studied chemistry and mathematics at the universities of Tübingen and Mainz and finalized with a PhD in 1986 on photochemistry.

He has 11 years of industrial experience in the field of film and paper converting especially on wet chemical and vacuum technologies. After this he was responsible for R&D, technical support and quality safety in a lacquer producing company for three years.

Since 2002 he works for the Fraunhofer Institute for Process Engineering and Packaging in Freising and since the end of 2003 he leads the department of „materials development“, which deals with packaging materials, film extrusion, film and paper converting. The main field is the development of ultra-high barrier films against permeation of gases and vapors. He coordinated and worked in several industrial and public funded projects on national and EU-level

호르스트 크리스티안 랑고프스키 [기조연설]
식품 산업에서 제품과 가공기술의 혁신을 위한 성공요소

Dr. Horst-Christian Langowski [Keynote Speech]
Success Factors for Product and Process Innovations
in the Food Sector

기조 연설 발표내용 요약

식품 산업에서 제품과 가공기술의 혁신을 위한 성공요소

식품시장에서 개발하려는 제품이나 공정개발이 성공하기 위해서는 몇가지 조건이 충족되어야 한다. 가장 중요한 조건은 소비자의 구매를 자극할 확실한 무엇이 있어야 한다는 것이다. 이런 부분은 선진국일수록 더욱 뚜렷하게 나타난다.

소비자의 구매를 자극하기 위한 부분은 편리함, 건강, 라이프스타일 그리고 기쁨으로 나눌 수 있다. 성공적인 개발을 위해서는 이 4가지의 카테고리 중 최소한 한가지는 충족 시켜야 한다. 소비자를 만족시킬 무언가를 충족시켰을 지라도 실제로 식품시장에서 성공 가능성은 낮다.

소비자를 충족시키는 신제품 개발 뿐만이 아니라 에너지를 절약하거나 더 저렴한 원료를 활용하는 공정개발도 식품기업에게는 성공적인 것이다.

하지만 신제품 개발 원가절감 등 보다 더 중요한 것은 식품의 품질과 안전이 충족되어야 한다는 것이다. 이 부분은 모든 단계에서 식품의 품질과 안전을 보장하기 위한 추가적인 역량이 필요하다는 것을 의미한다.

이번 심포지엄에서 식품이나 포장에 대한 우리의 노하우를 소개해 드리겠습니다.

호르스트 크리스티안 랑고프스키 박사

[Keynote Speech]

Outline of the presentation

Success Factors for Product and Process Innovations in the Food Sector

If a product or process development should succeed on the market (which is the meaning of a successful innovation), there are several prerequisites which have to be fulfilled. Predominant factor is a clear advantage for the customer, be it a food producer in the industry or the consumer. This is especially true in industrialized countries where many basic needs of producers and consumers have already been satisfied.

For the benefit of the consumer, food innovations can be grouped below the headlines of – convenience, - health, - lifestyle and – pleasure. An innovation has to give extra benefits within at least one of these four categories. But even then, accessible market niches are small in comparison to the commodity food markets, although the growth rates within some of these niches may be high.

Also process developments may show to be successful for the benefit of the food producers, especially if energy savings or less expensive raw materials are concerned.

Overall, however, no successful innovation may occur unless the requirements from food quality and safety are met. This fact underlines the need for additional competencies which have to be involved in the development processes throughout all stages.

Examples from our project range will be shown during the symposium highlighting the need for a comprehensive know how along the food and packaging value chain to enable innovations.

Dr. Horst-Christian Langowski

Horst-Christian Langowski
Fraunhofer IVV, Freising
Director

Success Factors for Product and Process Innovations in the Food Sector

Korea National Food Cluster (AnFC) Symposium
Seoul, November 17, 2015

Fraunhofer IVV

Horst-Christian Langowski
Fraunhofer IVV, Freising

Success Factors for Product and Process Innovations in the Food Sector

… and possible contributions of applied research

Fraunhofer IVV

Overview

1. Driving forces in food and process innovation
   - Global perspective
   - Consumer's perspective
   - Producer's perspective
2. Requirements for R&D infrastructure
3. Conclusions

Fraunhofer IVV

1. Global issues for food research

Worldwide challenges

- Shortage of fossil and natural resources
- Increasing population
- Climate change and environmental pollution

Fraunhofer IVV

Global issues for food research

- Shortage of fossil and natural resources
- Increasing population
- Climate change and environmental pollution

Interlinked issues raise many questions, e.g.:

- ➢ Can we afford the high growth rates in meat production?
- ➢ How does the use of renewable resources affect food prices and land use?

Fraunhofer IVV

Top 10. Energy containing Agricultural Products from worldwide Harvest 2013, FAO

Agricultural Product**)	Amount tons/a	kcal for nutrition	kcal per human and day*)
1. Maize	1,016,736,092	$3.3*10^{15}$	1,276
2. Rice	745,709,788	$2.6*10^{15}$	993
3. Wheat	713.182.914	$2.5*10^{15}$	950
4. Soybeans	276,406,003	$1.2*10^{15}$	469
5. Palm-Oil	55.800.940	$5.0*10^{14}$	191
6. Barley	144,755,038	$4.7*10^{14}$	179
7. Sugar cane	1,877,105,112	$4.7*10^{14}$	179
8. Rapeseed	64.563.586	$3.6*10^{14}$	138
9. Potatoes	368,096,362	$2.8*10^{14}$	108
10. Sorghum	61,384,559	$2.1*10^{14}$	82

*) based on 7.2 bn People

$4,531 \frac{kcal}{human\ day}$

Source: **) FAO-STAT, Data from 2013 and 2012

TOTAL (141 products): about 5500 kcal per person and day

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Global issues for food research:

Requirements for governmental funding of long-term programs, e.g.

- Use of plant-based proteins in food
- Use of food production residues in technical applications
- Strategies to avoid of food waste

But: These issues should not be intermixed with the shorter termed requirements for food and process innovations at the industry!

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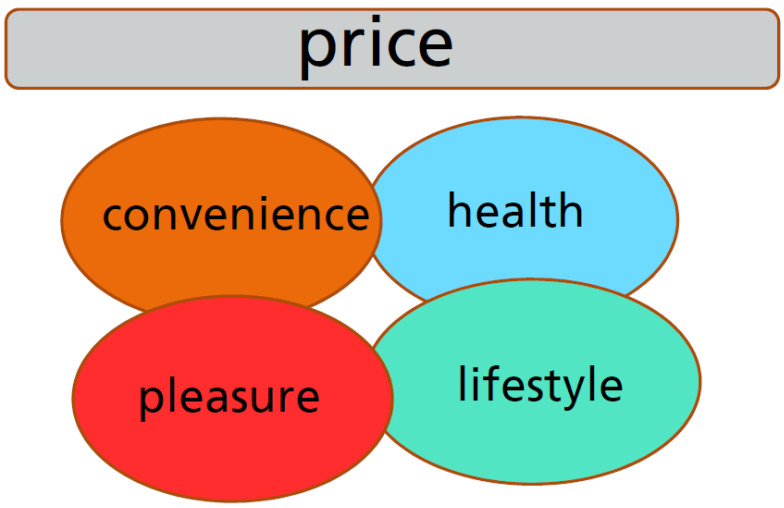
Consumers' view – the final driver for real food innovations



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Consumers' view

hedonism:
- convenience
- pleasure

differentiation, individualization:
- health
- lifestyle

- function
- Taste

quantifiable factors

- „free from…"
- „includes…"

non quantifiable effects
- sustainability
- environment
- animal well-being
- fair trade

immaterial factors

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Consumers' purchase decision at POS

hedonism:
- convenience
- pleasure

differentiation, individualization:
- health
- lifestyle

quantifiable factors — smaller part

immaterial factors — larger part

of purchase decision outside…

price

Fraunhofer IVV

Established food producers' view

- Functional view: fulfilment of the required functions of product and packaging
- Compliance with regulations: food, packaging, labelling, …
- Economic view: cost of materials and processes, reliability of production (predominant drive for innovations at large producers)
- Positive brand image

Fraunhofer IVV

The view of innovative producers (mostly SME's)

- Novelty vs. consumer perception
- Proper selection of raw materials and processes
- Functional view, compliance with regulations, economic view
- Identification of possible retail channels
- Establishment of a brand image

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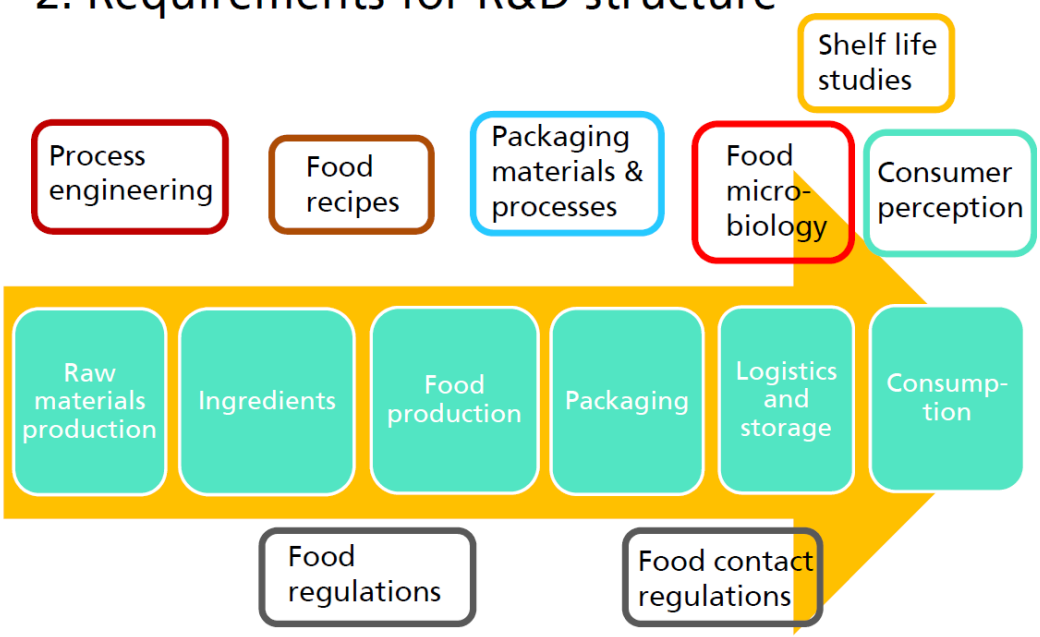
Summarized facts for food product innovations

- Most „innovations“ are just re-launches („new! 20% larger package!“)
- Most „true“ innovations are gradual improvements
- Many of them are developed by small or medium companies…
- …and they fail in about 90 % of the cases

Fraunhofer IVV

2. Requirements for R&D structure



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3. Conclusions

- Global issues do not drive innovations in the short term, but R&D must be prepared to deal with them
- Most innovations in the food sector are gradual improvements; many of them fail on the market
- Process innovations are mainly cost-driven
- Some process innovations may lead to new types of products

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3. Conclusions (contd.)

- R&D must have a high affinity to the needs of the industry
- R&D should be able to help SME's in their search for retail channels and in building a product image
- An important goal is a better understanding of consumer perception to reduce product launch failures
- Regulatory issues also ask for a high expertise on the R&D side

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3. Conclusions (contd.)

- An ideal R&D partner for the food industry is not an inventor of new products,
- but he facilitates their introduction to the market
- via his expertise in all relevant sectors
- and via his contact network through the whole supply chain

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캐롤린 하우저 [품질안전 - Part 1]
식품식품 포장재의 살균 방법 및 무균 충진 공정 검증

Dr. Carolin Hauser [Quality and Safety - Part 1]
Decontamination methods for food /
food packaging and aseptic filling validation

[품질안전- Part 1]

식품/식품 포장재의 살균 방법 및 무균 충진 공정 검증

식품업계는 소비자에게 높은 품질의 안전한 식품 제품을 제공해야 한다. 신선한 식품은 제조 및 가공 시에 특히 바람직하지 않은 미생물에 오염되는 경향이 있다. 프라운호퍼 공정공학 및 포장 연구소는 여러 다른 식품 제품에 대한 새로운 오염 제거 및 저온살균 기술의 적합성과 효과성을 연구한다. 제품에 대한 멸균의 효율성과 유통기한의 연장 가능성, 그리고 제품의 품질에 특히 주목하면서, 고주파가열, 대기압 플라즈마, 새로운 UV 소자, 제논/크세논 플래시 램프의 사용 등으로 가공시의 열처리를 연구한다. 즉 제품의 성격에 따라 어떤 멸균방법을 사용하느냐는 최적의 제조방법을 선정하는 중요한 요소이다.

만약 제품이 이미 저온살균 또는 멸균 공정을 거쳤다면, 그 제품들은 주로 무균 또는 거의 멸균 상태 하에서 포장 안에 집어 넣게 된다. 이 공정은 제품을 충진하는 공정 이전에 제품을 처리하는 것(예를 들면, 우유의 저온 살균 또는 초고온 처리)과 포장을 멸균하는 것을 포함한다. 식품업계는 이 공정에 과산화수소 및 과산화아세트산을 이용한 주로 습식화학공정을 사용한다. 프라운호퍼 연구소는 무균 및 거의 멸균 상태로 집어넣는 작업을 하는 공정에서 하는 멸균의 효율성을 수량화하기 위해 미생물 시험을 수행한다. 이 시험에서는 멸균 공정 바로 직전에 선택된 시험 세균으로 공장에 대한 고의적이고 규정된 오염을 하게 된다. 멸균 공정에서 살아남은 선택된 시험 유기물을 수량화함으로써 그 공정의 효과성을 평가할 수 있다. 미생물 선택의 중요성과 우리가 겪은 경험을 보여줄 것이다.

캐롤린 하우저 박사

[Quality and Safety - Part 1]

Decontamination methods for food/food packaging and aseptic filling validation

Dr. Carolin Hauser

The food industry must provide consumers with high-quality and safe food products. The manufacture and processing of fresh food products are particularly prone to contamination with undesired microorganisms. The Fraunhofer Institute for Process Engineering and Packaging IVV studies the suitability and effectiveness of new decontamination and pasteurization technologies for different food products. The use of radio frequency heating, atmospheric pressure plasmas, novel UV sources, and xenon flash lamps are investigated, with particular attention being put on the sterilization efficiency on the product, possible shelf-life extension and the product quality. The suitability for certain product groups and optimal treatment parameters for gentle product sterilization is a key factor therefore.

If products already have undergone a pasteurization or sterilization process, they are mainly filled into packaging under aseptic or near-sterile conditions. This process involves both treating the product (e.g. the pasteurization or UHT treatment of milk) and also sterilizing the packaging prior to the filling process. The food industry uses mostly wet-chemical processes for this, involving hydrogen peroxide and peracetic acid. The Fraunhofer IVV performs microbiological challenge tests in order to quantify the effectiveness of sterilization of aseptic and near-sterile filling plants. For these tests there is deliberate and defined contamination of plants with selected test germs immediately prior to the sterilization process. By quantifying selected test organisms that survive the sterilization process the effectiveness of that process can be appraised. The importance of the choice of microorganisms and experience will be shown.

Dr. Carolin Hauser

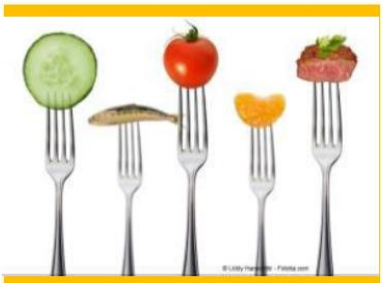
Decontamination for food/food packaging and aseptic filling validation

Dr. Carolin Hauser
Head of Business Field Food

November 2015

Fraunhofer IVV

Our Business Fields



Food

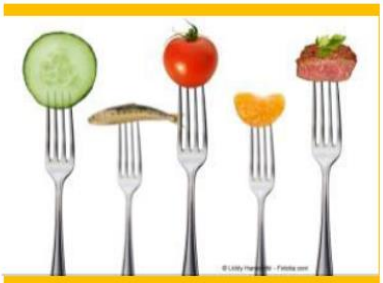
Processing Machinery

Packaging

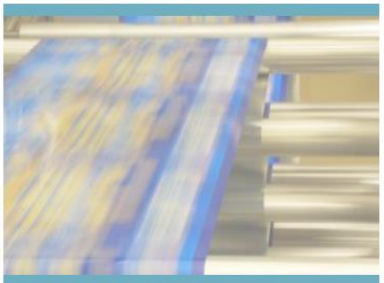
Recycling

Fraunhofer IVV

Our Business Fields



Food



Processing Machinery

Packaging

Recycling

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Outline

1. Decontamination methods of food
   - Unpacked food: **pulsed light** technology
   - Packed food: **radio frequency heating**

2. Decontamination of food packaging: **plasma**

3. **Validation** of sterilization processes

4. Conclusion

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Avoidable food waste in German households

11 Mio tons of food waste generally / year

6.7 Mio tons / year just in housholds

82 kg / person

Source: Studie der Universität Stuttgart, 2012, gefördert durch das BMELV

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1. Decontamination of food – unpacked food

EHEC outbreak 2011 Germany:
4000 illnesses, 53 deaths

http://www.was-wir-essen.de

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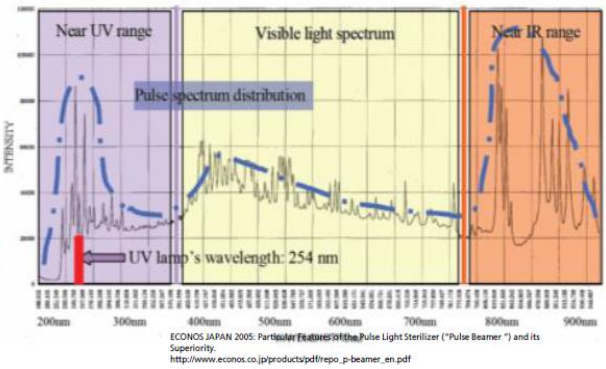
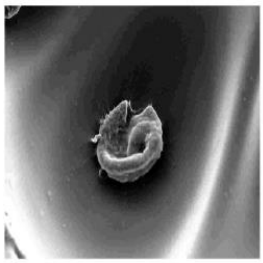
Pulsed light technology

Principle and set up



- Xenon flash lamp (200-1100 nm)
- Special shaped reflectors
- Very short high-energy light flashes (0,3 ms)
- Limited or no heating of the material
- No chemicals
- Approved for food applications by the FDA (max. 12 J/cm²) - Code 21CFR179.41

- 15% UV/ 50% VIS/ 35% NIR
  - Photochemical effect (damage of DNA; T-dimere etc.)
  - Photothermal effect (e.g. denaturation of protein)
  - Photoacoustic effect (explosions, particle impact)



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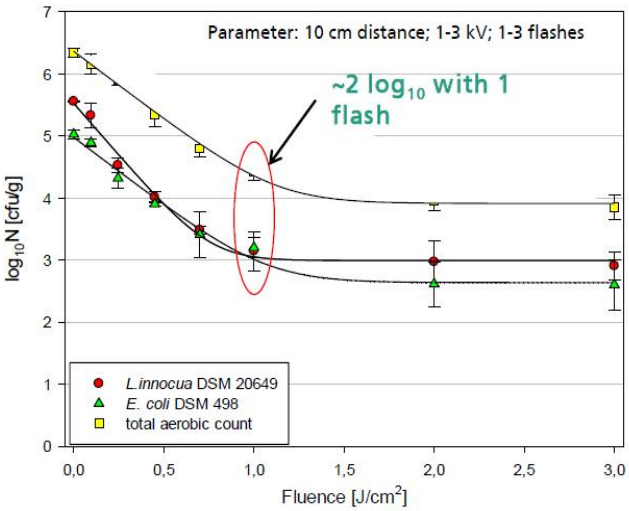
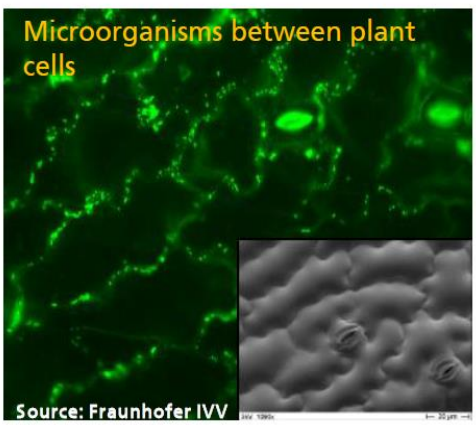
Pulsed light technology

Fresh cut endive salad – inactivation efficiency

- *Listeria innocua*, *Escherichia coli* and total aerobic count
- Inactivation of about **2 $\log_{10}$ CFU/g**
- Tailing observable – Matrix effects





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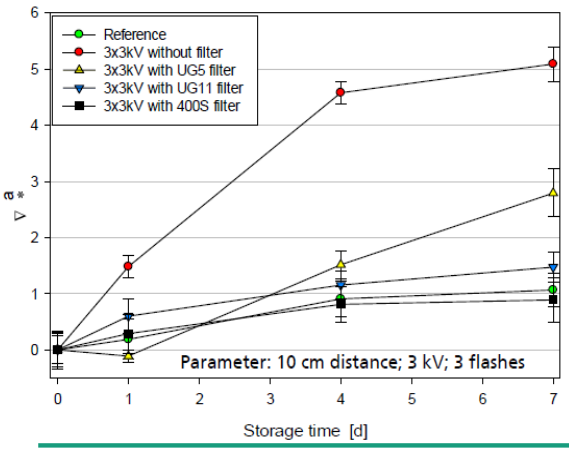
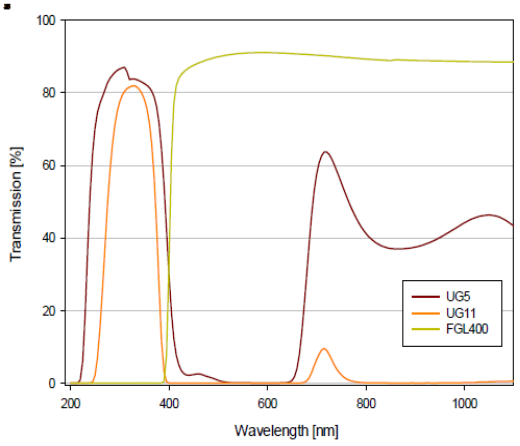
Pulsed light technology

Fresh cut endive salad – colour changes

- Effect of pulsed light on browning of salad: Application of **optical filters**
  - Strong Browning (Δa) without filters
  - Application of optical filters UG11 (275-375 nm) and UG5 (240-395 nm) reduce or prevent browning
  - Inactivation of about **1.8 $\log_{10}$ CFU/g**





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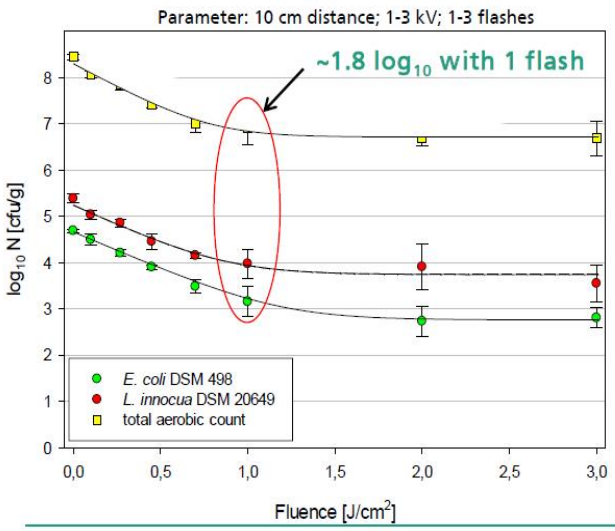
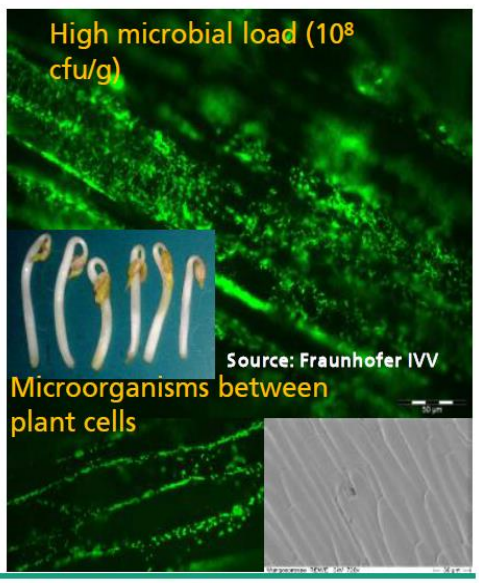
Pulsed light technology

Mung bean sprouts – inactivation efficiency

- *Listeria innocua*, *Escherichia coli* and total aerobic count
- Inactivation of about **1.8 $\log_{10}$ CFU/g**
- Tailing observable – Matrix effects





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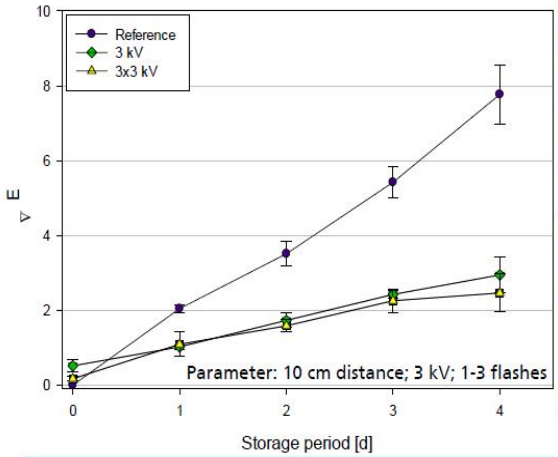
Pulsed light technology

Mung bean sprouts – colour changes

- Positive effect of pulsed light on color and texture of mung bean sprouts



References after 7 days

1x3 kV after 7 days

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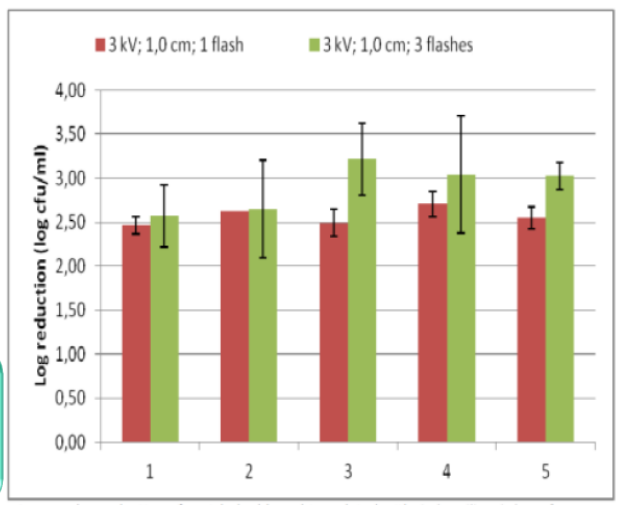
Pulsed light technology

Bread rolls – inactivation efficiency

- inactivation of 2.5 to 3 decades;
- top side and bottom side could be decontaminated at the same good level
- good reproducibility (s. 1-5)
- only slightly increase of the inactivation by application of 3 flashes compared to 1 flash
- no significant increase of inactivation with 5 or 10 flashes

No sensory or analytically detectable modifications of the food quality parameters !



Average log reduction of part-baked bread inoculated with *A. brasiliensis*

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Pulsed light technology

- **Pulsed light is an efficient method for fast decontamination of surfaces**
  - Determined inactivation rates of approx. 2 $\log_{10}$ (endive salad), 1.8 $\log_{10}$ (mung bean sprouts) and 2.5 $\log_{10}$ (bread rolls)
  - Optical filters enable gentle treatment of endive salad and prevent increase of browning and respiration rate
  - Pulsed light improves appearance of mung bean sprouts
  - No adverse quality changes of bread rolls

- **Industrial feasibility**
  - Limited effect on bulk goods
  - Industrial sorter system (optical sorter) singularize products like leafy greens
  - pulsed light systems could be integrated to enable product treatment of both sides

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1. Decontamination of food – packed food

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Radio-Frequency Heating

Boiling a
2500 g sausage

Pasteurizing pickled gherkins in 720 ml glass jar

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Radio Frequency Heating

Parameter	Radio-Frequency	Microwave	Ohmic
Frequency	13.56 MHz 27.12 MHz low	0.915 GHz 2.45 GHz high	50 Hz to 1 kHz
Wave length	1105 cm (in air) ~130 cm (water) high	12.2 cm (in air) ~1.5 cm (water) low	not relevant
Power penetration into material	~ 32 cm (tap water) high	~ 1 cm (tap water) low	large
Heating mechanism	Ion movement	Dipole rotation, ion movement	Ion movement
Exposition	Capacitor field, no electrode contact necessary	Radiation field, cavity field, no contact	Food in contact with electrodes, food in packages not possible

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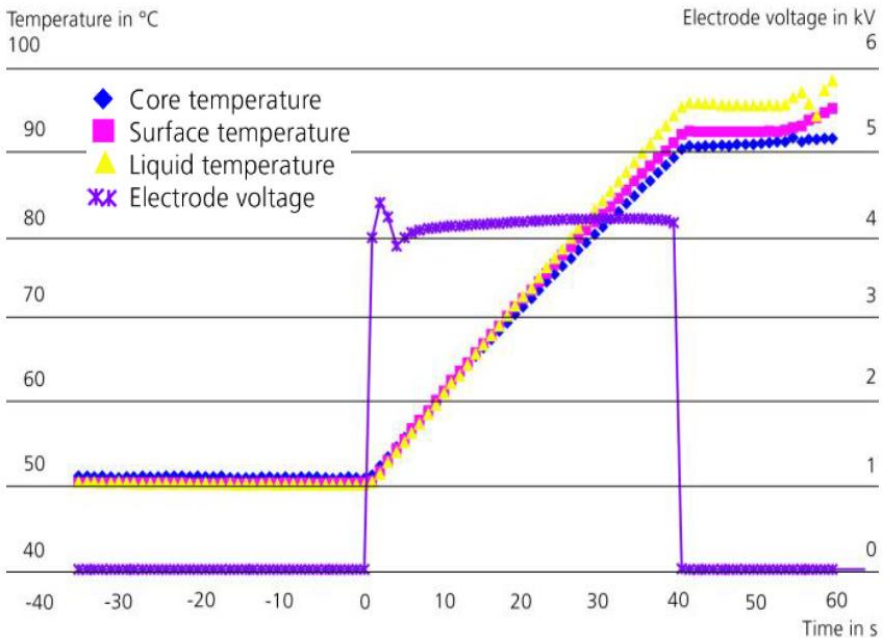
Radio Frequency Heating

Heating profile



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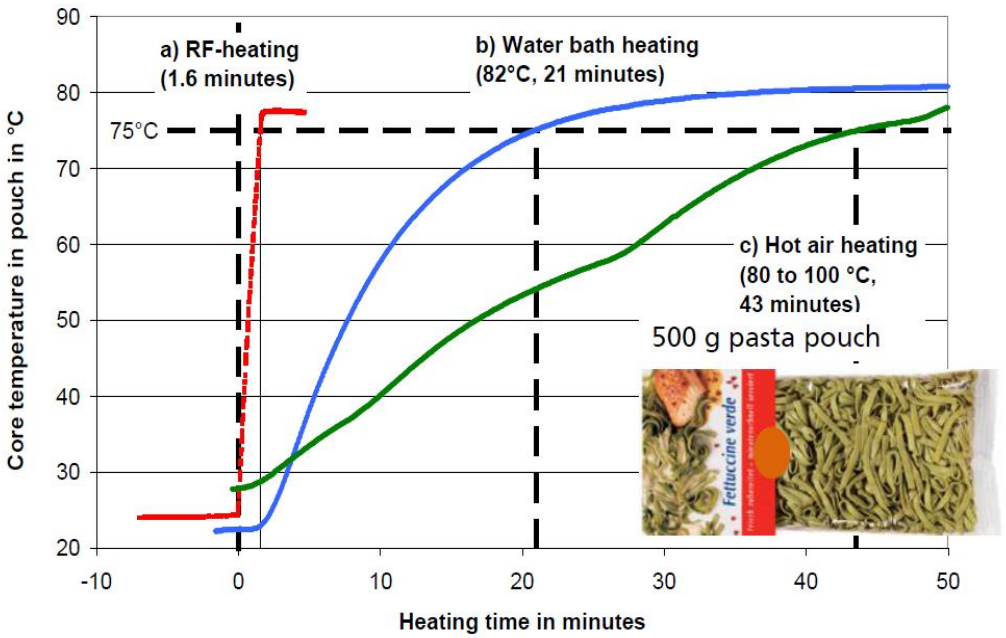
Radio Frequency Heating

Comparison of pasteurization technologies



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Radio Frequency Heating

Performance for different food

Product	RF-heating	Temperature holding time	Commercial process
Pasta, 500 g in pouch	1.6 min	3 min	70 min
Tofu, 200 g slice in vacuum pack	1.5 min	3 min	30 min
Boiled sausage, 2500 g	11 min	10 min	200 min
Pickled gherkins in 720 ml jar	3.25 min	2 min	30 min
Cherries in 720 ml jar	1.5 min	2 min	26 min

RF-heating saves 82 % – 94 % processing time!

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Radio Frequency Heating

Possible Packages

- vacuum packs,
- plastic skins,
- plastic trays,
- jars and beakers
- plastic or metal screw caps,
- plastic and glass bottles

No metal cans!

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2. Decontamination of food packaging

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Decontamination of food packaging

Packaging material can prevent microbial food spoilage (actively/passively) !

Requirement for a high microbiological stability is the packaging sterilization

Source: Fraunhofer IVV

Partial Decontamination

level of reduction and microorganism strains are not defined / pH < 4.5

Methods:

- Infrared Radiation
- UV-radiation
- H_2O_2 (low concentrations)
- Peracetic acid
- Pulsed UV light
- Photodynamic
- etc.

Sterilization / Aseptic packaging

clearly defined level of reduction and defined test organism: e.g. reduction of 5 $\log_{10}$ of *B. subtilis* for H_2O_2- technology

Methods:

- H_2O_2 (high concentration)
- Peracetic acid
- Saturated steam
- Electron beams

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Decontamination of food packaging - Plasma sterilization

Geometry of the packaging

Atmospheric-pressure plasma
(e.g. plasma jet, DBD)

Low-pressure plasma
(e.g. CCP, ICP, microwave)

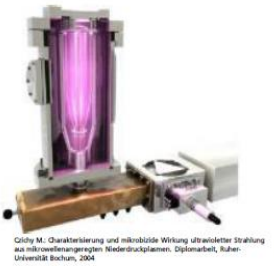
suitable for...

Source: Fraunhofer IVV

Source: Fraunhofer IVV

Flat substrates (lids, foils, films)

Source: Fraunhofer IVV



Gilchy M.: Charakterisierung und mikrobizide Wirkung ultravioletter Strahlung aus mikrowellenangeregten Niederdruckplasmen. Diplomarbeit, Ruhr-Universität Bochum, 2004

3D-substrates (bottles, cups etc.)

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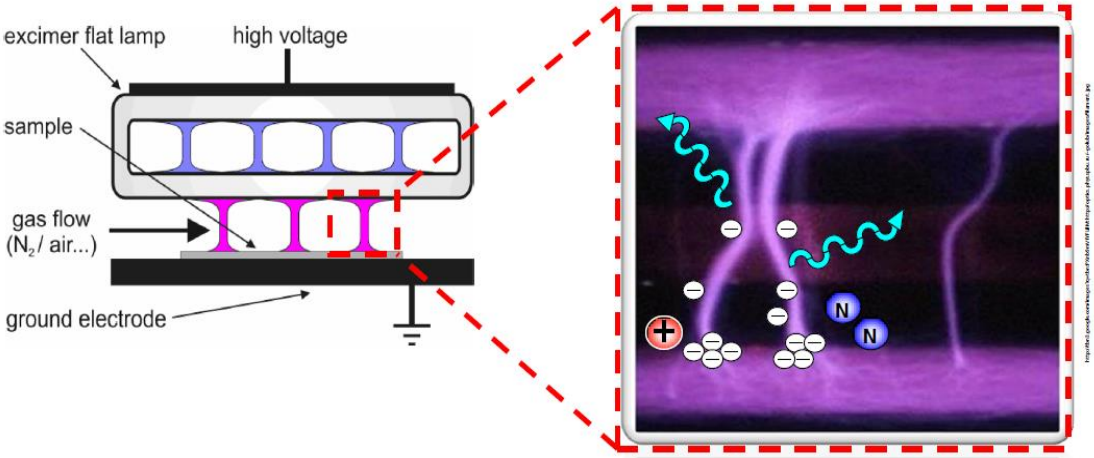
Decontamination of food packaging - Plasma sterilization

Set-up of a Cascaded Dielectric Barrier Discharge (CDBD)



- Excimer lamp emits monochromatic light (e.g. XeBr = 282 nm; KrCl = 222 nm)
- Combination of inactivation effects (UV radiation + plasma)
- Additional UV-radiation increases homogeneity of the discharge („Joshi-effect")

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Decontamination of food packaging - Plasma sterilization

Up-scaling

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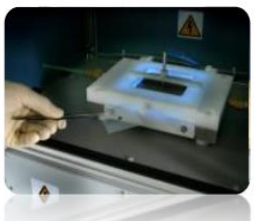
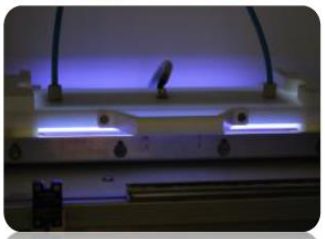
Lab-scale



EU / 01.04.2002 – 31.05.2005 (G1RD-CT-2002-00747)
COLAPE

KMU innovativ/ 01.10.2009-31.12.2012 (01LY0912B) **STERIPLAS**

Larger lab-scale



Pilot-plant-scale

Partners:

- RTDs: Fraunhofer ILT + Fraunhofer IVV
- Companies: AFS GmbH, SemiQuarz GmbH, Jürgen Löhrke GmbH

Fraunhofer IVV

Decontamination of food packaging - Plasma sterilization

Up-scaling

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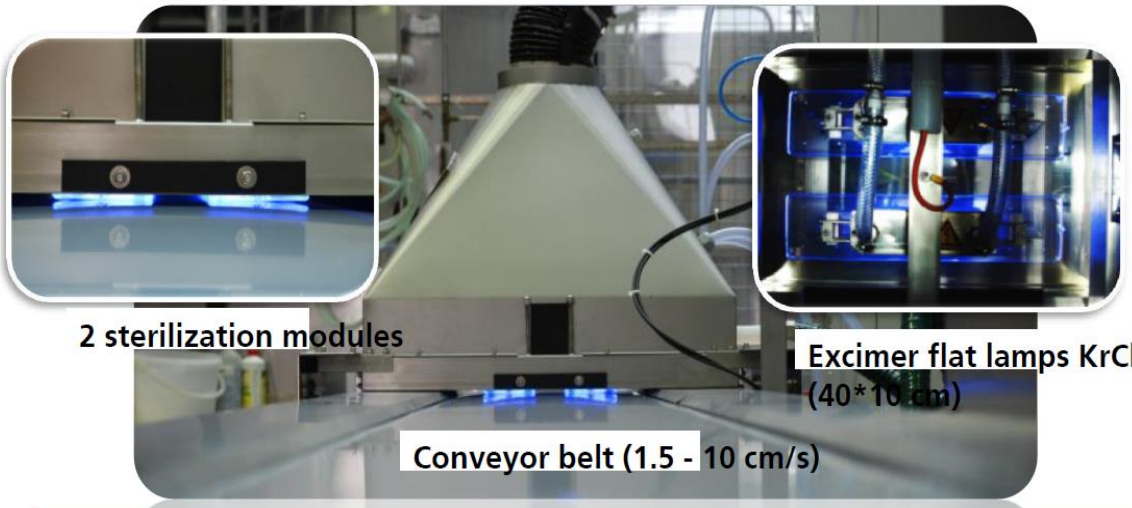
- Continuous sterilization of plastic films (width 37 cm)
- Generator: max. 1.5 kW / Distance: 2 mm
- Exhaustion: Removal of volatile compounds (e.g. ozone)
- Amount of modules depends from the sterilization requirements



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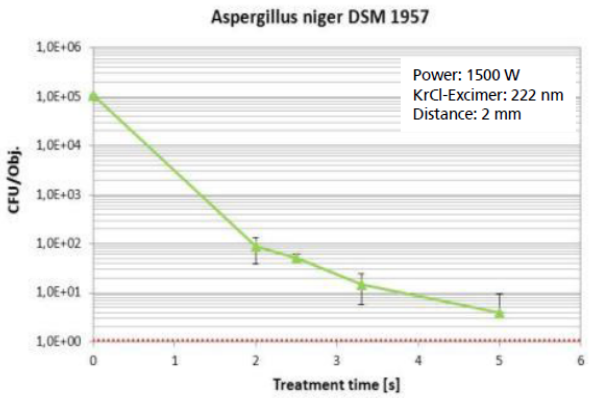
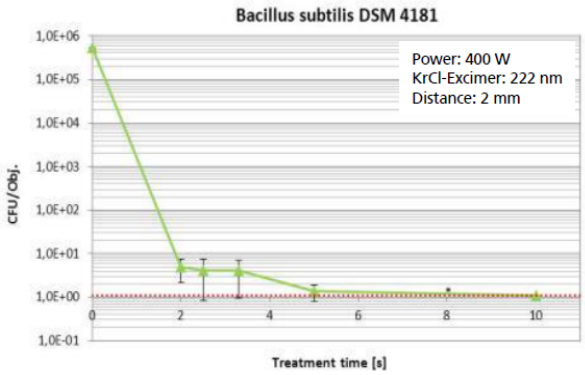
Decontamination of food packaging - Plasma sterilization

Up-scaling – Sterilization efficiency





- *Aspergillus niger* DSM 1957: **4 log within 3 s**
- *Bacillus subtilis* DSM 4181: **5 log within 2 s**

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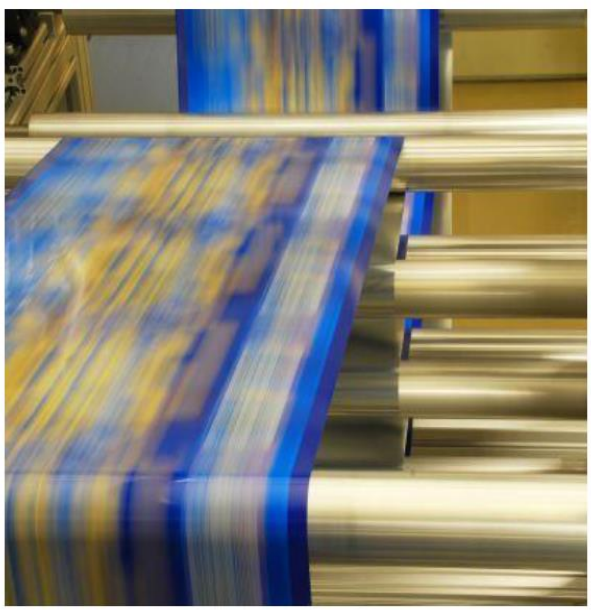
3. Validation of sterilization processes



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Validation of sterilization processes

Determination of the product failure rate ?

The following overview summarizes the criteria for distinguishing the types of checks.

	Artificial sterilization using test microorganism	Test of sterilizing functions	Machine ready for production	Test with original Product	Special production profile	Machine cleared for commercial production	Production run destined for sale	Start-up concluded
1. Microbiological challenge test	yes	yes	no	no	-	no	-	no

© Fachverband Nahrungsmittelmaschinen und Verpackungsmaschinen, Loner Strasse 18, 60528 Frankfurt, October 2007 (English edition, August 2008)

For determination of an failure rate < 1:10,000 more than 30,000 product samples have to be investigated for a confidentiality of 95%

Microbiological challenge tests are necessary for determination of the sterilization efficiency of aseptic or hygienic cold-filling machines

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Validation of sterilization processes

Objective: Determination of the efficiency of the filling-machine`s strerilization modules

Challenge-Test Process

1. Preparation of bioindicators
2. Validation process at the decontamination device
3. Determination of the sterilization efficiency
4. Evaluation of the obtained data

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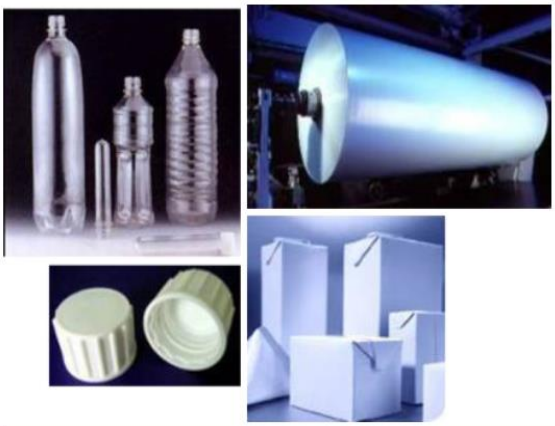
Validation of sterilization processes

Carrier Material + Test Microorganism

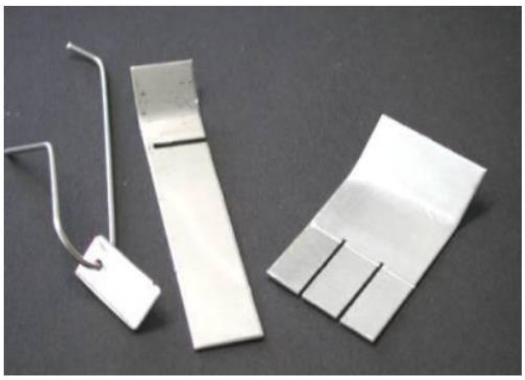
Sterilization of packaging material

Various packaging materials
(e.g. films, cups, bottles, lids)



Sterilization of the machine

Special carriers (e.g. metal stripes)



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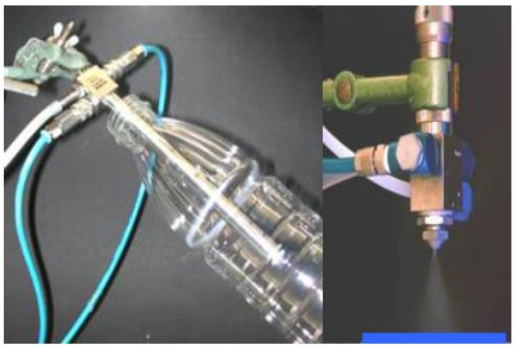
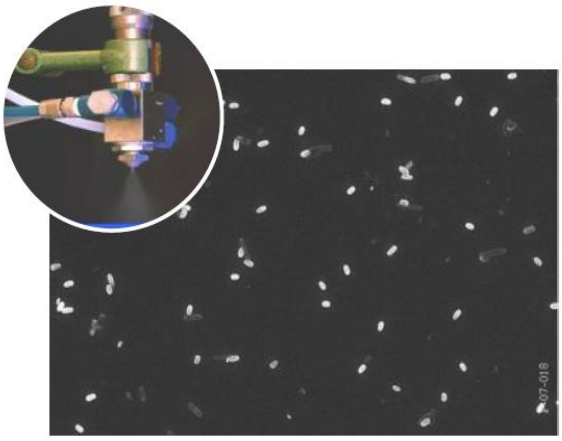
Validation of sterilization processes

Preparation and Inoculation

Spray contamination





Drying of suspensions under defined conditions

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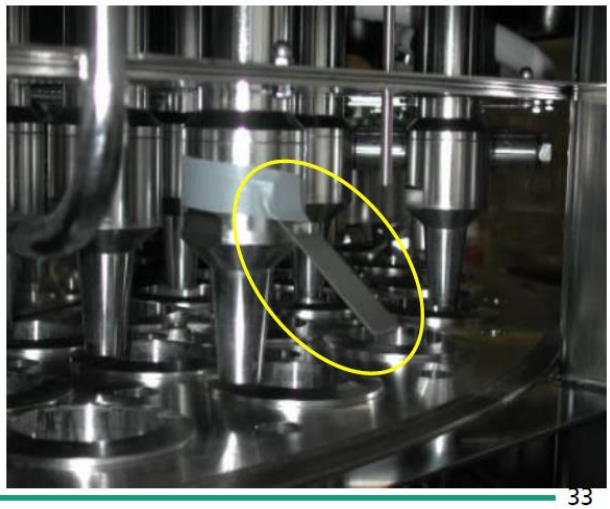
Validation of sterilization processes

Sterilization of packaging material

- Contaminated packaging material
- Distribution on different lines
- Different time intervalls

Sterilization of machine

- Contaminated carrier material
- Critical points



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Validation of sterilization processes

Determination of Sterilization Efficiency

- Washing process or direct pouring method
- Swap methods and contact plates only in exceptional cases
- Detection of viable count by
  - Filtration
  - Pour plate method
  - Spiral plating

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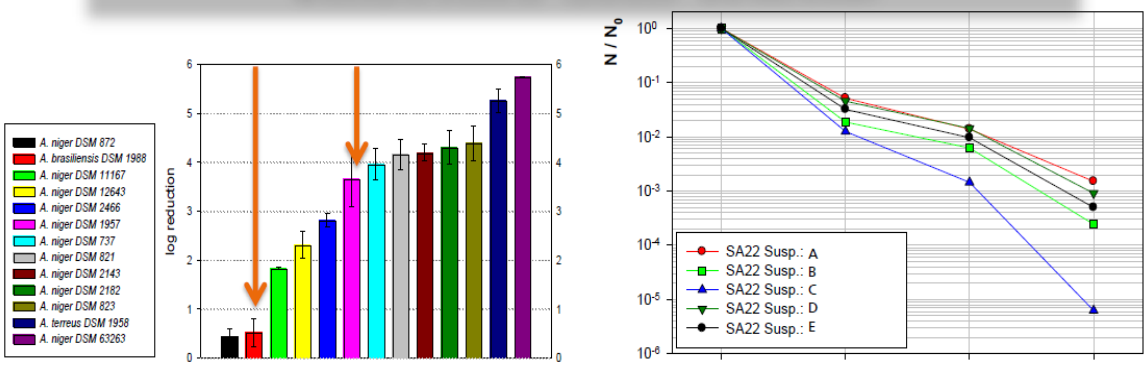
Validation of sterilization processes

Choice of test strains - resistance

- Test strains are used as a measurement tool
- Result of validation depends on the specific resistance of the species and test strain
- Resistance depends on different parameters (e.g. growth-conditions)

High deviations in resistance

Resistance should be "calibrated" and well known



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Summary

Decontamination methods for food/food packaging

- Quality and food safety should be the given highest priority
- Microbial contaminations are inevitable
- Various (novel) decontamination/sterilization methods
- Food and Food Packaging
- Method should be appropriate for the specific product
- Qualified validation is necessary

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Any questions?

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Dr. Carolin Hauser
Business Field Food

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크리스티안 차켈 [기능성 - Part 1]
혁신 가공기술이 적용된 최상의 기호도를 가진
건강 편의식 개발

Christian Zacherl [Functional Foods - Part 1]
Development of healthy and convenient food products with innovative technological processes, optimized for maximal taste

[**기능성** - Part 1]

혁신 가공기술이 적용된 최상의 기호도를 가진 건강 편의식 개발

첫 번째 발표는 식품가공분야 및 식품의 최근 발전현황을 소개하겠습니다. 우리 프라운호퍼 연구소는 주로 간편식품, 저칼로리식품, 식이섬유 함량이 높은 식품에 관해 연구하고 있습니다. 그리고 과일이나 야채의 색다른 식감, 식물성 단백질로 만든 고기 대용식품도 연구하고 있습니다. 우리는 가공절차, 재료배합, 식감 간의 상호작용을 연구해서 최고의 맛과 향을 만들어 내는 것을 목표로 하고 있습니다. 간편하게 먹을 수 있는 간편식품을 만들 때도 신선하면서도 비타민이나 영양성분이 남아 있을 수 있도록 적당한 열처리나 건조과정, 먹을 수 있는 비닐로 코팅처리를 하고 있습니다. 이런 차별화된 생산방식은 식품을 통하여 먹는 즐거움과 건강을 동시에 챙길 수 있도록 해 줍니다.

크리스티안 차켈

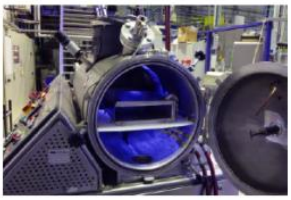
[Functional Foods - Part 1]

Development of healthy and convenient food products with innovative technological processes, optimized for maximal taste

The first presentation will give an overview on current developments in the sector of food processes and products. We develop high-quality, modern foods such as convenience foods, low calorie products and fiber-rich foods. We also develop foods with novel textures such as fruit and vegetable products and meat surrogates based on plant proteins. Our objective is always to understand the relationship between processing, formulation, and texture and to optimize the sensory properties (aroma, taste, and mouth-feel). In order to ensure convenience foods are “fresh” and retain their vitamins and nutritional secondary plant materials we are developing gentle heating and drying processes and edible coatings. This work allows us to bring together the health and enjoyment aspects of food in a special way.

Christian Zacherl

Development of healthy and convenient food products with innovative technological processes, optimized for maximal taste



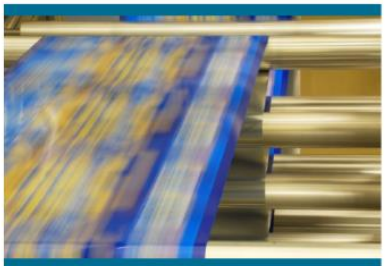
Christian Zacherl
Head of Business Field Food

November 2015

Fraunhofer

Business Fields

Food



Processing Machinery

Packaging

Recycling

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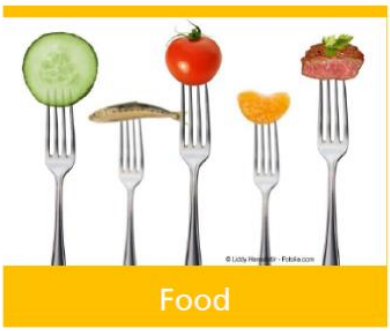

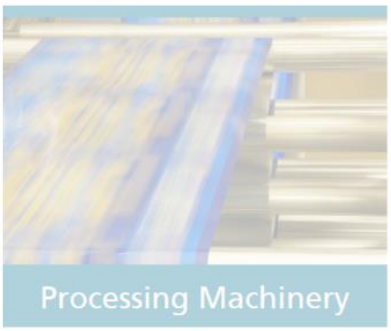

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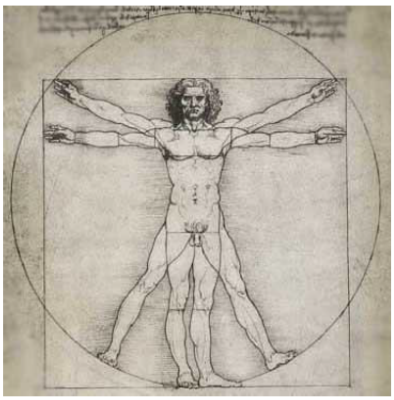
Building blocks of life



The human body consists of approximately 100 trillion cells. Per second around 1 Million cells are renewed. All 3 years around 90% of all body cells are replaced.

All building blocks for renewing our body originate from –

FOOD !

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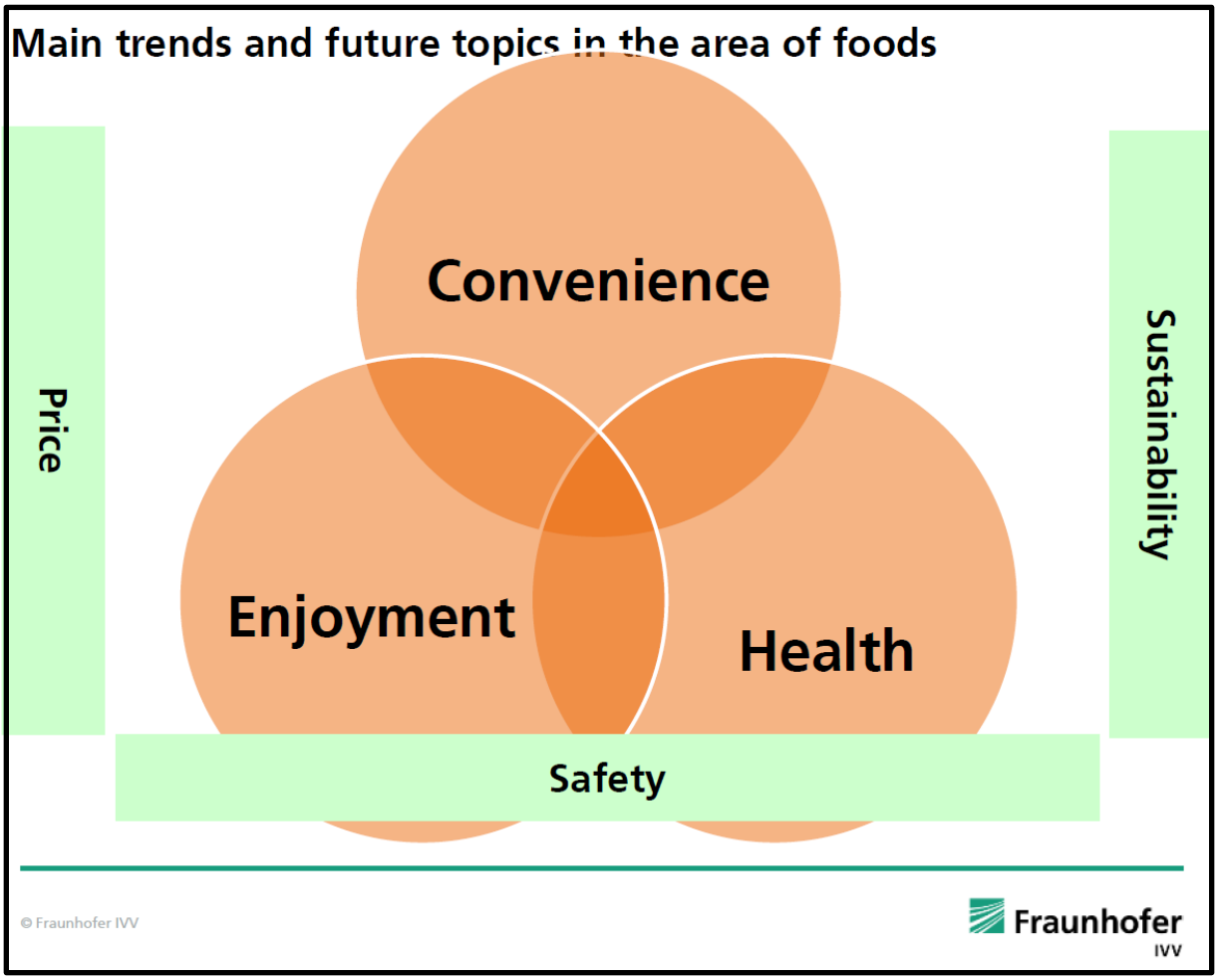
JUNK
FOOD
JUNKIE
We can choose the
building blocks of our
body individually – each day!


Main trends and future topics in the area of foods
Price
Convenience
Enjoyment
Health
Sustainability
Safety
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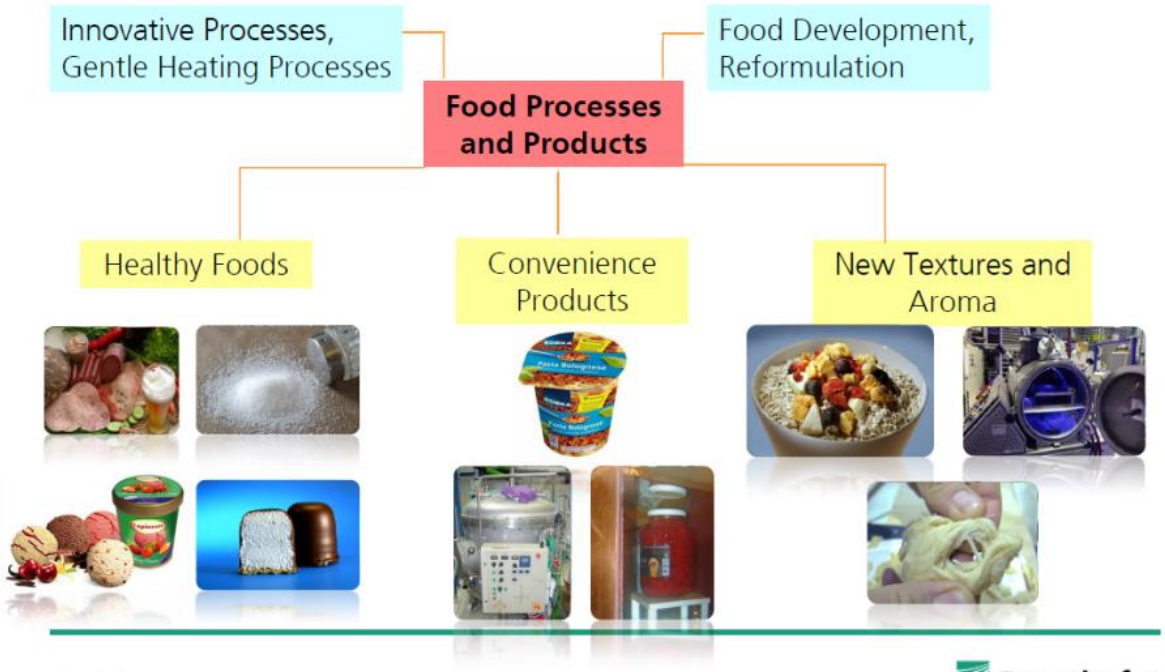
Food Processes and Products



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Food Processes and Products

Foods with reduced fat or reduced sugar, convenience products, new textures and aroma

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Food Processes and Products

Salt reduced foods

Background Salt- Nutrition

- Average salt consumption in EU: 8-12 g/day
- Recommended Intake: 5-6 g/day
- Overconsumption → raised blood pressure, risk of heart attack and cardiovascular diseases
- Reduction of sodium of 30% should be target for the next 10 years (EFSA, BFR)

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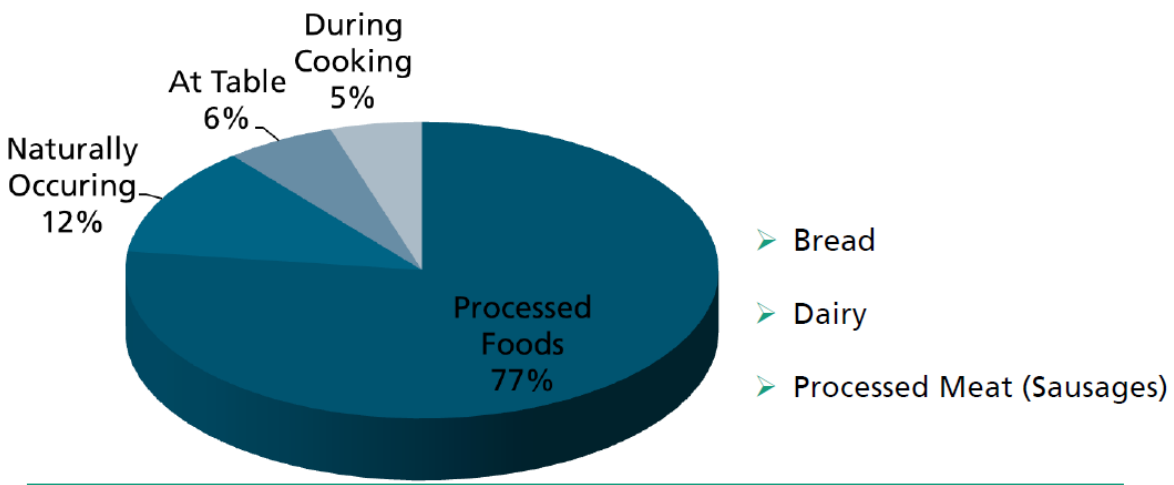
Food Processes and Products

Salt reduced foods

Major Sources of Sodium Intake



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Food Processes and Products

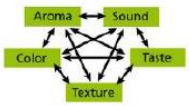
Salt reduced foods

Approaches for Salt Reduction

Stepwise reduction over time

Salt reduction by substitutes, e.g. KCl or other non-sodium ions

Salt boosters, e.g. saltiness by umami



Multisensory interactions

Distribution of salt

Source: Hannah Baker
Food Ingredients Europe Conference 2011

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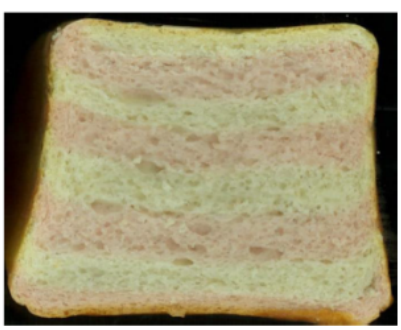
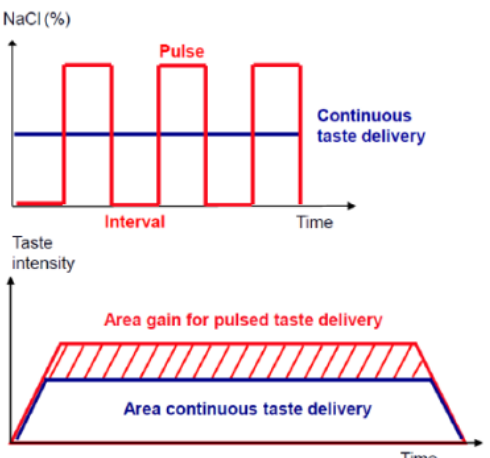
Food Processes and Products

Salt reduced foods

Innovative Approach:

Optimisation of salt release during mastication + Principle of sensory contrast





Source: Martijn Noort
Food Ingredients Europe Conference 2011,
Meiseman & Halpern 1973

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Food Processes and Products

Sugar-free, Tasty Foods with Optimized Digestibility

- Development of sweetening systems based on different sugar alcohols, sweeteners and filling ingredients
- Elucidation of interactions between sugar replacer, sweet taste, texture and aroma release
- Research on different food groups, e.g. sweet bakery, chocolate, marshmallows
- Optimising of the sweet profile, texture and mouth-feel of different foods

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Food Processes and Products

Low-fat Sausages

Using exclusively lean pork ham, no additional fat

- Only 2,5 % fat
- 60-80 % less calories than conventional sausages
- Free of fat substitutes
- Outstanding taste via innovative technology and new plant ingredients
- process possible with conventional equipment

Cutter

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Food Processes and Products

Low-fat Sausages

- Idea coming from a small butcher
- Cooperation financed by an internal Fraunhofer funded project
- Patent application
- Searching for industrial partners
- License contract

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Food Processes and Products

Low-fat Sausages

New processes for the production of sausages without added fat

No fat and additives by the use of a new process at very low temperatures

- ⇨ optimized protein solubility
- ⇨ juicy and firm texture
- ⇨ less than 3 % fat
- ⇨ high consumer acceptance
- ⇨ reputation for Fraunhofer

Fraunhofer-fitness-sausage produced by the largest Food-Retailer in Germany

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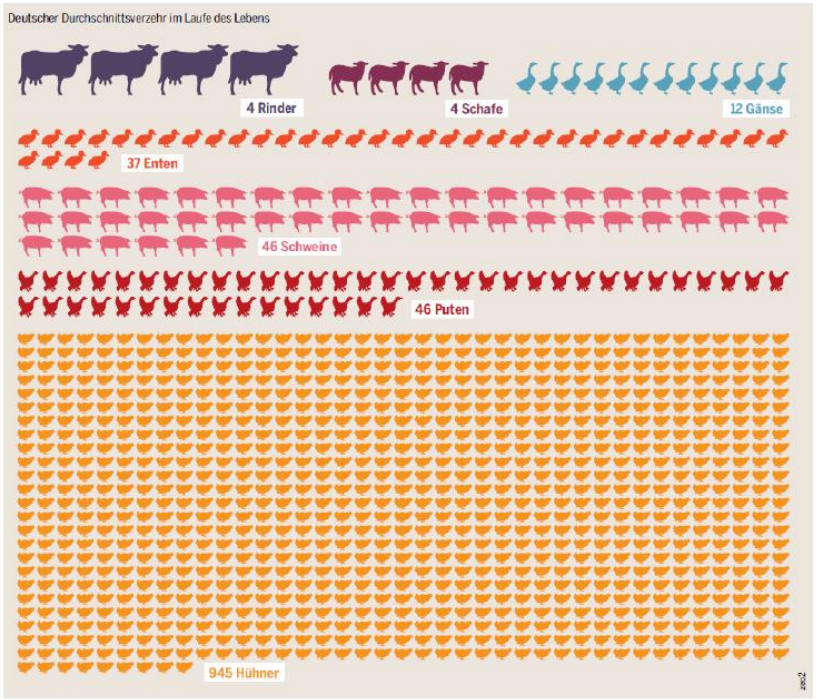
Food Processes and Products



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Food Processes and Products

Plant based meat alternative products

Based on plant proteins providing meat-like fibrous structure

- Based on various raw materials: pea, lupine, soy, wheat, bean
- fresh product > 60% water content
- Different applications, as nuggets or Schnitzel
- continuous processing technology

Meat-like texture

Plant based Schnitzel

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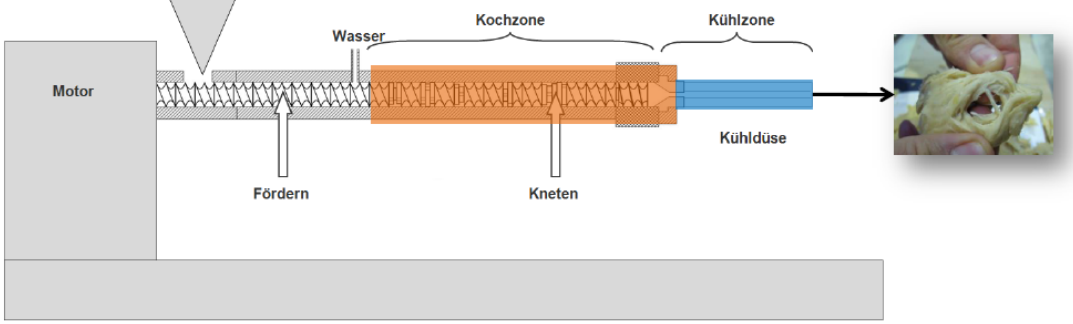
Food Processes and Products

Plant based meat alternative products

Wet cooking extrusion

Ingredients: Water, plant protein, spices

- ✓ Aligned fibers → meat-like texture
- ✓ Only plant based ingredients →vegan product
- ✓ No animal based fats
- ✓ no cholesterol



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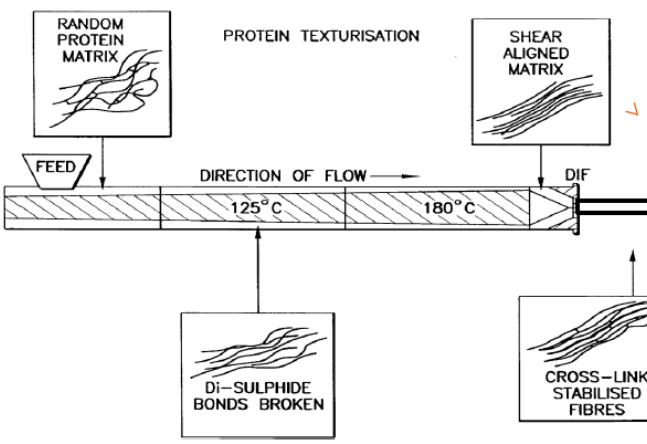
Food Processes and Products

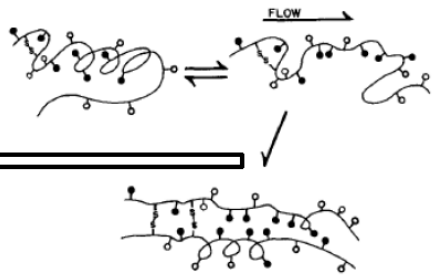
Plant based meat alternative products

Wet cooking extrusion - principe



Chemical crosslinking

- Covalent bonds (Disulfide bridges)
- Non-covalent interactions (H2-bridges, ionic and hydrophobic interactions)



Camire et al, 1992

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Food Processes and Products

technological processes for gentle processing of foods, e.g. drying, heating methods, extrusion

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Food Processes and Products

Radio-frequency Heating of Food

Pasteurisation/sterilisation of packed food

Alternating electrical field (frequency 27,12 MHz)

Warm-up time does not depend on the size of the package

Food is heated up 10-fold faster than in autoclave

↓

Gentle heating

↓

Higher product quality

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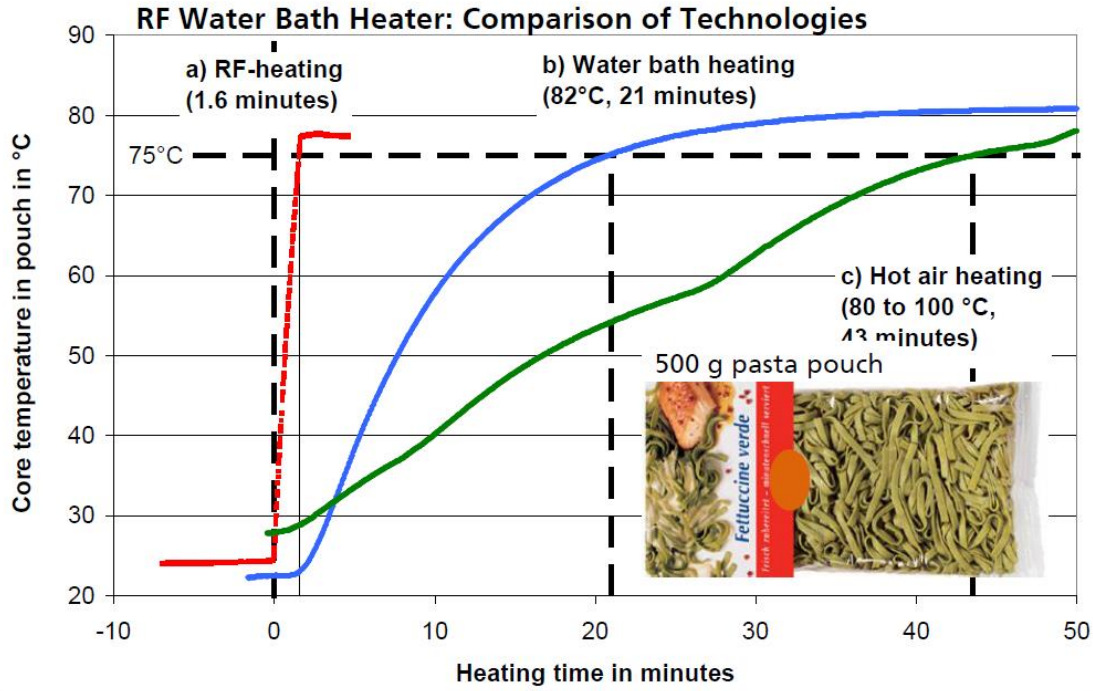
Food Processes and Products



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Food Processes and Products

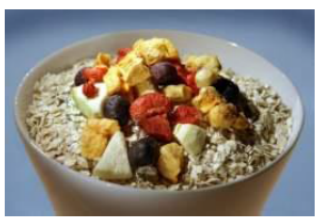
Vacuum-expanded Fruits and Vegetables

Products:

- Strawberries
- Banana Chips (fat free)
- Apples
- Melons
- Grapes
- Other fruits

Applications of products:

- Breakfast cereal mixtures
- Cereal bars
- Confectioneries with coatings
- Fruit snacks, vegetable snacks



Pre-drying (convection) → Vacuum-expansion → End-drying

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Food Processes and Products

Vacuum-expanded Fruits and Vegetables

1. Pre-Treatment
2. Pre-Drying
3. Puffing under vacuum
4. Post-Drying

Application of Energy
- Air Convection
- Microwave
- Infrared

Pre-Drying → Vacuum-Expansion → Post-treatment

90-80% → 45-25% → 12-8% → 4-6%

Water Content of Product

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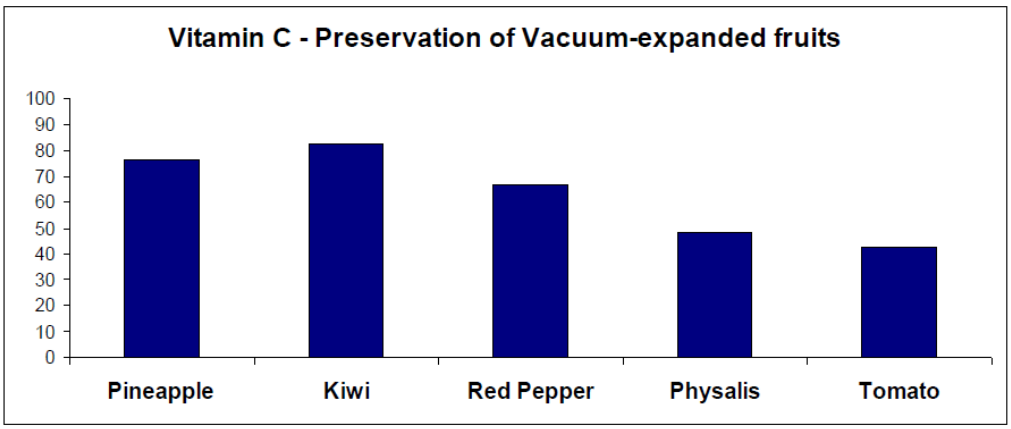
Food Processes and Products

Vacuum-expanded Fruits and Vegetables

Strengths of the Technology: Example Vitamin C



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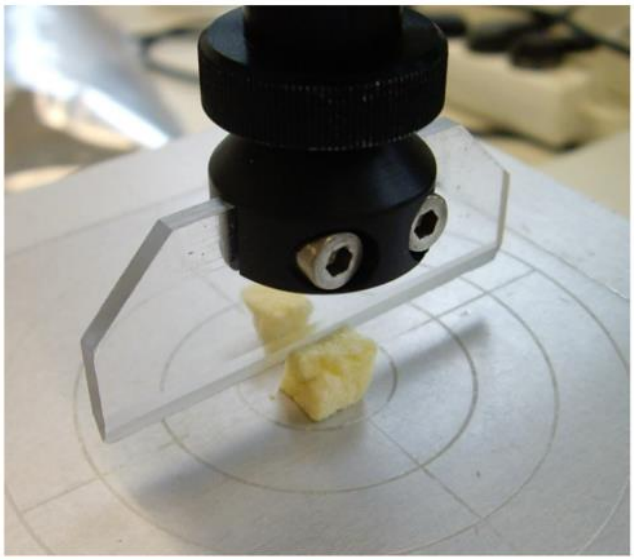
Food Processes and Products

Vacuum-expanded Fruits and Vegetables

Strengths of the Technology: Optimized Texture

Penetration test with blade-shape measuring: Simulation of Teeth



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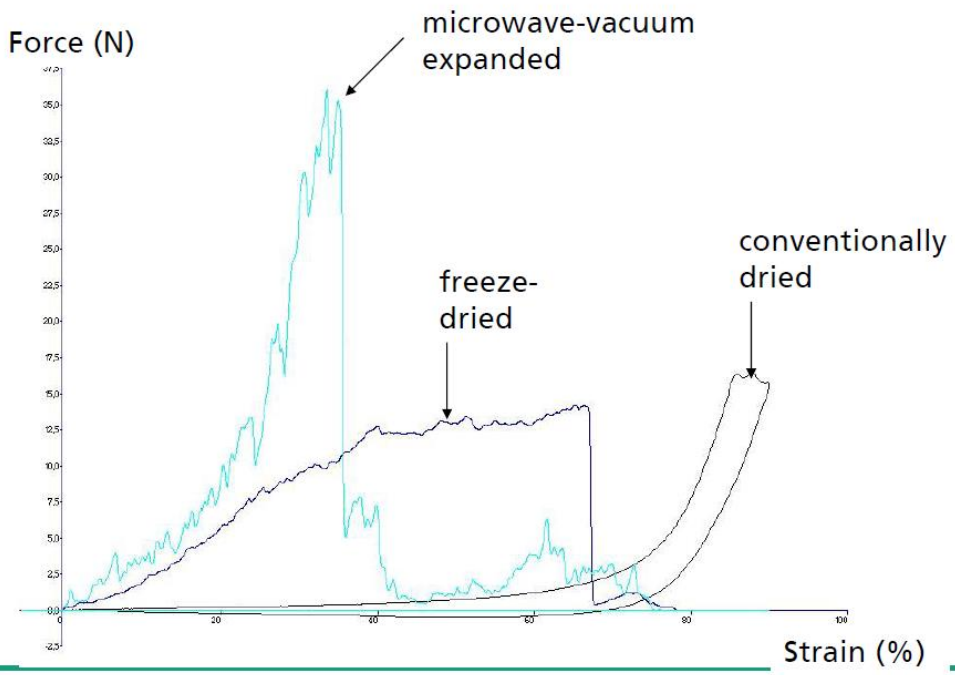
Texture compared to other Technologies



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Food Processes and Products

Vacuum-expanded Fruits and Vegetables

Strengths of the Technology: Optimized Texture

Freeze-drying | Puffing | Conventional drying | Freeze-drying | Puffing | Conventional drying

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Food Processes and Products

Vacuum-expanded Fruits and Vegetables

Comparison to other Technologies

Drying Method	Ratio of Processing Cost	Quality
Air Drying	1	poor Retention of fresh Product Quality, leathery shrunk Products
Freeze Drying	5	chalky Texture, reduced Colour, soft, crumbly, not crispy
Vacuum-Expansion	1.5	excellent Colour, crispy Texture, Concentration of characteristic Aroma

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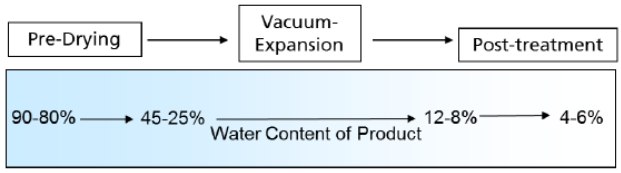
Food Processes and Products

Vacuum-expanded Fruits and Vegetables

Strengths of the Technology

- ✓ Wide Range of raw Materials
- ✓ Unique Crunch and Pleasure
- ✓ Optimization in Colour and Texture
- ✓ No Losses in Fibres, Protein and Lipids
- ✓ High in Vitamins and secondary plant metabolites (e.g. Polyphenols)
- ✓ Significant cheaper than Freeze Drying



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Food Processes and Products

Sensorial Evaluation and optimization of product properties

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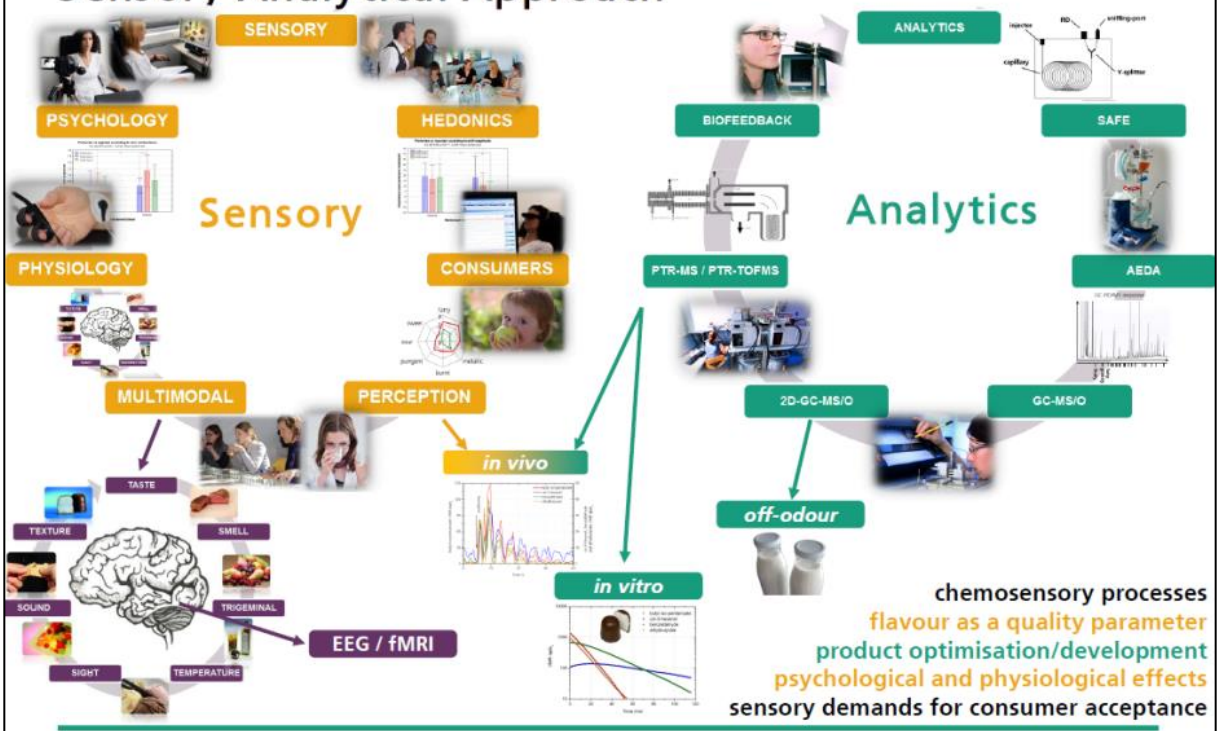
Sensory Analytical Approach



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Sensorial Evaluation of Foods

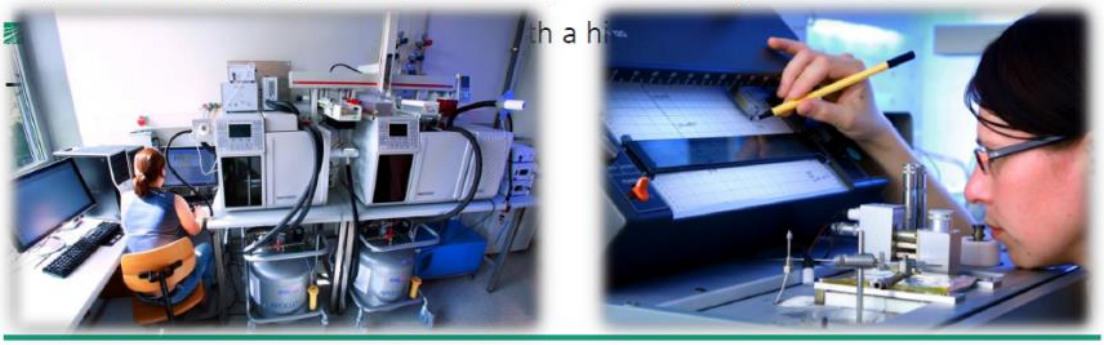
Assessing Odour Quality – GC-Olfactometry

- Assessment of **dominant** and/or **profile changes** of aroma compounds
- **Gentle extraction** of aroma compounds:

→ solvent assisted flavour evaporation (SAFE) distillation

- **High sensitivity and selectivity** via comprehensive techniques:

→ gas chromatography mass spectrometry / olfactometry (GC-MS/O)



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Sensorial Evaluation of Foods

Assessing Odour Quality – Sensory

- Trained sensory panel

→ sensory impressions ratings (taste, aroma, texture, etc.) + interactions

→ sensory correlations with chemical-analytical and physical parameters

Images © Fraunhofer IVV

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Sensorial Evaluation of Foods

Flavour Release in Real-Time

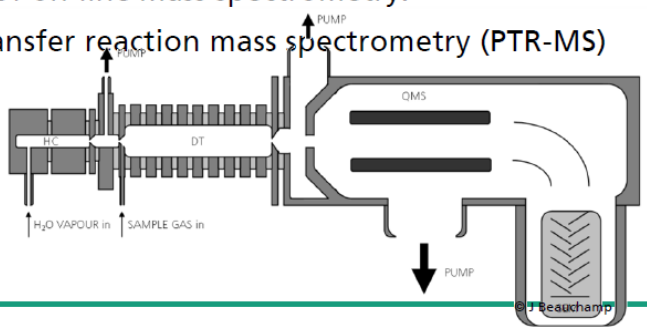
Characterisation → food aromas : release processes

Optimisation → processes, formulations, texture : sensory parameters

Assessment → food aroma perception : release during consumption

Application of on-line mass spectrometry:

→ proton transfer reaction mass spectrometry (PTR-MS)



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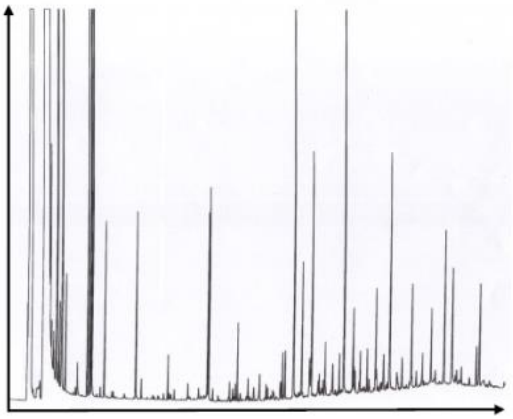
Sensorial Evaluation of Foods

Aroma Compound Detection using GC-MS/O

- Comprehensive
- Unequivocal compound identification
- Quantitative



Chromatogram

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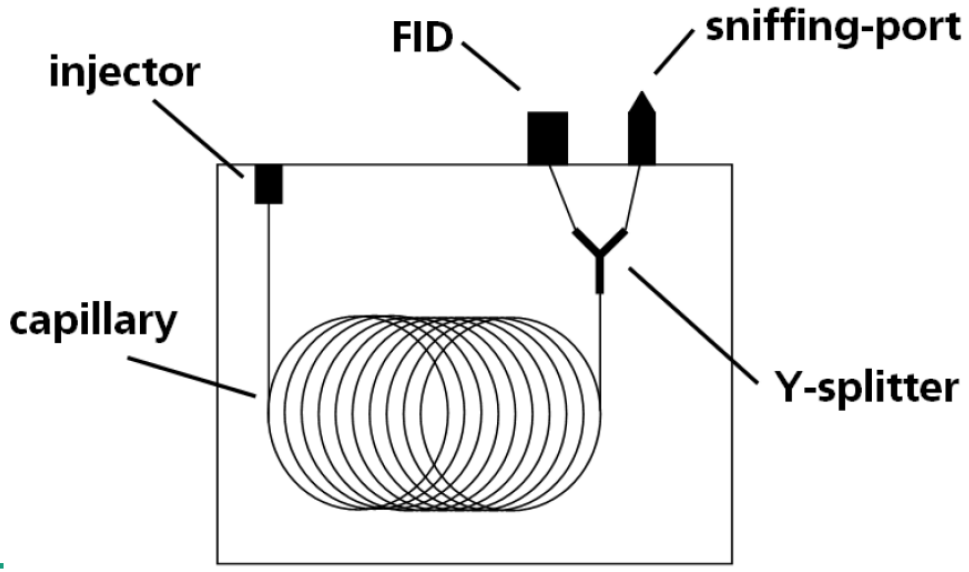
Sensorial Evaluation of Foods

Assessing Odour Quality – GC-Olfactometry



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Sensorial Evaluation of Foods

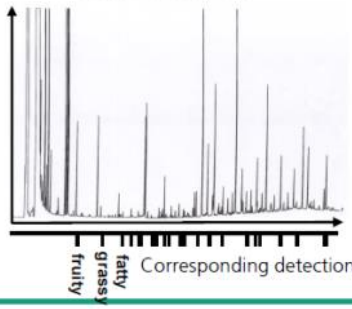
Assessing Odour Quality – GC-Olfactometry

Food sample

SAFE distillation

GC-FID/olfactometry

GC-FID/MS response



Corresponding detection via the nose

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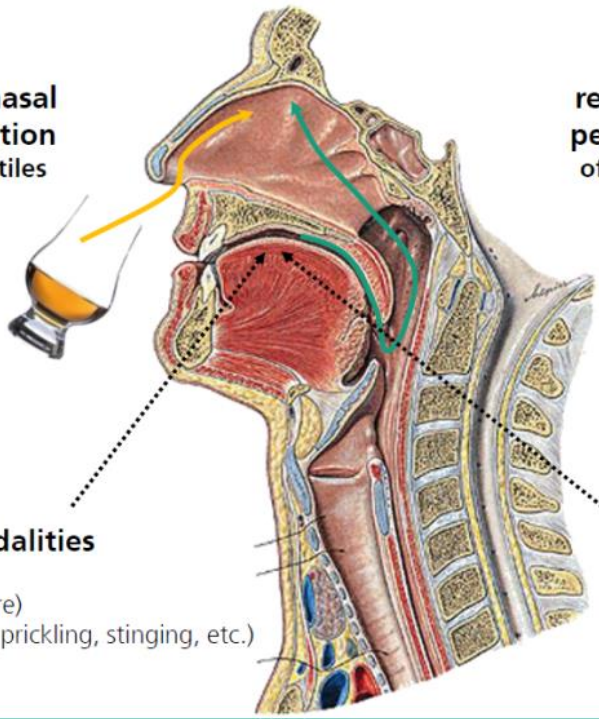
Sensorial Evaluation of Foods

Flavour Perception

orthonasal perception of volatiles

retronasal perception of volatiles



Other sensory modalities
Temperature
Tactile sensations (texture)
Trigeminal (astringency, prickling, stinging, etc.)

Taste
(Non-volatiles)

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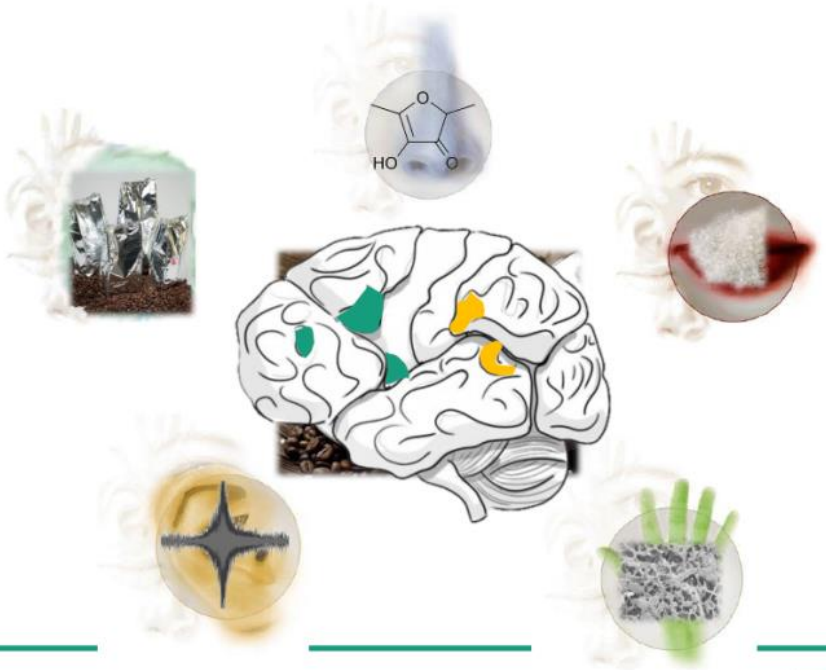
Sensorial Evaluation of Foods

Flavour Perception – Multisensory Integration



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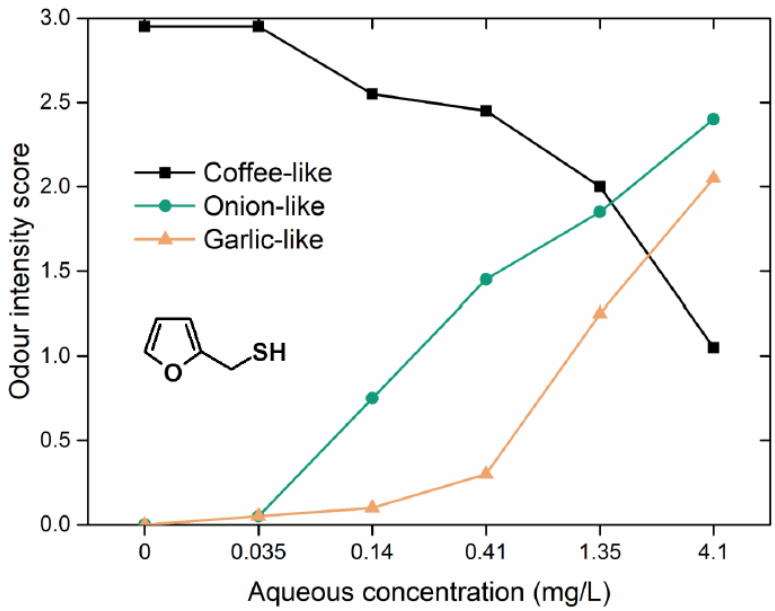
Sensorial Evaluation of Foods

Assessing Odour Quality – Concentration vs. Quality

- More is **not always better**: increasing **2-furfurylthiol** in a **coffee beverage**



M Czerny, Fraunhofer IVV, unpublished data

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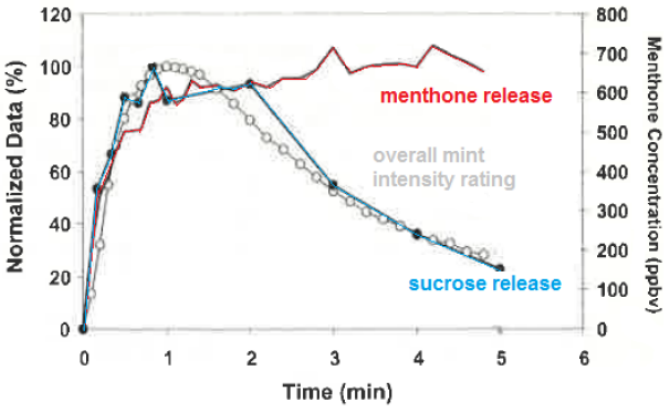
Sensorial Evaluation of Foods

Assessing Odour Quality – Cross-Modal/Congruency

- **Cross-modal interactions** & **congruency** play an important role in **perception**



Davidson *et al.* 1999, J. Agric. Food Chem. 47 (10), 4336–4340
Mestres *et al.* 2006, J. Agric. Food Chem. 54 (5), 1814–1821

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Sensory Analytics – Summary

- **Chemical characterisation of odorous compounds by MS**

→ food aromas | odours of consumer products | off-odours

- **Sensory assessment of odours**

→ Perception | thresholds | character

- **Odorant dynamics**

→ during mastication (nosespace) | during perception (intranasal)

- **Acceptance, preference, perception**

→ hedonic tests | consumer consensus | psychological response | physiological effects

→ **Odour characterisation: from formation to perception** ←

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Thank you very much!

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롤란드 프란츠 [패키징 - Part 1]
식품 포장재 안전성 평가 기술(나노물질, 이취, 법적동등성) 등

Dr. Roland Franz [Food Packaging - Part 1]
Food content materials(FCM) – chemical migration, compliance and safety assessment

[**패키징** - Part 1]

식품 포장재 안전성 평가 기술(나노물질, 이취, 법적동등성)등

유럽에서 식품접촉물질은 모든 식품접촉물질에 대한 일반적인 요구조건을 규정한 프레임워크 규정 (EC) 제1935/2004을 기본으로 한다.

활성지능 포장을 포함한 모든 식품포장 연관 재질과 물질은 GMP 기준에 부합하여야 하며, 일반적인 사용조건하에서 포장재에 포함된 성분의 이행으로 인해 다음과 같은 변화가 있어서는 안된다.

(a) 건강 위협.
(b) 바람직하지 않은 식품 성분을 변화
(c) 관능적 품질 변패

특정 물질 또는 물질 및 물품 집단에 대한 특정 법령은 다음 법령에 규정되어 있다.
- 세라믹 제품에 대한 지침 84/500/EEC
- 재생산 셀루로오스 필름에 대한 지침 2007/42/EC
- 재활용 플라스틱 물질에 관한 규정 EC 282/2008
- 활성 및 지능성 물질과 물품에 대한 규정 EC 450/2009
- 플라스틱에 대해서는 규정 EU 10/2011

식품포장재에 사용된 플라스틱에 대한 규정 EU 10/2011핵심 규정이며, 이 규정은 식품접촉 플라스틱 제조에 사용 가능한 것으로 승인된 거의 1000가지 물질의 목록이 포함되어 있으며 아래 웹 페이지에서 확인 가능함

https://webgate.ec.europa.eu/sanco_foods/main/?event=substances.search&substances.pagination=1

EU 차원에서 관리되지 못하는 물질 및 물품에 대해서는 현재 개별 회원국의 법규에 따라 관리되고 있다.
유럽연합의 식품포장애 안전성 법규에 대한 전체 내용은 다음 사이트에서 찾아볼 수 있다.

http://ec.europa.eu/food/food/chemicalsafety/foodcontact/eu_legisl_en.htm

본 발표에서는 다음 주제의 법적 요구조건에 관해서 개략적으로 설명할 것이며, 프라운호퍼 IVV의 노하우와 서비스가 귀사가 봉착하고 있는 문제점에 대해 경제적인 해결책을 제시할 수 있을 것이다.
- 유해물질 스크리닝 시험을 포함하는 이행 동등성 실험
- 식품포장재에 인위적으로 첨가하지 않는 물질
- 이행 시험 결과의 법적 동등성 및 안전성 평가
- 식품포장재에서 나노물질의 이행 안전성
- 이취 원인물질의 분석과 정성

롤란드 프란츠 박사

[Food Packaging - Part 1]

Food Contact Materials (FCM) – Chemical Migration, Compliance and Safety Assessment

Dr. Roland Franz

In Europe, food contact materials (FCM) fall under the scope of the Framework Regulation EC 1935/2004 which lays down the general requirements for all food contact materials. Article 3 requires:

"Materials and articles, including active and intelligent materials and articles, shall be manufactured in compliance with good manufacturing practice so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could:

(a) endanger human health
(b) bring about an unacceptable change in the composition of the food
(c) bring about a deterioration in the organoleptic characteristics thereof."

Specific legislation for particular materials or groups of materials and articles is given by
- Directive 84/500/EEC for ceramics
- Directive 2007/42/EC for regenerated cellulose film
- Regulation EC 282/2008 for recycled plastic materials
- Regulation EC 450/2009 for Active and intelligent materials and articles and
- Regulation EU 10/2011 for plastics

Plastics Regulation EU 10/2011 is the most important one in Europe. It sets the rules for plastic food contact materials and contains a list of almost 1000 substances authorised for the manufacture of food contact plastics. A list of these substances can be found at:

https://webgate.ec.europa.eu/sanco_foods/main/?event=substances.search&substances.pagination=1

Groups of materials and articles for which EU legislation is not yet in place are covered by national legislations of European Member States.

A full overview of the European legislation can be found at:

http://ec.europa.eu/food/food/chemicalsafety/foodcontact/eu_legisl_en.htm

In the presentation an overview will be given on the following topics against the legal requirements and how Fraunhofer IVV know-how and services can provide economic solutions:
- Migration and compliance testing including screening methods
- Not intentionally added substances (NIAS) in FCM
- Compliance and safety assessment of migration test results
- Migration potential of nanoparticles in polymer nanocomposites
- Analysis and identification of off-odours and off-smells

Dr. Roland Franz

Fraunhofer IVV

Food Contact Materials (FCM) – Chemical Migration, Compliance and Safety Assessment

Dr. Roland Franz,

Head of Department
‚Product Safety and Analytics'

Korea National Food Cluster (AnFC) Symposium
Seoul, 17th November 2015

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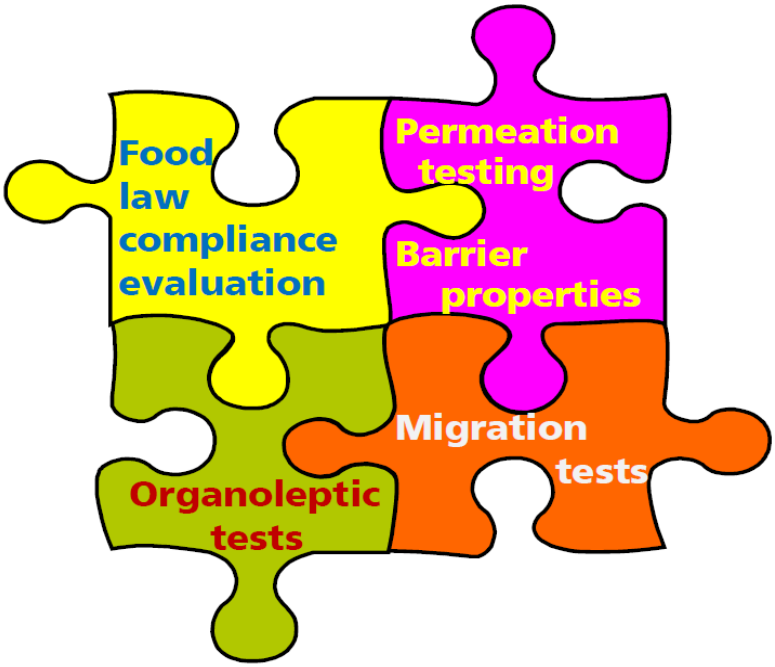
Compliance of Packaging Materials is like a Puzzle



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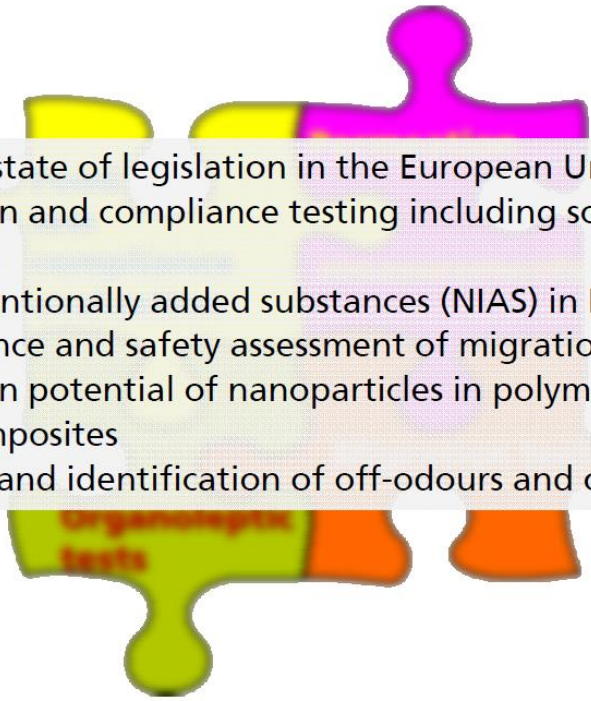
What is on the agenda?



- Current state of legislation in the European Union (EU)
- Migration and compliance testing including screening methods
- Non-intentionally added substances (NIAS) in FCM
- Compliance and safety assessment of migration test results
- Migration potential of nanoparticles in polymer nanocomposites
- Analysis and identification of off-odours and off-smells

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Current state of legislation in the European Union (EU)

http://ec.europa.eu/food/food/chemicalsafety/foodcontact/eu_legisl_en.htm

In the EU food contact materials and articles are regulated by:

- Framework Regulation EC 1935/2004 - general requirements for all food contact materials
- Legislation on specific materials - groups of materials and articles listed in the Framework Regulation
- Directives on Individual Substances or groups of substances used in the manufacture of materials and articles intended for food contact
- National legislation covering groups of materials and articles for which EU legislation is not yet in place

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Current state of legislation in the European Union (EU)

The EU regulatory overarching roof that covers all FCMs

FRAMEWORK REGULATION (EC) No 1935/2004

General requirement of Article 3:

"Materials and articles, including active and intelligent materials and articles, shall be manufactured in compliance with good manufacturing practice so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could:

(a) endanger human health

(b) bring about an unacceptable change in the composition of the food

(c) bring about a deterioration in the organoleptic characteristics thereof.

Good Manufacturing Practice REGULATION (EC) No 2023/2006

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Current state of legislation in the European Union (EU)

EU Legislation on specific materials - groups of materials and articles listed in the Framework Regulation

- Ceramics
  Directive 84/500/EEC: limits Cd, Pb & gives analytical method
- Regenerated cellulose film
  Directive 2007/42/EC: authorised substances, conditions of use, provisions for plastic coated regenerated cellulose film
- Recycled plastic materials
  Regulation EC 282/2008: authorisation of recycling procedures
- Active and intelligent materials and articles
  Regulation EC 450/2009: sets requirements for safe use and authorisation scheme
- Plastics
  Regulation EU 10/2011: sets the rules for plastic food contact materials

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Current state of legislation in the European Union (EU)

EU Regulation 10/2011 on plastics FCM

- What rules does the Regulation set?
  - European Union List of authorised monomers and additives for use in plastics manufacture (995 substances listed the EU Commission FCM database: https://webgate.ec.europa.eu/sanco_foods/main/?event=substances.search&substances.pagination=1)
  - Restrictions and specifications for authorised substances including specific migration limits
  - Rules on non-intentionally added substances (NIAS) i.e. impurities and reaction products
  - Overall migration limit (10 mg/dm²)
  - Rules on compliance especially migration testing, listing simulants, testing (t, T) conditions
  - The concept of functional barrier
  - Authorisation for nano-materials before use
  - Declaration of compliance and supporting documentation.

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Current state of legislation in the European Union (EU)

EU Regulation 10/2011 on plastics FCM

- What does the Regulation cover?
  - Printed or coated plastic materials and articles
  - Printed or coated plastic multi-layer materials and articles held together by adhesives or other
  - Plastic layers or coatings forming gaskets in caps and closures
  - Plastic layers in multi-material, multi-layer materials and articles

- Five amendments so far
  - EU Regulation 321/2011: bans the use of Bishenol A in plastic infant feeding bottles.
  - EU Regulations 1282/2011, 1183/2012, 202/2014, 174/2015: adding new substances, amending restrictions and specifications of already authorised substances in the Union list, corrections
  - 6th Amendment is expected shortly

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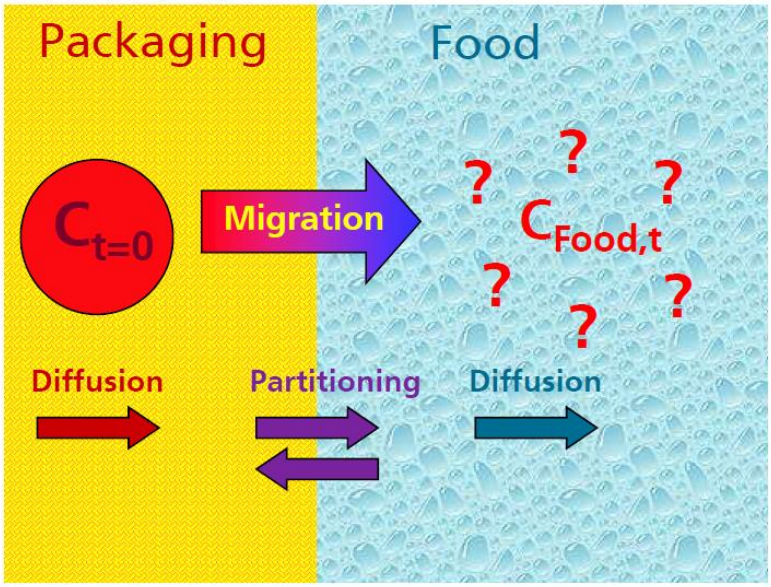
Migration & compliance testing incl. screening methods

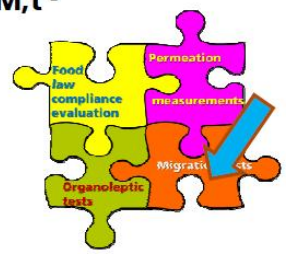


The key question

How can I get
- quickly,
- reliably and
- at affordable costs

the concentration of the migrant in food

$C_{M,t}$?



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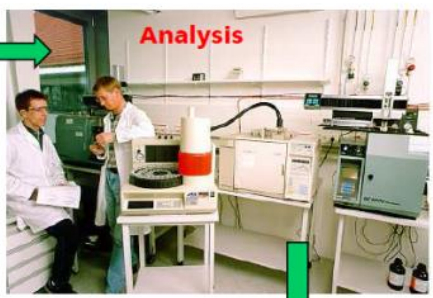
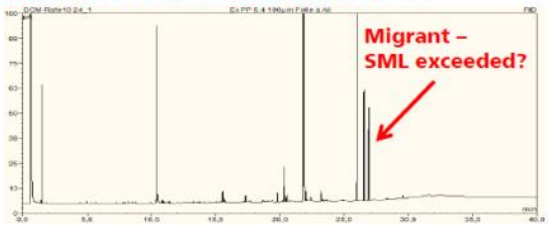
Experimental migration/compliance testing



This is time and costs consuming!

⇒ We offer more economic & rapid alternatives:
- Screening tests
- Migration modelling

Result (from GC measurement)



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Compliance of Packaging Materials

Analytical Equipment

- Extraction techniques: headspace, solvent extracts, purge&trap, thermo-desportion, ASE, SPE, SPME
- State-of-the-art instrumental equipement: GC und HPLC with various detector systems, MS, low and high resolution, coupled techniques: GC/MS, HPLC/MS, MS/MS, AAS, XRF, 1 and 2 dimensional GC/MS/olfactometry, aroma extract dilution analysis (AEDA), Field flow fractionation
- Labs for trace and ultra-trace analysis
- Sensory analysis laboratory: panel & GC-sniffing, Quantitative determination of trace amounts of odorants (stable isotope dilution analysis)

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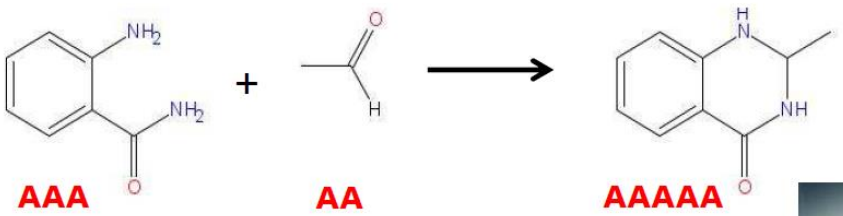
Case example: Acetaldehyde (AA) scavenger anthranilamide (AAA) used in PET water bottles

Chemical reaction:



AAA **AA** **AAAAA**

AA is sensorially active in bottled water and can be unpleasantly tasted by the consumer at concentrations in the low ppb range !!

AAA (FCM no. 164) is listed in EU Regulation 10/2011 with SML = 50 ppb (µg/kg)

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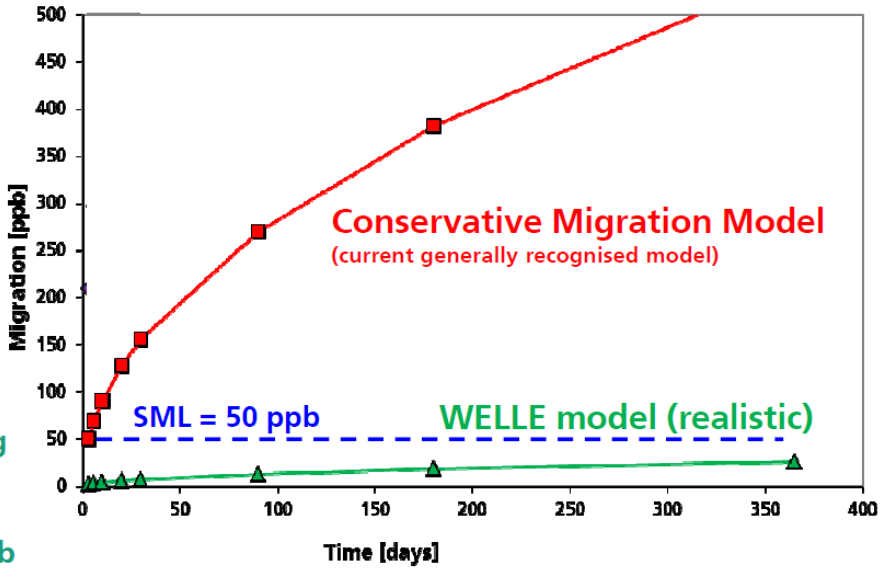
Migration modeling of AAA from PET bottle into water at room temperature up to 1 year

Assumption: typical AAA use level in PET: 500 ppm



Validation of WELLE model by migration testing for 10d@40°C

Predicted: 21 ppb
Measured: 17 ppb

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Non intentionally added substances (NIAS) in FCM

- What are non-intentionally added substances (NIAS)?
  - impurities of substances used
  - reaction intermediates formed during the polymerisation process
  - decomposition or reaction products

→ can occur in the final product.

→ are exempted from the authorisation and inclusion in the positive list of EU Regulation 10/2011

→ in accordance with internationally recognised scientific principles on risk assessment (Article 19)

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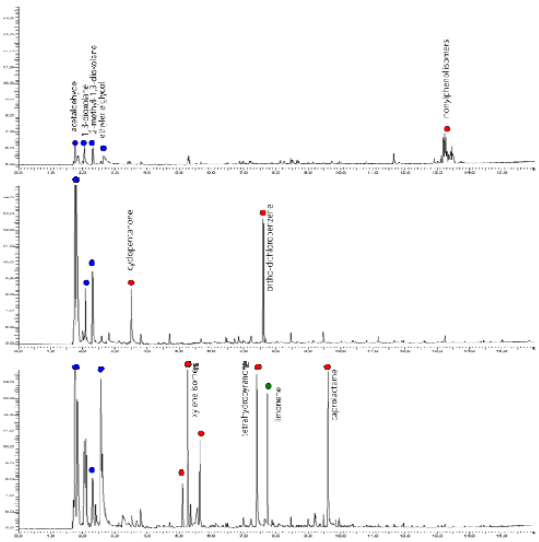
Non intentionally added substances (NIAS) in FCM



Examples of gas chromatogram obtained from PET bottles drawn from the market with NIAS :

Chemical structures:
in blue: PET polymer based,
in red: additives or masterbatches,
in green: substances from the beverages

Franz, R. Welle, F. Investigation of non-intentionally added substances (NIAS) in PET bottles and closures. Poster presentation at the 4th international Symposium on Food Packaging, 19-21 November 2008, Prague

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Non intentionally added substances (NIAS) in FCM

- Approaches for the risk assessment of NIAS
- Case-by-case approach considering available toxicological information and the migration level
  - The "classical" migration categories:
    - Migration < 0.05 mg/kg
    - Migration 0.05 - 5 mg/kg
    - Migration 5 - 60 mg/kg
    - "no detectable migration" < 10 µg/kg (10 ppb)
- Toxicological assessment can be based on:
  - Threshold of Toxicological Concern (TTC)
  - Computational methods (SARs, QSARs)
  - Read across
  - Margin of Exposure (MOE) Concept

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Compliance & safety assessment of migration test results

- Compliance with compositional requirements
  All used monomers and additives must be listed ('Positive list') of EU Plastics Regulation 10/2011
- Compliance with limitations given in Regulation 10/2011
  - Overall migration limit (OML)
  - Maximum permitted quantity in the material (QM)
  - Specific migration limit (SML)
    - Calculation of 100 % migration,
    - Migration modelling
    - Experimental migration measurements
- Case-by-case assessment of NIAS and other non-evaluated substances
  In accordance with internationally recognised scientific principles on risk assessment (Article 19)

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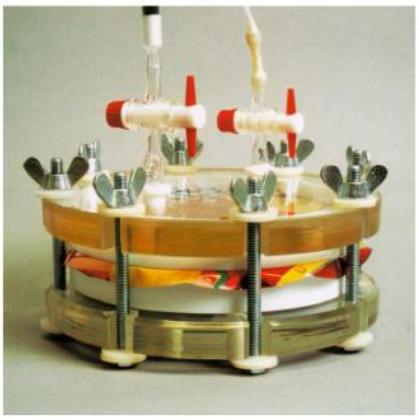
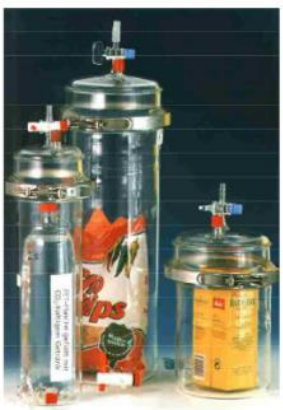
Compliance of Packaging Materials

Permeation Measurements

Barrier properties to avoid loss of flavours and to protect against contamination from external chemicals





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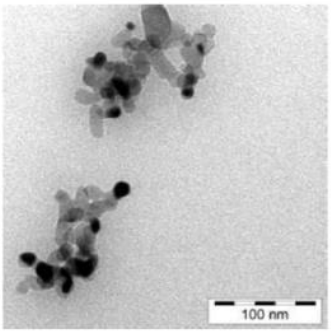
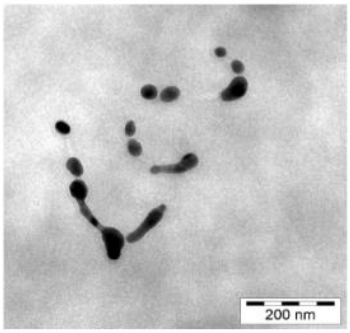
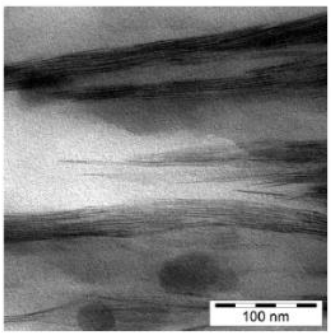
Migration potential of nanoparticles in polymer nanocomposites







Examples for nanomaterials in LDPE

- Titanium nitride
- Silver nanoparticles
- Intercalated organomodified clay

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Regulatory situation of nanomaterials in EU

- EU Recommendation on the definition of a nanomaterial (2011/696/EU):
  - *A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm.*
- All nanomaterials need to be approved as such on a case by case basis (listing in EU Plastics Regulation 10/2011 without specification as nanomaterial is not sufficient!)
- Actually approved nanomaterials as additives in food contact plastics:
  - Synthetic Amorphous Silica
  - Carbon Black
  - Titanium nitride (reheat additive for PET)
  - Butadiene-Acrylate-Methacrylate-Styrene-copolymers (impact modifiers in PVC)

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Migration of nanomaterials from food contact plastics?

- Studies of Fraunhofer IVV showed experimentally:
  - Nanoparticles completely incorporated into plastics **do not migrate** into food simulants (carbon black, synthetic amorphous silica, nano clay, titanium nitride and others) at detection limits of 0.02 – 25 µg/dm².
  - Silver nanoparticles showed migration of ionic silver (intentionally used for antimicrobial effect), but not of silver particles.
- Theoretical considerations (migration modeling) strongly underpin the assumption that nanoparticles are immobilised when fully incorporated in food contact plastics (no direct contact):
  → Particles larger than 3 – 5 nm diameter cannot migrate out of a plastic matrix.
- Our publications related to nanoparticle migration:
  - Bott J., Störmer A., and Franz R., 2014. In: Chemistry of Food and Food Contact Materials: From production to plate. Benvenuto M A, et al. (eds): ACS Symposium Series 1159, American Chemical Society, Washington DC, US. doi:10.1021/bk-2014-1159.ch005
  - Bott, J., A. Störmer and R. Franz (2014). Food Additives & Contaminants: Part A **31**(10): 1769-1782.
  - Bott, J., A. Störmer and R. Franz (2014). Food Packaging and Shelf Life **2**(2): 73-80.

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Analysis and identification of off-odours and off-smells

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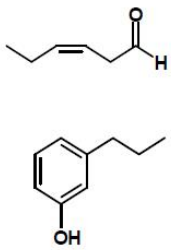
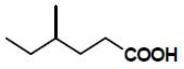
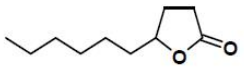
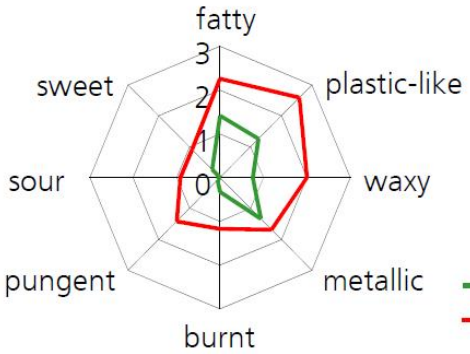
Sensory quality of packaging materials and off-odours









Off-odour formation from:

Irradiation
Light exposure
Temperature

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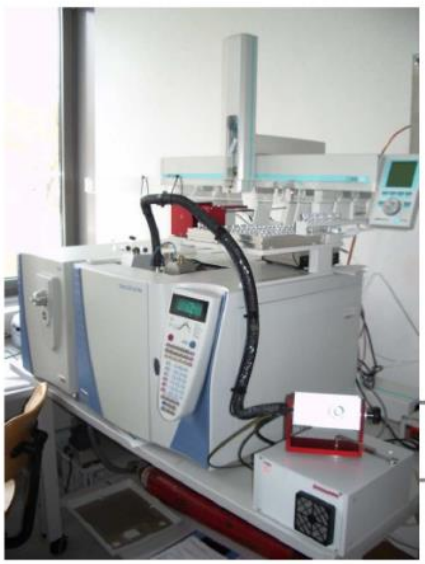
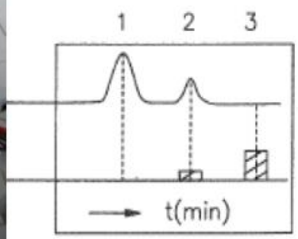
Case examples - a complex formation of an extremely active off-odour (‚Cat Piss')

GC-Sniffing as a suitable tool for identification of the cause of the off-odour

Separation and identification of off-odours via physical and phsiological detectors





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Case examples - a complex formation of an extremely active off-odour (‚Cat Piss')

Clarification
via GC sniffing

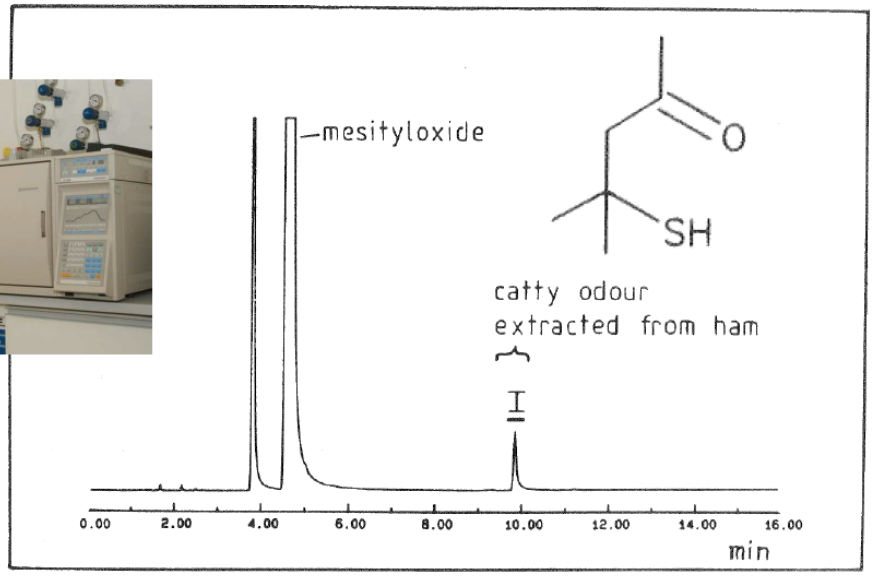

Figure 2. FID gas chromatogram of the reaction mixture resulting from mesityl oxide and hydrogen sulphide and the observed range of retention times, for the extracted odour given off the ham. Column: 25-m Carbowax 20M with 0.32 mm i.d. and 0.25 μm film thickness. Column temperature: programmed at 5°C min^{-1} from 50 to 180°C. Injector temperature: 200°C. Detector (FID) temperature: 200°C. Carrier gas: helium at 8.7 psi column pressure

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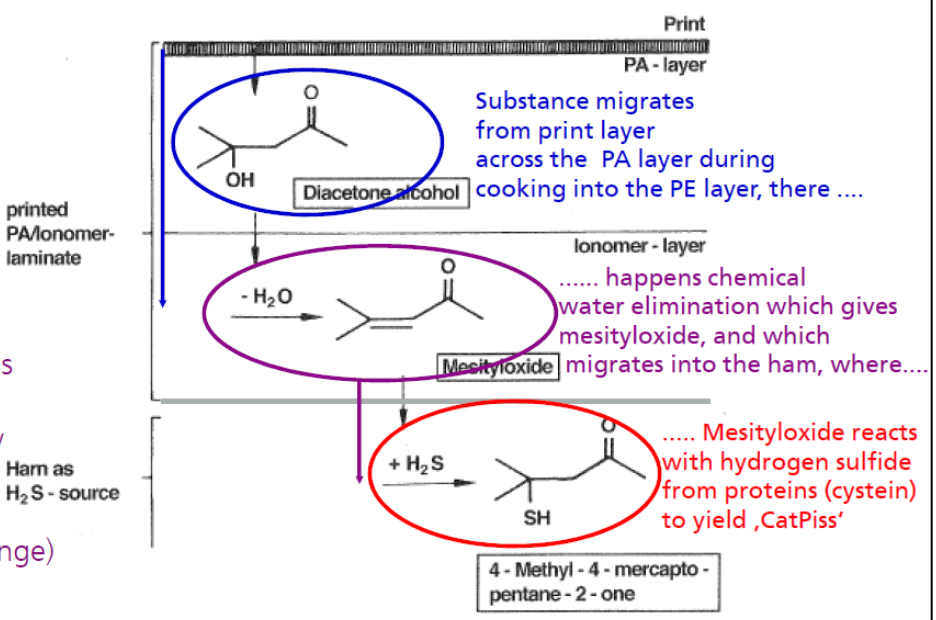
Case examples - a complex formation of an extremely active off-odour (‚Cat Piss')



Complex
mechanism causes
an off-odour
with an extremely
low odour
thresholds
(in the sub ppt range)

Figure 13-5: Formation mechanism of the off-odor-compound.

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Thank you for your attention!

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캐롤린 하우저 [품질안전 - Part 2]
식품의 품질개선 및 유통기한 연장

Dr. Carolin Hauser [Quality and Safety - Part 2]
Quality enhancement and shelf-life prolongation of food

[**품질안전** - Part 2]

식품의 품질개선 및 유통기한 연장

세계보건기구(WHO)의 세계적인 식품 낭비 와 음식물 쓰레기에 관한 최신 보고서에 따르면 전 세계적으로 매년 약 300억 톤의 식품이 손실되거나 낭비된다. 현재 전 세계적으로 식품의 손실을 줄이기 위해 품질을 보존하고 유통기한을 연장하는 것이 핵심 사안이다. 하지만 품질 부패는 식품 제품마다 다 다르다. 품질 손실은 물리적, 화학적 및 미생물학적 반응에 의해 유발될 수 있다. 가장 전형적인 물리적 품질 반응은 신선 또는 신선 절단 농산물의 수분 손실이다. 이에 식용 코팅은 신선 절단 농산물의 수분 손실을 줄일 수 있는 혁신적인 기술이며, 항미생물제 또는 산화방지제도 품질손실을 막는 역할을 한다. 식품을 생산하는 기술도 또한 물리적인 품질에 급격한 영향을 줄 수 있다. 이것은 초콜릿 기술을 통해서 보여줄 것이다.

식품의 화학적 품질은 주로 산소와 빛의 영향을 받는다. 그 결과 제품의 품질을 최대한 오래 보존하기 위한 완벽한 포장 및 보관 해결책을 찾기 위해서 포장된 제품의 구체적인 산소 내성을 아는 것이 대단히 중요하다.

전형적인 품질 손실 가운데, 미생물학적 반응은 품질의 부패를 유발할 뿐 아니라 식품과 관련된 질병 및 발병을 유발할 수 있다. 이와 대조적으로 자연 및 신선 식품에 대한 소비자들의 수요는 지속적으로 증가하고 있다. 항미생물학적 포장과 같은 혁신적인 기술과 자연스러운 항미생물제에 대한 잠재성을 논할 것이다.

캐롤린 하우저 박사

[Quality and Safety - Part 2]

Quality enhancement and shelf-life prolongation of food

Dr. Carolin Hauser

According to the latest WHO report on Global Food Losses and Food Waste about 30 billion tons of Food get lost or wasted globally each year. Preserving quality and prolonging the shelf-life of food is therefore a key issue in order to decrease the global food losses. But quality decay differs from food product to food product. Quality losses can be caused by physical, chemical and microbiological reactions. The most typical physical quality reaction is water loss of fresh and fresh-cut produce. Edible coating is an innovative technology, which is able to decrease the water loss of fresh-cut produce while bringing also other advantages like incorporation of antimicrobials or antioxidants. But also the technology of producing the food can influence the physical quality drastically. This will be shown on chocolate technology.

Chemical quality of food is mainly influenced by oxygen and light. Consequently, it is crucial to know the specific oxygen tolerance of the packaged product in order to find the perfect packaging and storage solution to preserve its quality as long as possible.

Among the typical quality losses, microbiological reactions can not only cause quality decay, but may also lead to food related illnesses and outbreaks. In contrast, consumers' demands for naturally and fresh products have been risen continuously. Innovative technologies such as antimicrobial packaging and the potential of natural antimicrobials will be presented.

Quality enhancement and shelf-life prolongation of food

Dr. Carolin Hauser

Head of Business Field Food

November 2015

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Quality decay

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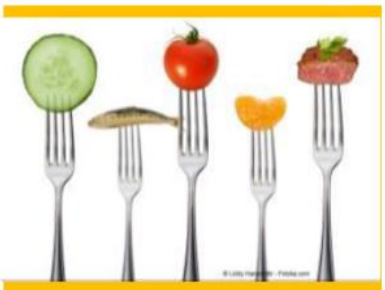
Our Business Fields



Food

Processing Machinery

Packaging

Recycling

Fraunhofer IVV

Our Business Fields

Food

Processing Machinery

Packaging

Recycling

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Outline

1. Physical Quality
   - Chocolate techology
   - Edible coating
2. Chemical quality
   - Oxygen
   - Light
3. Microbiological quality
   - Natural antimicrobials
   - Antimicrobial packaging
   - Chitosan
     - Antimicrobial packaging
     - Edible Coating

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Desiccation
Weight loss

Physical quality

Fat bloom

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Physical Quality

Fat Bloom of Chocolate

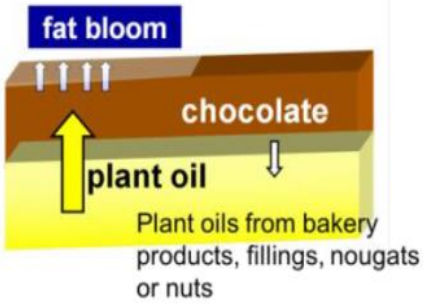
Fat migration of products enrobed with chocolate

Problem

95 % of practical problems arise from fat bloom,
but 95 % of research is on polymorphic transformation

Influenced by:

- Tempering degree,
- oil release of the filling and the chocolate,
- milk fat content,
- production technique



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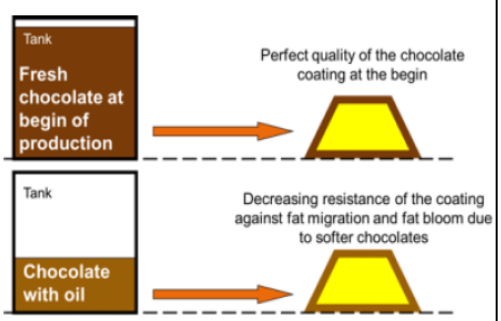
Physical Quality

Fat Bloom of Chocolate

Fat migration of products enrobed with chocolate

Investigations

- Adjustment of tempering conditions to altered crystallization kinetics
- Analytical control of fresh products by TD-NMR, DSC, texture measurments, HPLC, SFC
- Mixing behavior of bakery and filling fats with milk fat and cocoa butter
- Chemical mechanisms, kinetics (diffusion equation)
- Mobile oil and oil binding capacity



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Physical Quality

Chocolate technical centre for smallscale production (3-5 kg)



- Roasting of cocoa and oil seeds
- Mixing and grinding with roller or ball mills
- Conching
- Tempering
- Molding (Cold forming, one-shot)
- Manufacturing of filled chocolate products by cold forming or one-shot technology

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Physical Quality

Weight loss of fresh-cut produce


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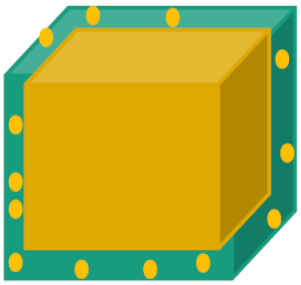
Physical Quality

Edible Coating



Materials:

- Proteins (whey, casein, soy, gluten)
- Carbohydrates (alginate, chitosan, methylcellulose, starch)
- Waxes and oils

-> food components

Demands:

- Lower water loss
- Specific barrier (oxygen, water vapor, CO_2)
- Mechanical stability
- Color stability
- No sensorial impact
- Addition of antimicrobials, antioxidants, etc.

-> depending on the needs of the individual product

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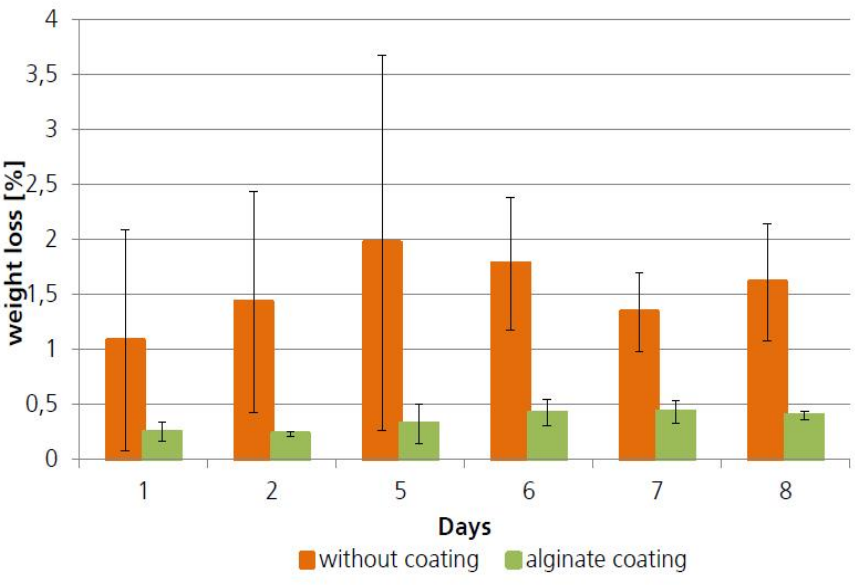
Physical Quality

Edible Coating – weight loss effect

FRESH COAT



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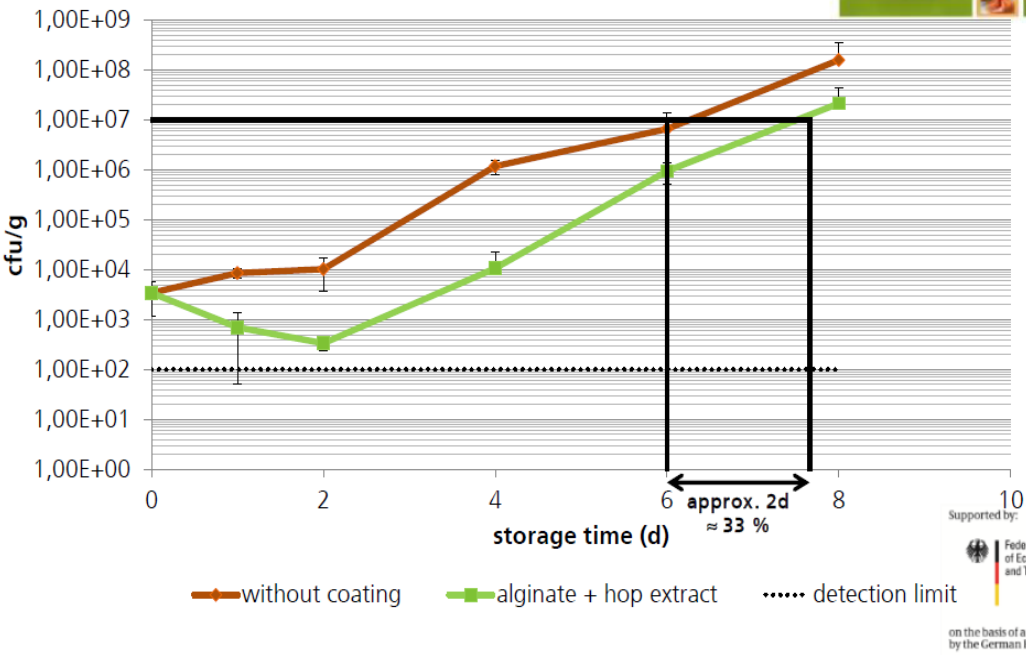
Physical Quality

Edible Coating – incorporation of antimicrobials



Supported by:
Federal Ministry of Economics and Technology
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Chemical quality

Off-odour
Vitamin loss

Greying
Rancidity

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Chemical Quality

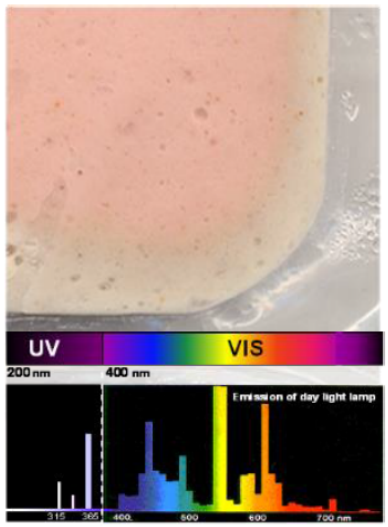
Influence of Oxygen and Light

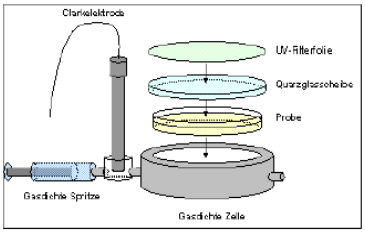
Background

- Plastic instead of glass
- Transparent packaging
- Residual oxygen contents in the packaging
- Food with photo-sensitizers

Quality changes

- Autoxidation
- Photo-oxidation (e.g. photo-sensitizer)
- ▶ Color changes, rancidity, off-flavor etc.





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Chemical Quality

Influence of Oxygen and Light

Research and know-how on the following topics:

- Damages by oxygen (e.g. lipid oxidation, photo-oxidation, off-flavor)
- Required oxygen (e.g. respiration, microbiological risks, color)
- Oxygen sources (e.g. headspace, permeation, dissolved oxygen)
- Oxygen tolerance (e.g. determination of food sensitivity)

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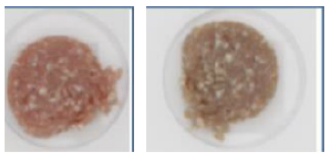
Chemical Quality

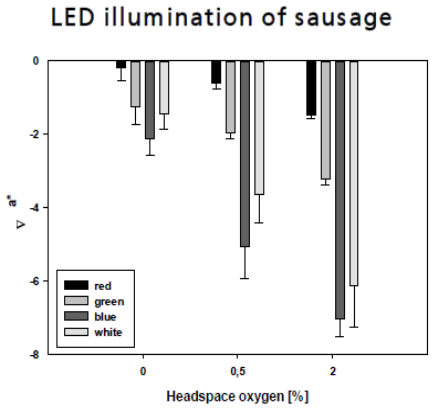
Influence of oxygen and light

Technology transfer to industry for the evaluation of

- UV-filters
- Lightning concepts
- Antioxidants
- Packaging concepts (oxygen barrier)
- Modified Atmosphere Packaging
- Oxygen Scavenger



Oxygen tolerance:
1.6 mg O_2/100g



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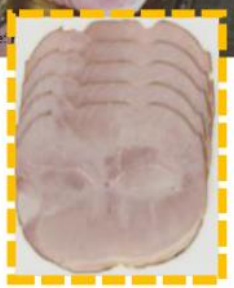
Chemical Quality

Influence of oxygen and light – use of oxygen scavenger

GEPRÜFTE Qualität Bayern



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Contaminations

Microbial quality

Contaminations

EHEC outbreak 2011 Germany:
4000 illnesses, 53 deaths

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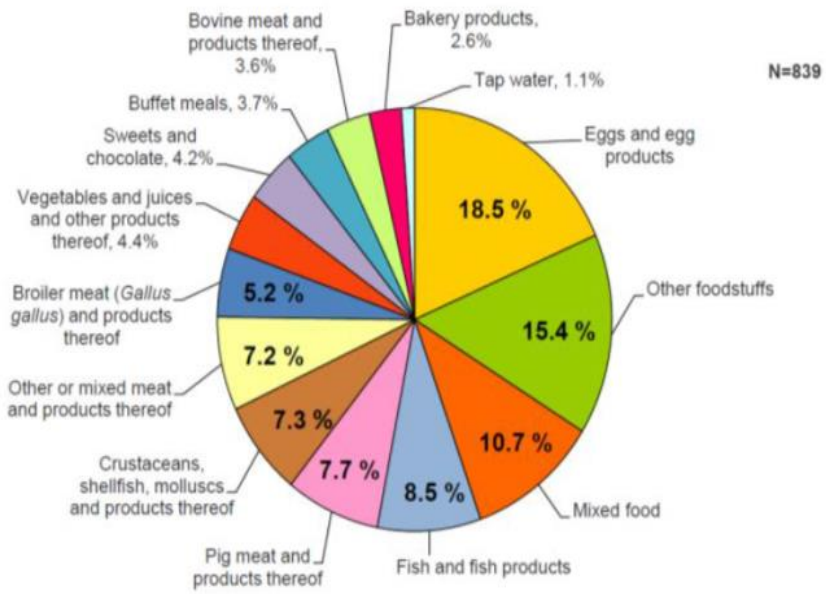
Microbiological Quality

Food-borne zoonoses: outbreaks EU 2008-2013



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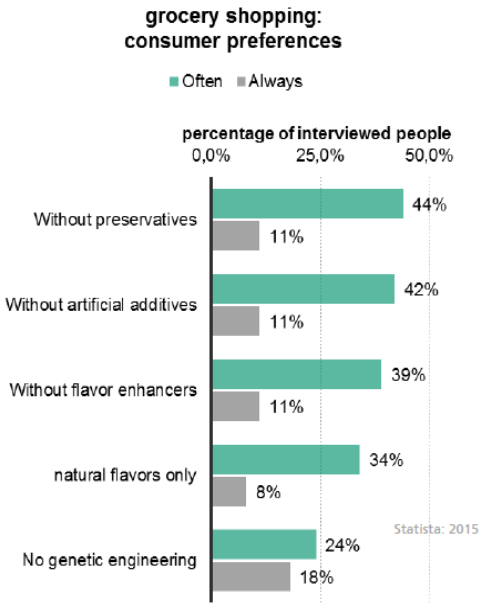
Microbial Quality

How to address food safety issues in regard of consumer preferences?



→ consumer preferences

- convenience
- clean labeling
- minimal processing:
  - washed
  - cut
  - mixed
  - packed

→ increasing demands towards producers:

- food safety
- shelf life

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Microbial Quality

Consumer trends – FRESH natural antimicrobials

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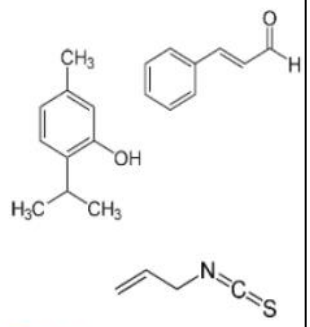
Microbial Quality

Classes of „natural antimicrobials“

Single components
- volatile
- non-volatile

Essential oils
- mixtures
- volatile

Preservatives
- single components
- non-volatile



Plant extracts
- mixtures
- non-volatile
- + solvent

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Microbial Quality

Screening volatile plant extracts for antimicrobial activity

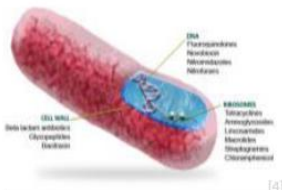
→ *in vitro* screening vs. food associated bacteria

→ 184 volatile extracts from 86 plant varieties

→ vs. *Escherichia coli* + *Staphylococcus aureus*

→ Screening steps:

1. minimal inhibitory concentration (MIC) (bacteriostatic)
2. minimal bacteriocidal concentration (MBC)
   - → in liquid growth media (solution vs. emulsion vs. dispersion)
   - → across the vapor phase



→ Identification of active compounds

→ Identification of antibacterial mode of action

[3] http://static1.squarespace.com/static/52f02ddae4b02fdbc093a745/t/5465f5b6e4b094164a000ade/1415968182670/
[4] http://amrls.cvm.msu.edu/pharmacology/antimicrobials/resolveuid/797f2109b405eba1ed7393d25f426f13

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Microbial Quality

Screening results

→ 17 extracts with MIC < 200 µg/ml vs. *Escherichia coli*

→ 35 extracts with MIC < 200 µg/ml vs. *Staphylococcus aureus*

Selected screening results:		minimal inhibitory concentration [µg/ml]					
plant		*E. coli* DSM 1103			*S. aureus* DSM 1104		
trivial name	botanical name	Ex 1	Ex 2	Ex 3	Ex 1	Ex 2	Ex 3
Citronella	*Cymbopogon nardus*	200		/	200		/
Chinese cinnamon	*Cinnamomum cassia*	200		<50	200		<50
Cinnamon bark	*Cinnamomum zeylanicum*	200	50	.	200	50	
Lemongrass	*Cymbopogon citratus*	400	400	400	400	100	400
Litsea	*Litsea cubeba*	200	200	200	< 50	100	100
Niaouli	*Melaleuca quinquenervia*	6400	/	3200	200	100	1600
Neem tree	*Azadirachta indica*	1600			<50		
Oregano	*Origanum vulgare*	<50	100	<50	<50	<50	<50
Palmrose	*Cymbopogon martinii*	200	200	400	400	200	800
Patchouli	*Pogostemon cablin*	/	/	/	<50	200	200

/ - no inhibition; blank space – not available;

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Microbial Quality

Natural Antimicrobials– Hop extract

Objective:

- Natural antimicrobial agent for prolonging the shelf life of fresh produce (Clean labelling)

Procedure

- Determination of the antimicrobial efficiency of various hop extracts
- Investigation of influence parameters (pH-value, synergism effects)
- Evaluation of sensory properties
- Development of application methods for fresh products and covenience food (e.g. fresh produce, meat)

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Microbial Quality

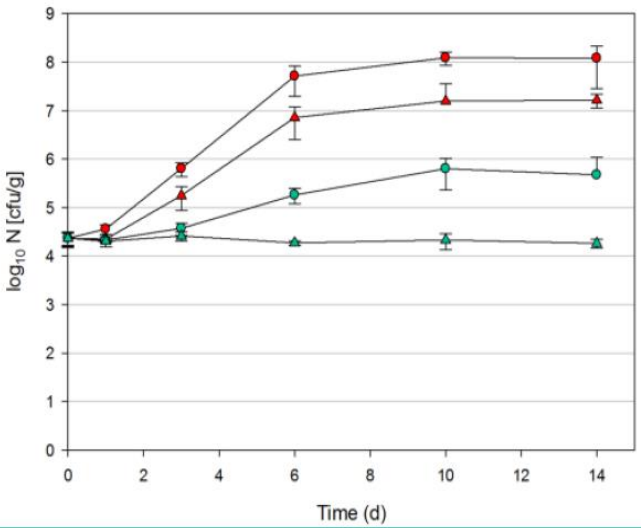
Natural Antimicrobials – Hop extract

Results:

- Effective against gram+ bacteria (e.g. listeria)
- Application in marinaded pork: Increased the shelf life by 50%

(●) reference, total aerobic, mesophillic cell count,
(▲) hop containing marinade (5000 ppm), total aerobic, mesophillic cell count,
(●) reference, *L. monocytogenes*,
(▲) hop containing marinade (5000 ppm), *L. monocytogenes*

Hop extracts on meat in marinade



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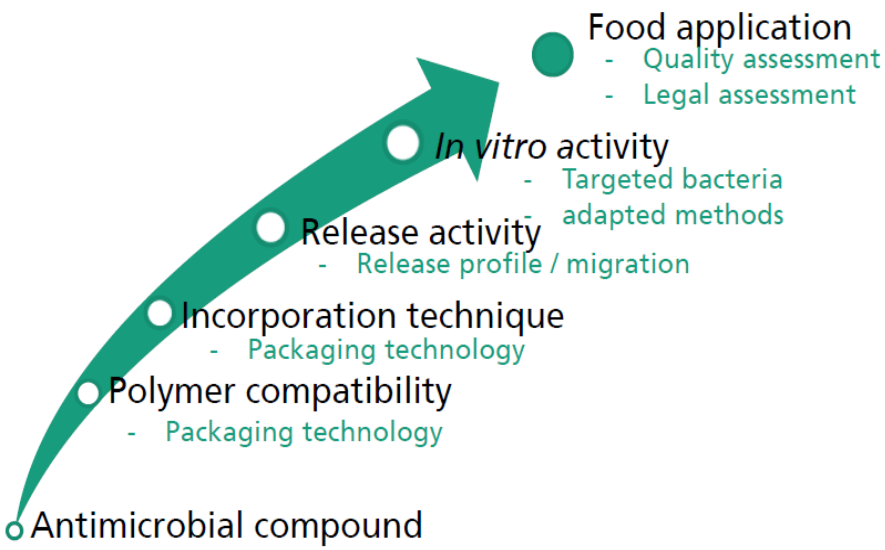
Microbial Quality

Antimicrobial packaging - development



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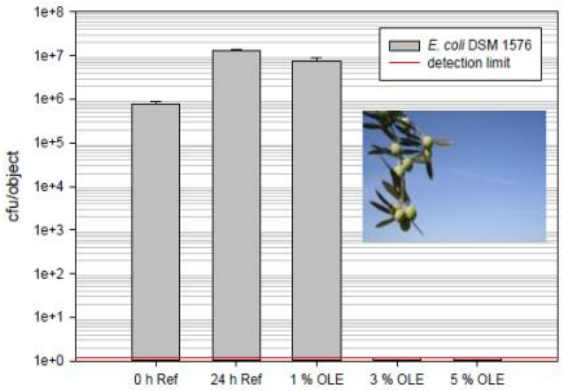
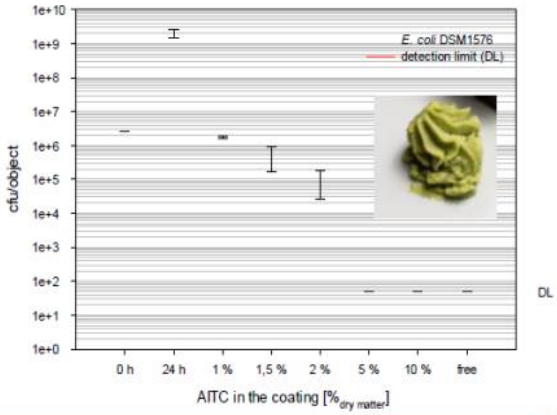
Microbial Quality

Antimicrobial packaging – prooves of concept





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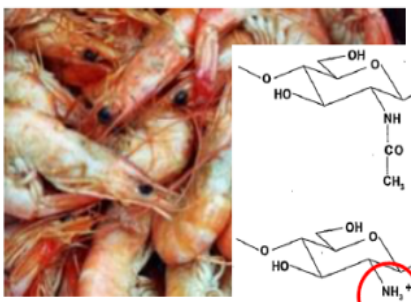
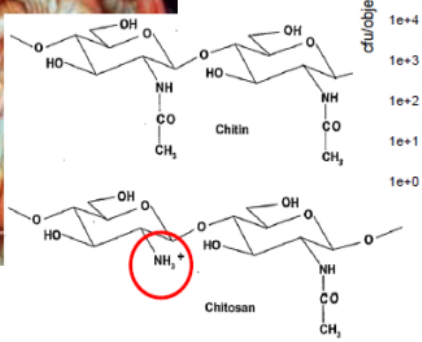
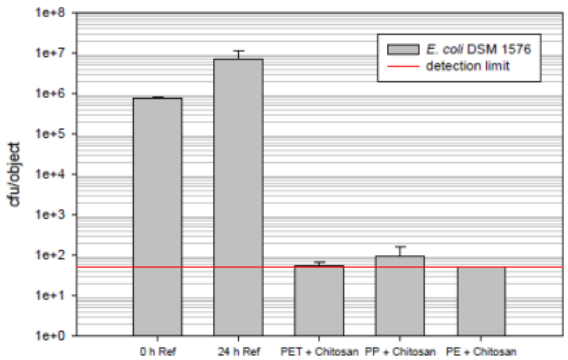
Microbial Quality

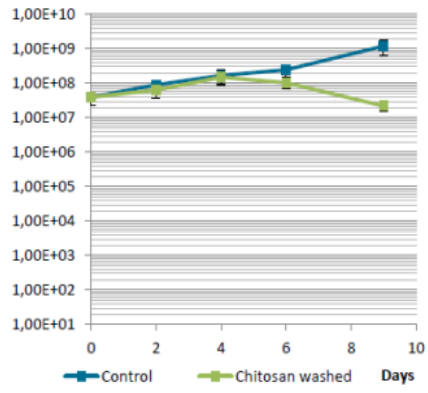
Chitosan







- Inherent antimicrobial efficiency
- Thin layer -> low amounts
- Already used as dietary supplement
- Edible **and** packaging coating



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FRESH COAT

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Conclusions

Quality enhancement and shelf-life prolongation

- Quality and food safety should be the given highest priority
- Quality decay can be caused by different reactions
- Understanding the mechanisms is crucial
- Food Technologies and Food Packaging can enhance quality
- Method should be appropriate for the specific product
- Qualified development and assessment is necessary

Hansik: you are what you eat

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Any questions?

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Dr. Carolin Hauser
Business Field Food

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phone: +49 8161 491-626
email: carolin.hauser@ivv.fraunhofer.de

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크리스티안 차켈 [기능성 - Part 2]
식품 맞춤형 기능성 물질 (천연 물질의 추출, 분리, 개량기술)

Christian Zacherl [Functional Foods - Part 2]
Tailor-made functional ingredients for foods – extraction, fractionation and modification

[**기능성** - Part 2]

식품 맞춤형 기능성 물질(천연 물질의 추출, 분리, 개량기술)

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크리스티안 차켈

[Functional Foods - Part 2]

Tailor-made functional Ingredients for foods – extraction, fractionation and modification

In the second talk, the research and development in the area of functional ingredients will be presented: In this technology field, we recover ingredients from plant raw materials for a variety of applications in foods, animal feeds, and cosmetics. Depending on the specifications that are required we modify the ingredients using physical, chemical, and biochemical methods. We thus realize products having customized technological or physiological properties, for example for improving texture, optimizing the nutritional value, or achieving a bioactive effect. The raw materials we use are residual plant materials after oil recovery, from the fruit and vegetable processing industry, and from the processing of oil seeds and protein seeds (e.g. press cake after the recovery of sunflower oil, rapeseed oil, and linseed oil). In addition, leguminous plants (e.g. lupins, peas, soya, and beans), cereals (e.g. rice and spelt), and pseudo-cereals (e.g. buckwheat and amaranth) are also suitable raw materials. We focus on using the recovered proteins, dietary fibers, and secondary plant materials, in particular phenolic components and carotenoids

Christian Zacherl

Tailor-made functional Ingredients for foods – extraction, fractionation and modification

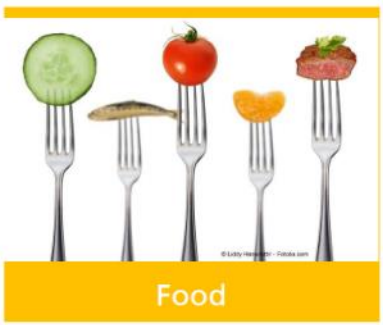


Christian Zacherl
Head of Business Field Food

November 2015

Fraunhofer

Business Fields


Food


Processing Machinery

Packaging


Recycling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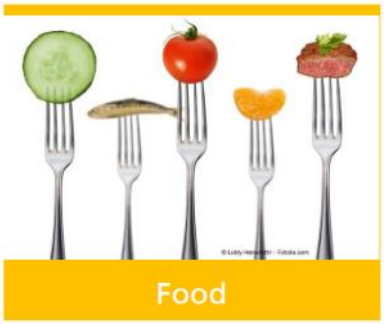
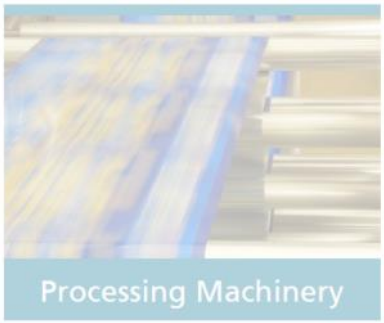
Business Fields



Food



Processing Machinery

Packaging

Recycling

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Functional Ingredients

Development of Tailor-made Food Ingredients

Plant-based raw materials
- Oil and protein crops
- By-products of fruit and vegetable processing

Extraction

Modification

High-quality ingredients for
- Food
- Feed
- Cosmetics

Residues from fruit and vegetable processing

Oilseeds, proteinseeds, grains:
Lupin, sunflower, soy,
rapeseed, linseed, rice

Proteins,
dietary fibres,
secondary plant
metabolites

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Functional Ingredients

Development of Tailor-made Food Ingredients

Plant-based raw materials
- Oil and protein crops
- By-products of fruit and vegetable processing

Extraction

Modification

High-quality ingredients for
- Food
- Feed
- Cosmetics

Protein extraction

Explosion-protected extraction plant

- Dehulling, flaking, milling
- Fractionation
- Separation, filtration
- Drying
- Modification
- Characterisation

Ultrafiltration

Spray-dryer

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Functional Ingredients

Application in Food

▶ e.g. Replacement of animal protein (egg, milk) and soy

Egg-free mayonnaise

Egg-free marshmallows

▶ e.g. Replacement of fat

Fillings for chocolate

Sausage for spreading

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German Future Prize 2014

Healthy and delicious lupine proteins

(from left to right) Dr. rer. nat. Stephanie Mittermaier, Dr.-Ing. habil. Peter Eisner, Dipl.-Ing. agr. Katrin Petersen,

Awarded:

Dr. Stephanie Mittermaier and
Dr.-Ing. habil. Peter Eisner
Fraunhofer Institute for Process Engineering and Packaging IVV, Freising

Dipl.-Ing. agr. Katrin Petersen
Prolupin GmbH

Lupines can constitute an important nutritional element of the human diet. Scientists have found a way to process lupine seeds so they can be turned into protein-rich, flavor-neutral ingredients for foods.

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Functional Ingredients

Health Benefits

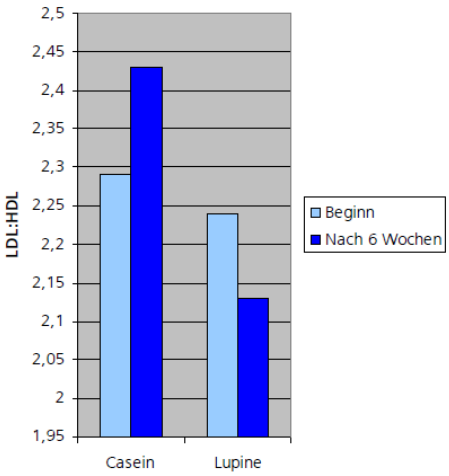
Cholesterol-lowering effects of lupin protein

Impact of lupin protein on the lipid metabolism in humans

Clinical trial

- 43 test persons, 6 weeks
- Diet contained 35 g lupin protein OR 35g casein per day
- Determination of wanted HDL cholesterol and unwanted LDL-cholesterol

▶ **The relation of LDL:HDL improved significantly after consuming a diet rich in lupin protein.**



Weiße et al (2009) Lupin protein compared to casein lowers the LDL-cholesterol to HDL-cholesterol-ratio of hypocholesterolemic adults Eur J Nutr, published online Aug 13th 2009

InnoNet-Projekt Lupine, **16IN0390**, cooperation with the University of Halle

Bundesministerium für Wirtschaft und Technologie

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Functional Ingredients

Pure vegetable ice cream

Lupin ice cream with lupin protein and rape seed oil

- without lactose
- free of cholesterol
- rich in unsaturated fatty acids
- very creamy – healthy enjoyment

Quelle: https://www.facebook.com/madewithluve?fref=ts

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Functional Ingredients

Plant based food ingredients

Lupin Ice-Cream

Lupin Ice Cream

- 1989-2004: Lupin technology development founded by government (BMBF, EU)
- 2004: Idea for ice-cream developed at Fraunhofer together with a partner
- Development funded by an internal Fraunhofer project (2005-2008)
- 2009: founding a Fraunhofer Spin-off company PROLupin
- 2010: Installing the Production
- May 2011: Entering the Supermarkets

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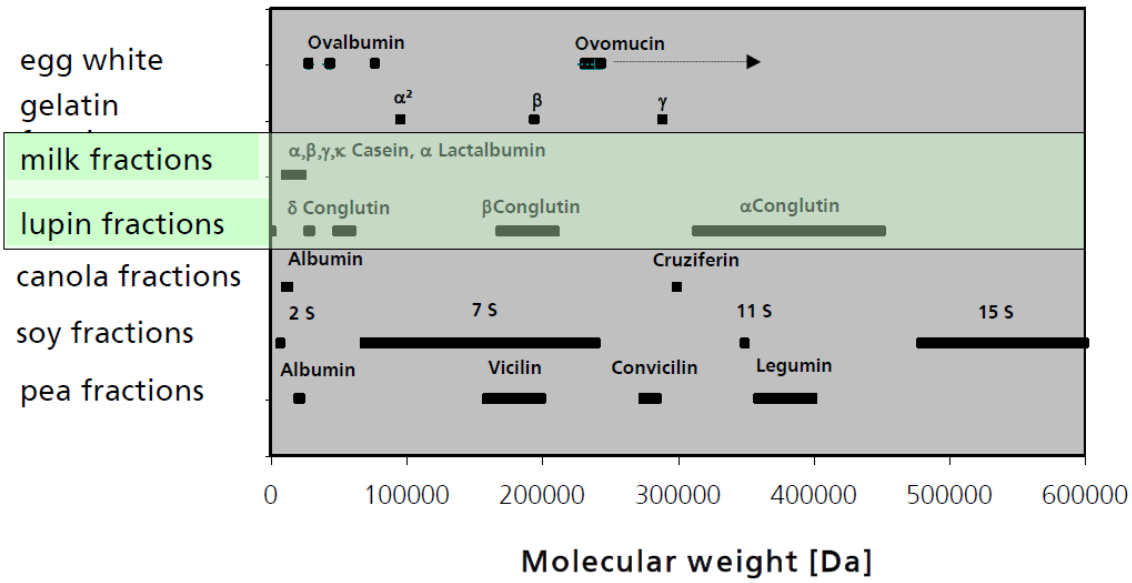
Ice cream – properties lupin protein



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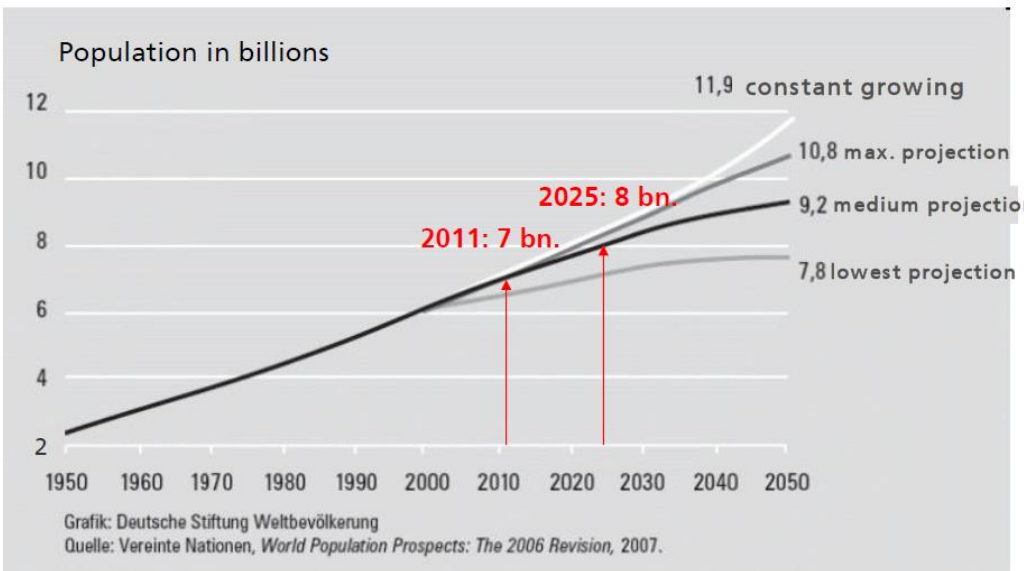
Functional Ingredients – integrated utilization

Development of world population until 2050



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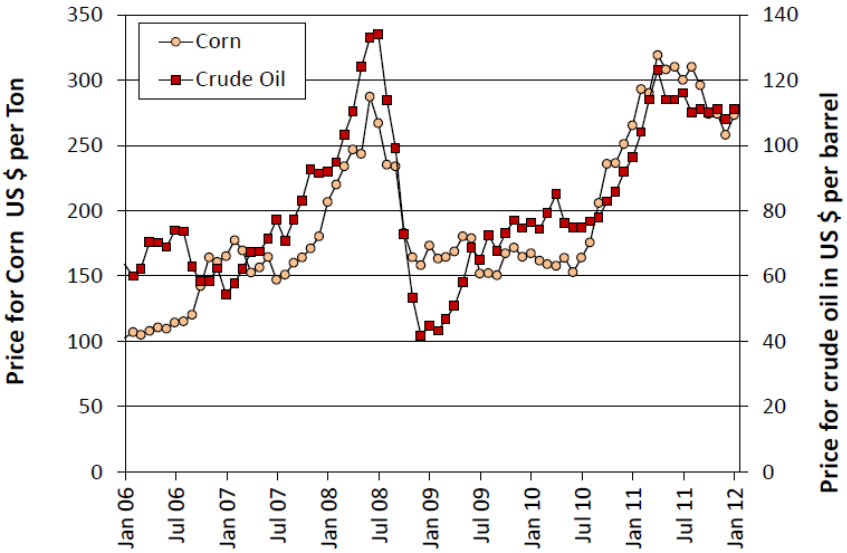
Functional Ingredients – integrated utilization

The Competition of Food and Energy



Indexmundi 2012

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Functional Ingredients – integrated utilization

Competition Food and Energy: Consequences example Corn

Bio-Ethanol

Aim:
Integrated use
of vegetable
raw materials –
simultaneous
food- and
energy-
Production

Tortillas

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Functional Ingredients – integrated utilization

Integrated use of vegetable raw materials

Vegetable raw materials
Protein- and Oilseeds

→ Production
Purifying

High valuable **food ingredients**

Technical raw materials

Bio-Energy

Lupin, Sunflower, Soy,
Rapeseed, Pea, Linseed

Proteins, Fiber Ingredients,
secondary plant metabolites
organic waste

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Functional Ingredients – integrated utilization

Example: Sunflower kernels – integrated use

Increased added value through total use of all fractions

Food and Feed Ingredients

Sunflower Kernels

- De-hulling → Hulls → *Energy*
- Pressing
- De-oiling → Oil → *Food use or raw material for Bio-fuels*
- Extraction → Fractionising → Molasses → *Fermentation, Bio-Ethanol*
- Milling Sieving → Formulation
- Protein Concentrate → Antioxidant → *Additive for Food, Cosmetics Fuels*

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Functional Ingredients – integrated utilization

Example: Sunflower kernels – integrated use

Increased added value through total use of all fractions

Increase in Added Value from

1.000 €/ha

to

1.900 €/ha

…ergy

…d use or …y material Bio-fuels

Molasses

Fermentation, Bio-Ethanol

Milling Sieving → Protein Concentrate

Formulation → Antioxidant

Additive for Food, Cosmetics Fuels

Food and Feed Ingredients

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Functional Ingredients

Application in Feed: Aquaculture, Pet Food

- Increasing the protein content / nutritional value
- Reducing unwanted components
- Replacing fish meal / animal meal by plant proteins
- New process for incorporating high levels of fat in pet food
- Testing the processability of new feed formulations

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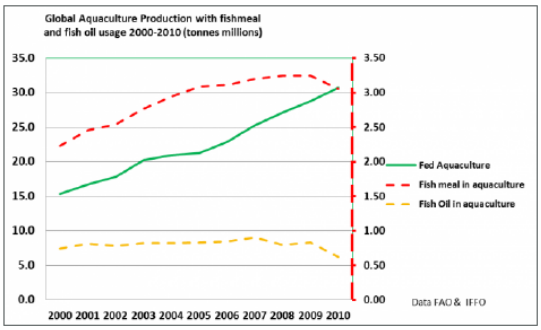
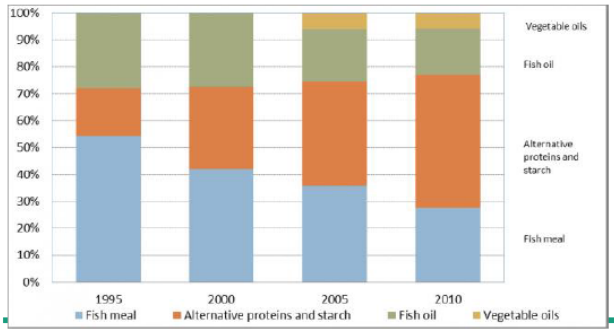
Functional Ingredients

How aquaculture growth influences the feed composition?





➔ Fairly constant consumption of fish meal and oil despite increasing fish production in aquaculture

➔ Increasing fish meal and oil substitution due to plant alternatives

Data FAO & IFFO

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Functional Ingredients

Development of fish feed with reduced amounts of fish meal using side streams from oil processing

Linseed cake

Rape seed cake

Sunflower cake

Soy press cake

Challenges:

Fish feed production:

- Adaptaion of technological processing parameters
- Adjusment of physical properties of the fish feed pellets

Feeding trials:

- Growth performance indicators of the novel feed
- Fish meat quality

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Functional Ingredients

	Protein [g/100 g TS]	Fibre [g/100 g TS]	Ash [g/100 g TS]
Rape cake 	(29,4) → 38,4	(19,7) → 10,7	6,9
Sunflower cake 	(22,4) → 34,7	(31,8) → 19,5	6,3

	Protein digestibility [%]	
	native	fibre-degraded
Rape seed cake	42,3	86,6
Sunflower cake	25,0	81,0

Gefördert durch: Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz aufgrund eines Beschlusses des Deutschen Bundestages

ptble

LfL Fischerei

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Thank you very much!

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클라우스 놀러 [패키징 - Part 2]
포장을 통한 제품의 가치 향상

Dr. Klaus Noller [Food Packaging - Part 2]
Enhanced product protection – active packaging functions for improved product protection

[**패키징** - Part 2]

포장을 통한 제품의 가치 향상

산소흡착 :

산소흡착 기술을 통한 포장내부의 산소 제거가 식품의 품질과 유통기한에 미치는 영향에 대해 발표할 것이다. 특히 기업과의 공동연구에서 가장 많이 제기되는 질문들과, 문제점 그리고 해결방안에 대해 이야기 할 것이다.

수분흡착 :

습기의 관리과 흡착은 과학과 산업 영역에서 매우 중요한 논제이다. 흡습 능력의 향상, 작용 메커니즘에 대한 연구 그리고 흡습 시간에 대한 기술적 연구가 수행되고 있다.

자외선 흡착 :

마지막으로 자외선의 부정적인 영향으로부터 식품을 보호하기 위한 포장재질 및 방법을 통한 자외선 흡착 기술과 이러한 흡착기술에 제품의 품질에 미치는 영향에 대해 설명할 것이다.

마지막으로 천연물 기반 고차단성 코팅제 제조 및 가공기술의 적용사례를 첨부하였다.

클라우스 놀러

[Food Packaging - Part 2]

Enhanced Product Protection - Active Packaging Functions for improved Product Protection

First oxygen scavengers, their main applications in industry, the technology to produce them, their properties and the effects on the shelf life and food product quality by avoiding of oxidation will be presented. At the example of a finished project with an industrial partner, typical questions, tasks and the solution will be shown.
Humidity regulation and absorption has become an important topic in science and for industrial applications. The technology to increase capacities, investigations on the working mechanisms and their time dependence have been performed.
Finally research on light absorption to protect food products from the negative influence of UV light are shown and how these absorbers influence the product quality.
A short last chapter about an example of a biopolymer based barrier coating is attached.

Klaus Noller

Enhanced Product Protection

Active Packaging Functions for improved Product Protection

Klaus Noller, Sven Sängerlaub,
Doris Gibis, Klaus Rieblinger

Seoul, 17th of November 2015

Fraunhofer IVV

Oxygen scavengers

Humidity regulation and absorption

UV- and light-absorption

Barrier coating based on whey

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Oxygen Scavenger

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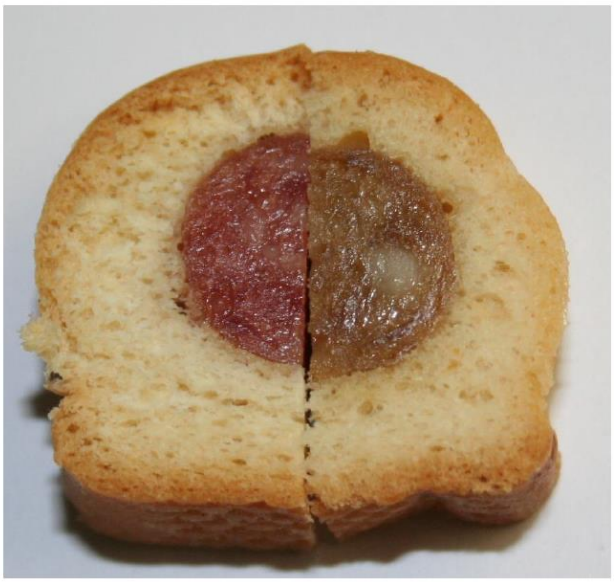
Why we need oxygen scavengers?



autoxidation

photooxidation

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Oxygen scavengers – state of the art

sachets,

labels

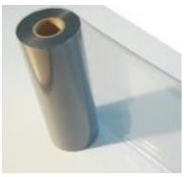
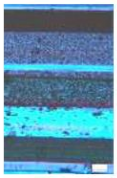

closures,

PET-bottles




films,

trays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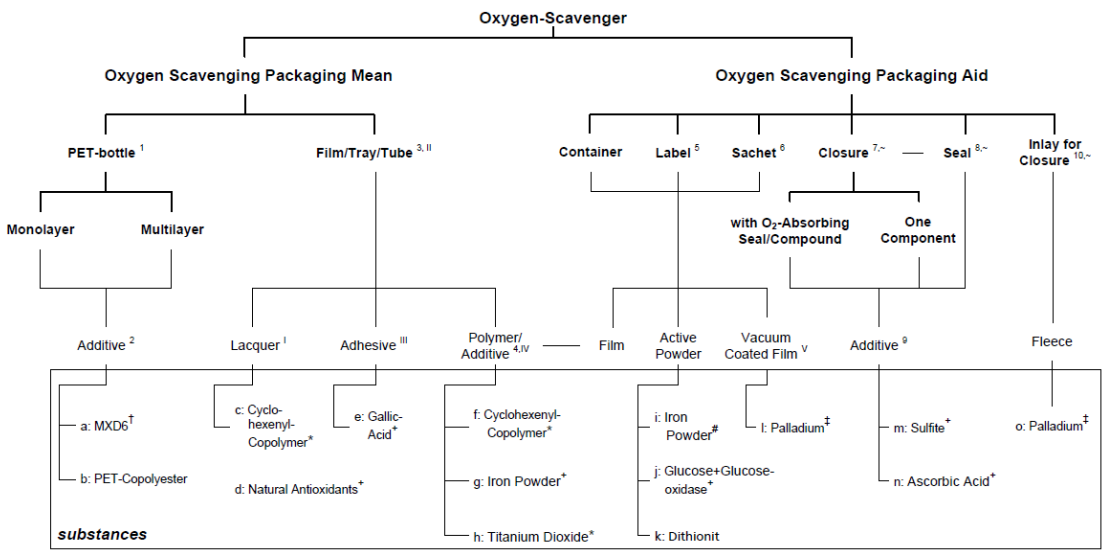
Oxygen scavengers – state of the art



~ for beverage packagings

Activation

† heat during extrusion
# self-activated (humidity)
‡ H_2-gassing
* UV-light/light
+ humidity of food

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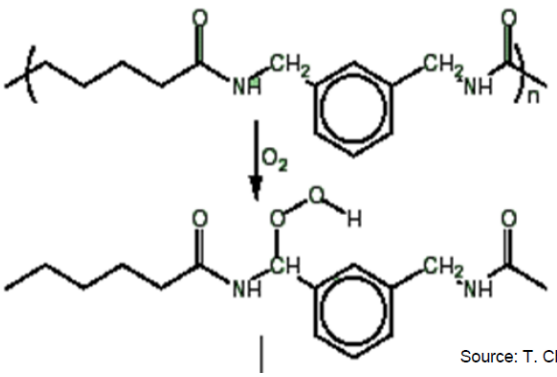
Oxygen scavengers – some reactions

$$Fe + \tfrac{1}{2} O_2 + H_2O \rightarrow Fe(OH)_2$$

$$2\ Fe(OH)_2 + \tfrac{1}{2} O_2 + H_2O \rightarrow 2\ Fe(OH)_3$$

$$Na_2SO_3 + \tfrac{1}{2} O_2 \rightarrow Na_2SO_4$$



Source: T. Ching, Tasteless Oxygen Scavenging Polymers, 2000

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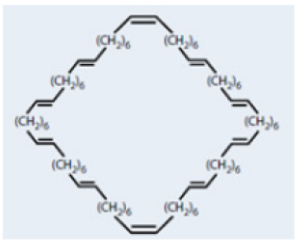
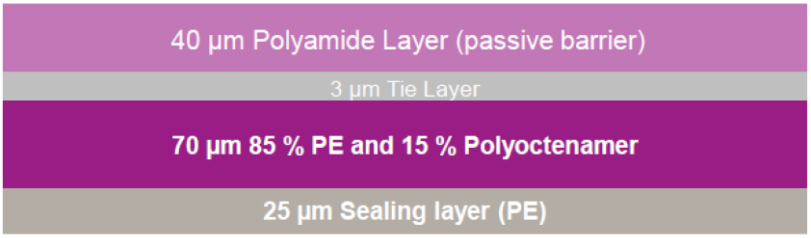
Oxygen scavengers – some reactions

Polyoctenamer is a polymer with unique properties:



~ 50 % large rings

	Polyoctenamer
Mw	~ 120.000
Tg	- 65 °C
Crystallinity at 23 °C	30 %
Melting point	54 °C
Thermal decomp.	~ 300 °C



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Category		Shelf life	Sensorial effect	Use of additives
	**Cake & Pastry**	x4	Better taste	Possible to leave out <u>all</u> additives, incl. acids and other natural anti-mould ingredients
	**Cheese**	x2	Better taste, smell and texture	Possible to leave out <u>all</u> additives
	**Processed meat**	x1	Better color, more natural look	Reduce nitrite level to minimum
	**Nuts**	x2	Better taste, smell and texture	n.a.
	**Tortillas**	x4	Better taste, smell and texture	Possible to leave out <u>all</u> additives, incl. acids and other natural anti-mould ingredients
	**Coffee**	x2	Better aroma	n.a.
	**Bread**	x3	Better taste	Possible to leave out <u>all</u> additives, incl. acids and other natural anti-mould ingredients

***FRESHCARE® is safe and in line with USA & EU regulations**

- Use of FRESHCARE® on food products is FDA approved, EU Reg.1935/2004 certificates available
- FRESHCARE® is non-toxic, is taste- and odourless

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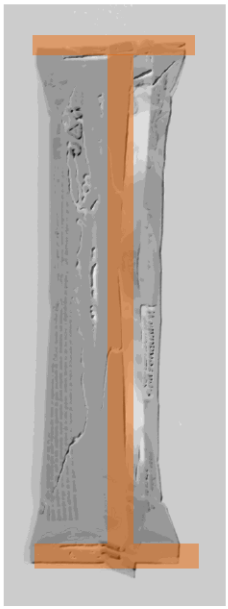
Snack; Packaging

packaging material:	Al-laminate
headspace:	180 cm³
inner area:	250 cm²
sealing layer width:	1 mm

residual O_2-concentration:	< 1 % ~ 1,5 mg O_2
O_2-permeation, sealing layers:	0,25 mg O_2 / 182 days
O_2-diffusion, pinhole d=10 µm:	7,6 mg O_2 / 182 days



Main oxygen impact caused by pinholes

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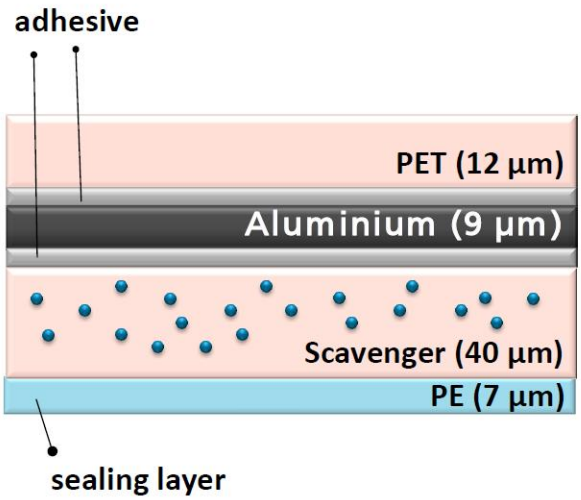
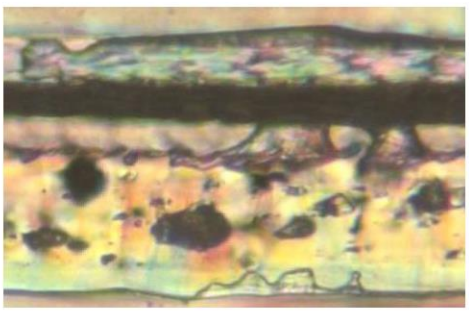
Snack; Oxygen scavenger film – iron based





Scavenger layer: 50 % w/w SHELFPLUS®O_2 2400 + 50 % w/w PE

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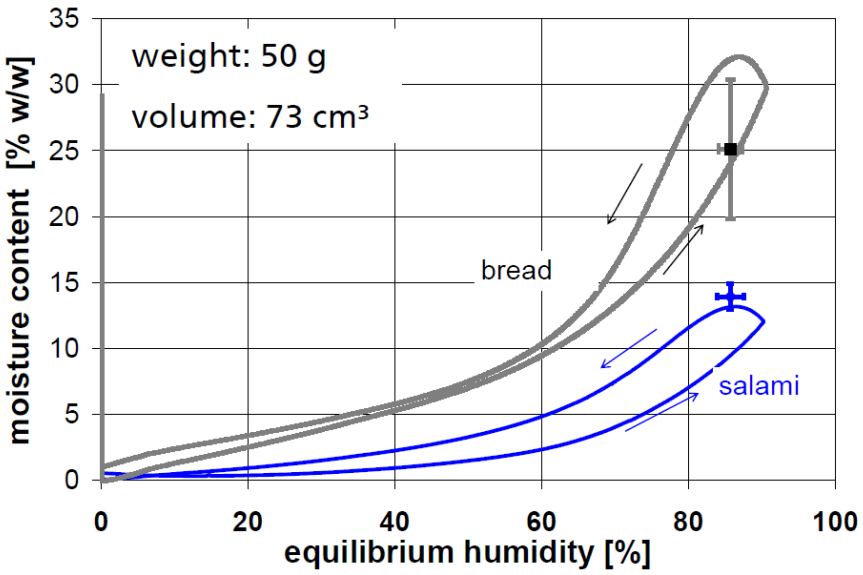
Snack product



Humidity of snack sufficient to activate O_2-scavenger

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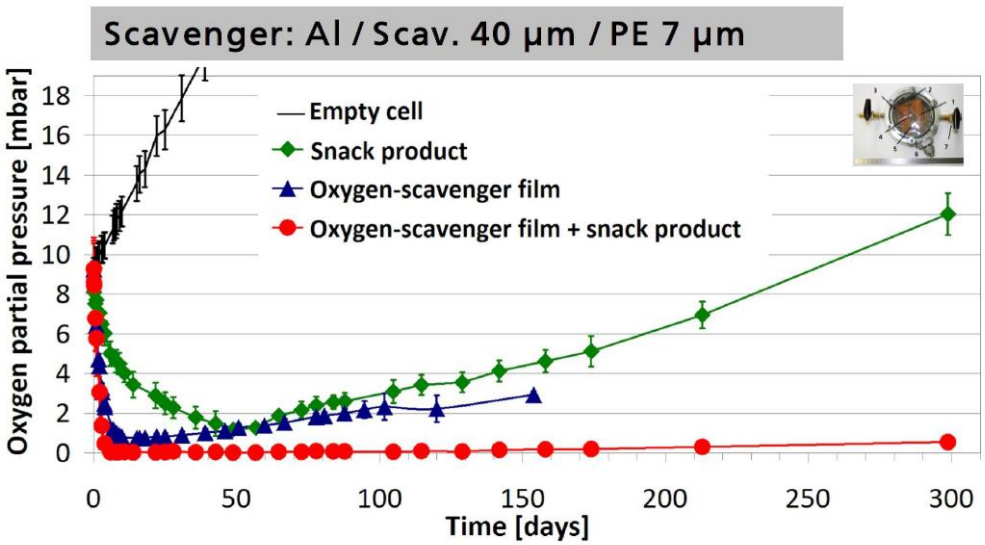
Snack; Activity of scavenger: combination snack/scavenger



Oxygen scavenger film absorbs O_2 faster than snack

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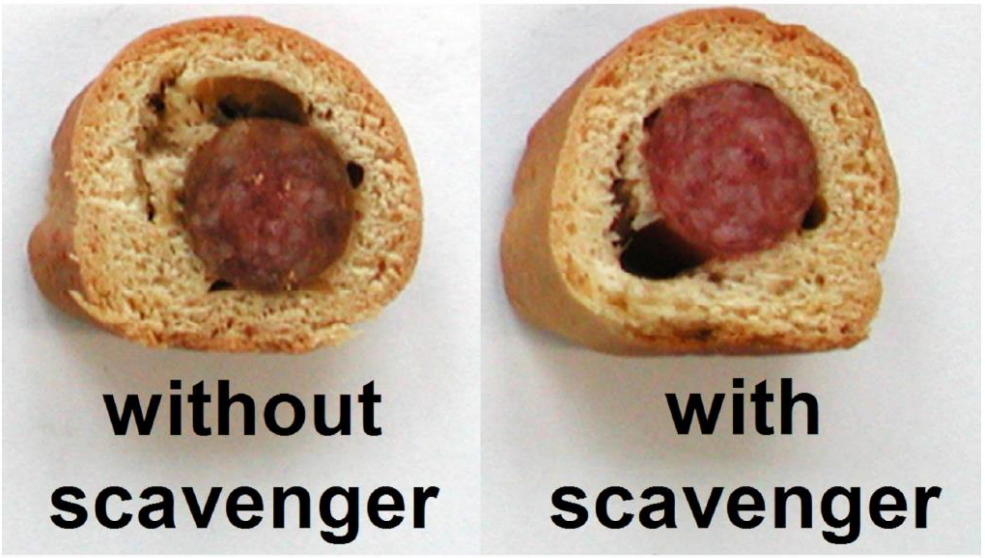
Snack; Activity of scavenger: combination snack/scavenger

after 300 days



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Snack; Activity of scavenger: combination snack/scavenger

(2) snack product: $K_1 = (0.021 \pm 0.002)$ mg (O_2) mbar $(O_2)^{-1}$ day^{-1}
(3) scavenger film $K_2 = (0.066 \pm 0.003)$ mg (O_2) mbar $(O_2)^{-1}$ day^{-1}
(4) scavenger film and snack product: $K_3 = (0.102 \pm 0.010)$ mg (O_2) mbar $(O_2)^{-1}$ day^{-1}

Table 5. Hexanal quantified in salami samples and baked bread.

				Peak area after storage (300 days)		
					In package with sealing defect	
Volatiles	Retention time	Odour quality	Peak area of fresh sample	In original package	Without scavenger	With scavenger
Hexanal (salami sample)	12.5	Green, grassy	<1000	3556	4224	<1000
Hexanal (baked bread)	12.5	Green, grassy	<1000	<1000	<1000	<1000

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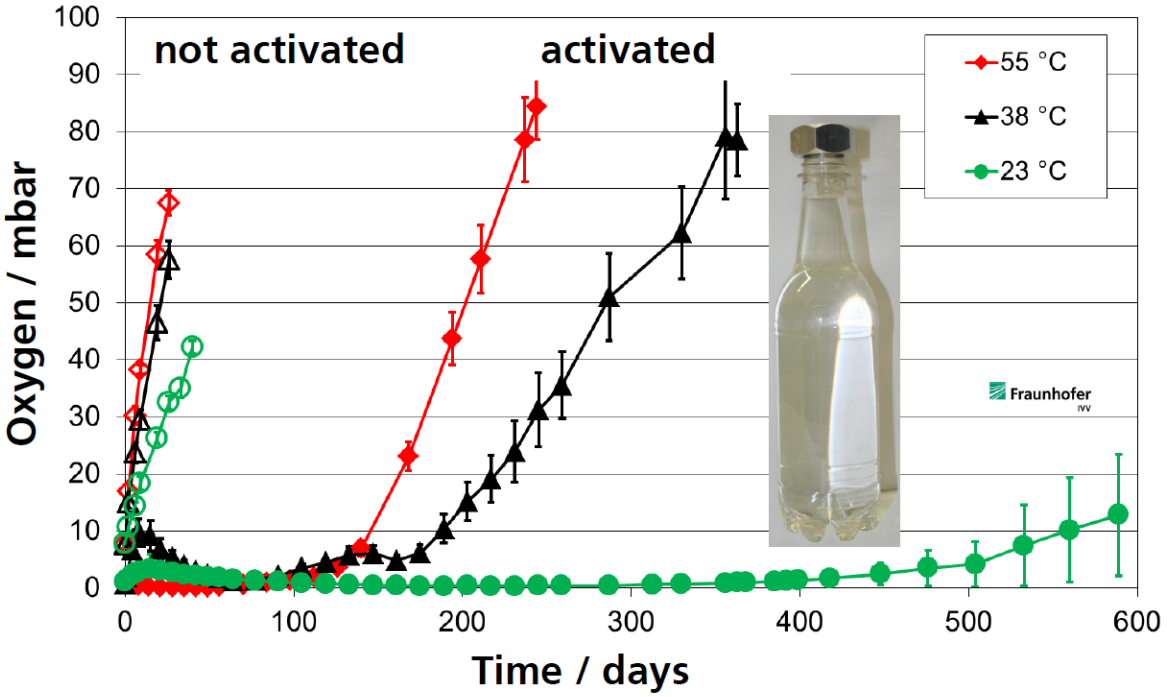
PET bottles



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Oxygen scavenger	absorption capacity / $mg \cdot g^{-1}$
MXD6	75
'SHELFPLUS'	25.4 to 86
OSP™'	60 to 100
'ORMOCER®'	90
poly(1,4-butadiene)	140
'O2Block®'	> 10 - 25
Gallic acid in PE	20 – 50

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Humidity regulation

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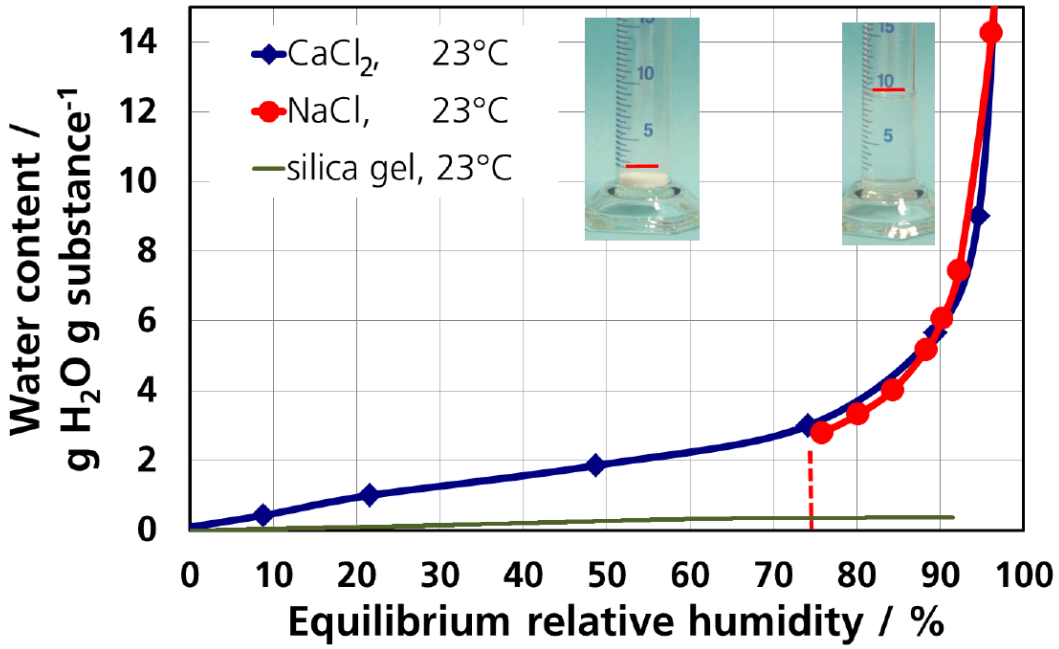
Water vapour sorption isotherms



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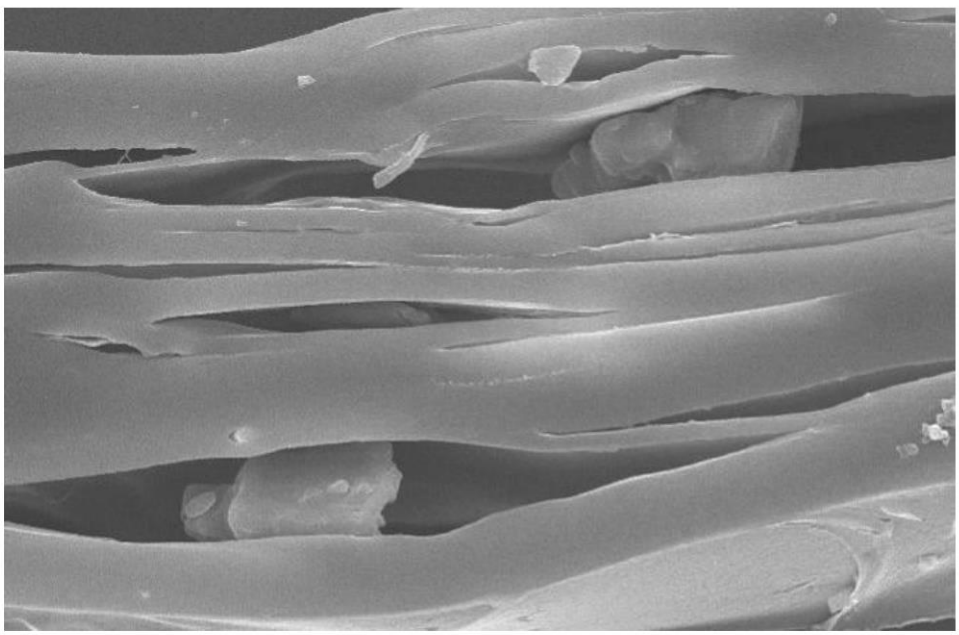
PP - NaCl



Active layer must contain cavities to store salt solution

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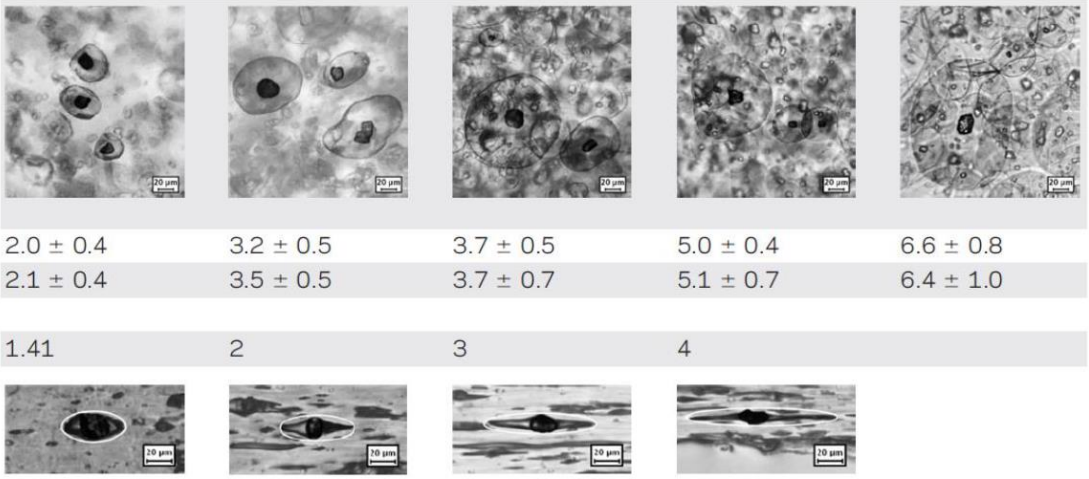
Humidity regulation: structure of the film



2.0 ± 0.4	3.2 ± 0.5	3.7 ± 0.5	5.0 ± 0.4	6.6 ± 0.8
2.1 ± 0.4	3.5 ± 0.5	3.7 ± 0.7	5.1 ± 0.7	6.4 ± 1.0
1.41	2	3	4	

Sängerlaub, S., M. Böhmer, and C. Stramm, Influence of stretching ratio and salt concentration on the porosity of polypropylene films containing sodium chloride particles. Journal of Applied Polymer Science, 2013. 129(3): p. 1238-1248.

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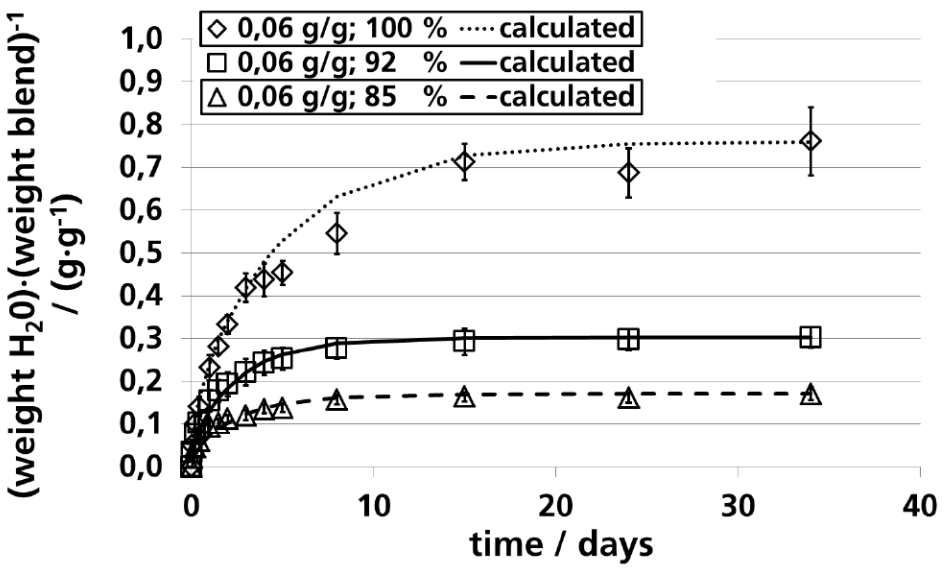
NaCl in PP; foamed and oriented; RH



$$\frac{m_t}{m_\infty} = 1 - \sum_{n=0}^{\infty} \frac{8}{(2n+1)^2 \cdot \pi^2} \cdot e^{\frac{-D \cdot (2 \cdot n+1)^2 \cdot \pi^2 \cdot t}{4 \cdot l^2}}$$

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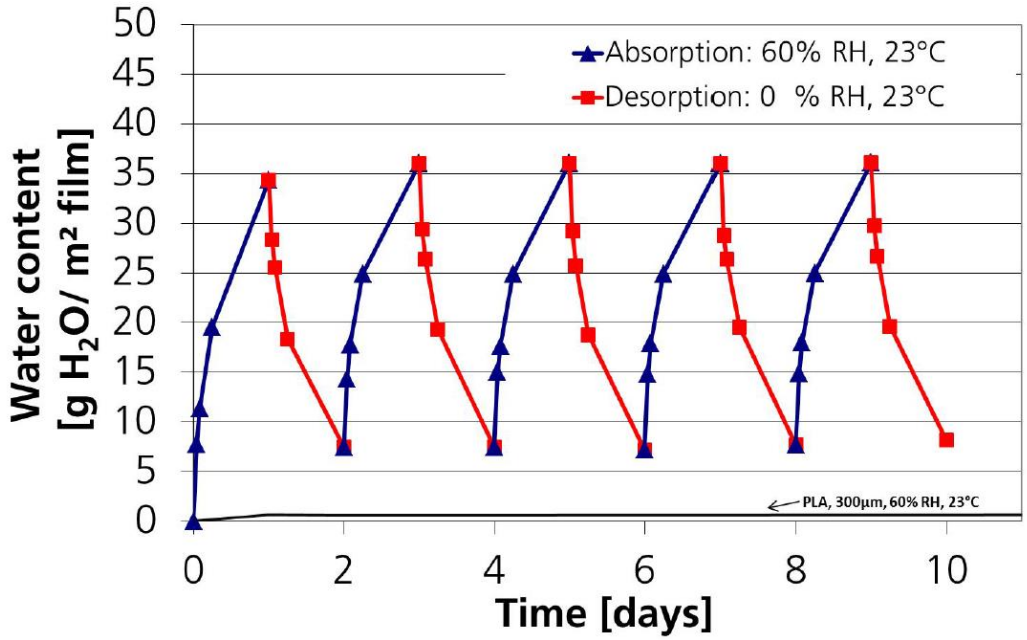

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UV- and light absorption

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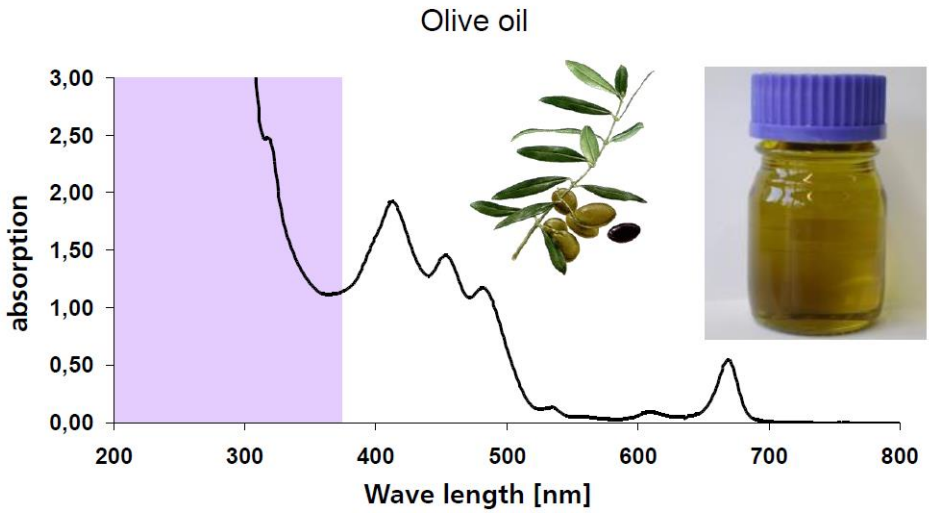
UV-light absorption, olive oil



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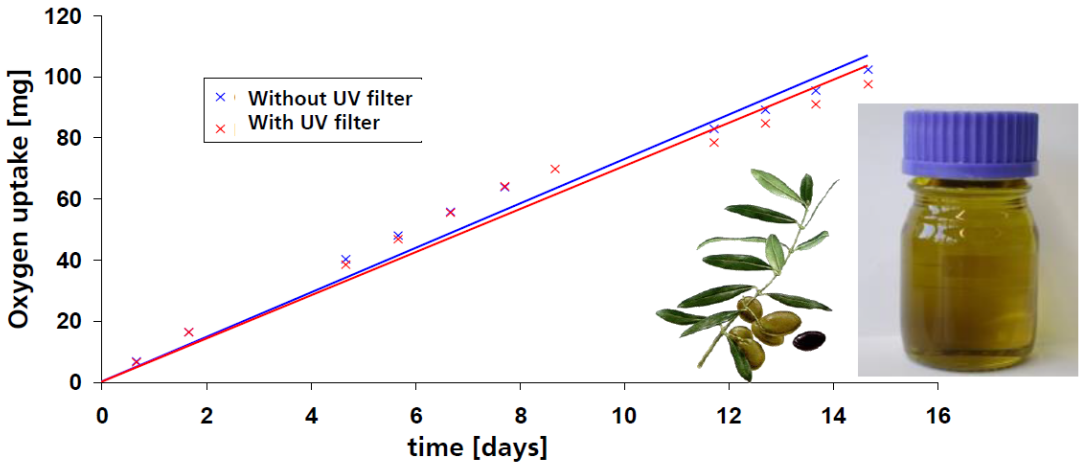
UV-light absorption, olive oil



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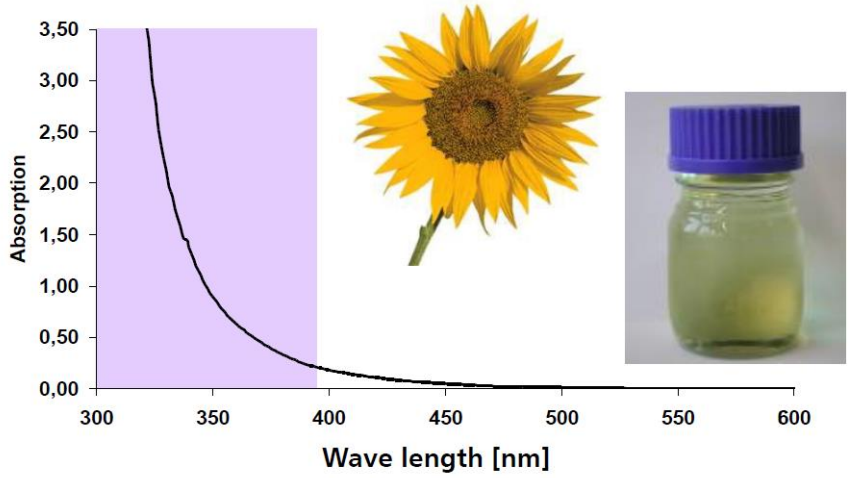
UV-light absorption, sunflower oil



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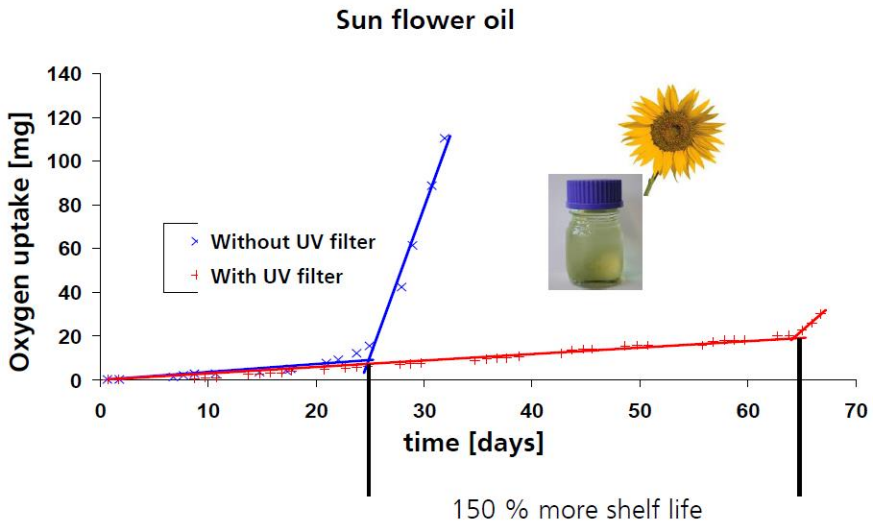
UV-light absorption, sunflower oil



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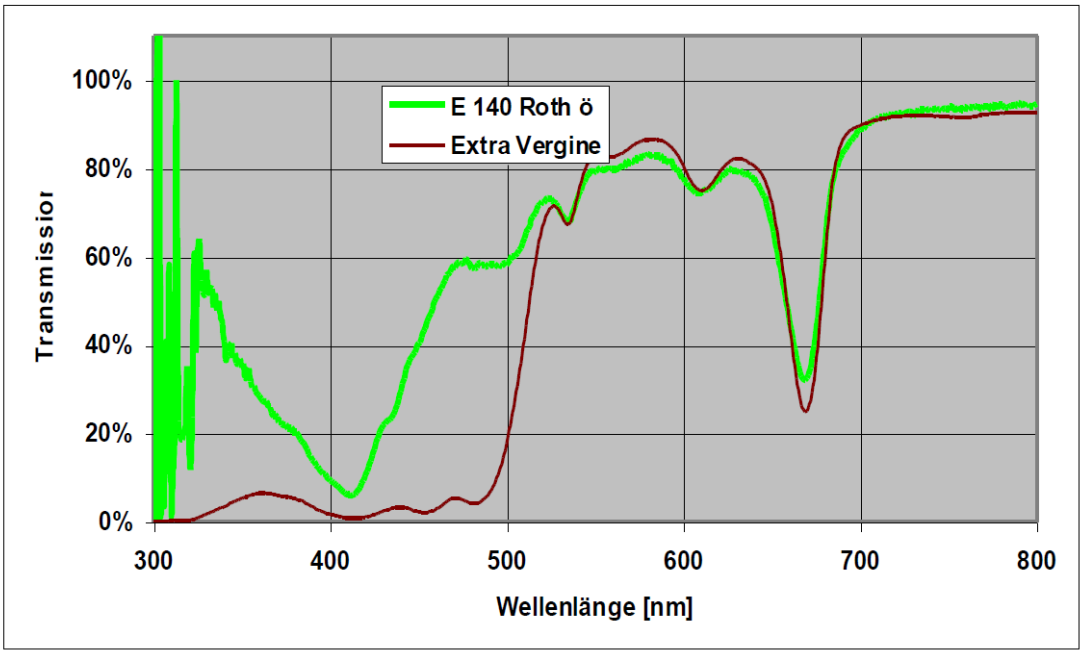
Chlorophyll based Light Absorber



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Chlorophyll/Riboflavin based Light Absorber

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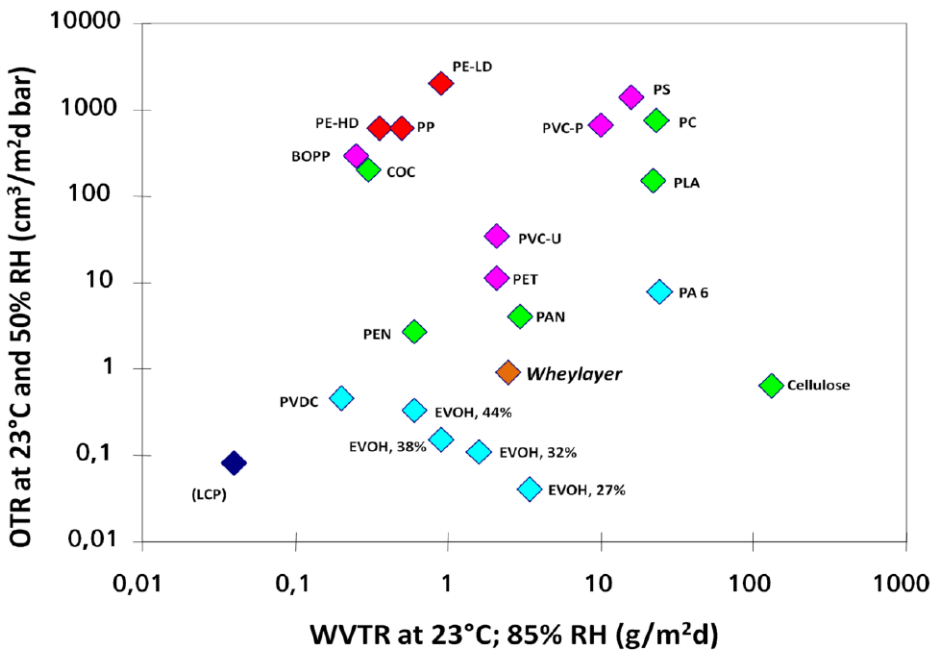
Barrier coating based on whey

Fraunhofer IVV

Barrier by whey

WheyLayer²



normalized to 100 µm

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Barrier by whey

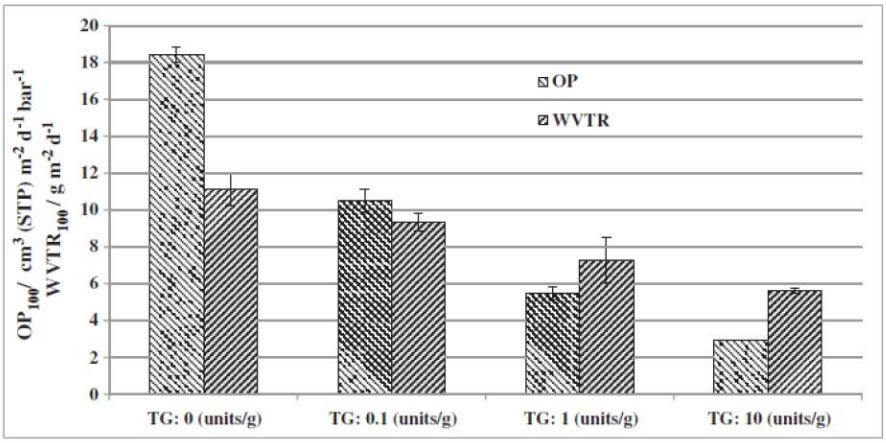

Figure 2. Oxygen permeability (OP_{100}) at 23 °C and 50% RH for coatings; crosslinking time: 120 min and $WVTR_{100}$ at 23 °C and 85% →0% RH of the coatings; crosslinking time: 120 min.[75]

Schmid, Packag. Technol. Sci. (2014)

Fraunhofer IVV

Barrier by whey

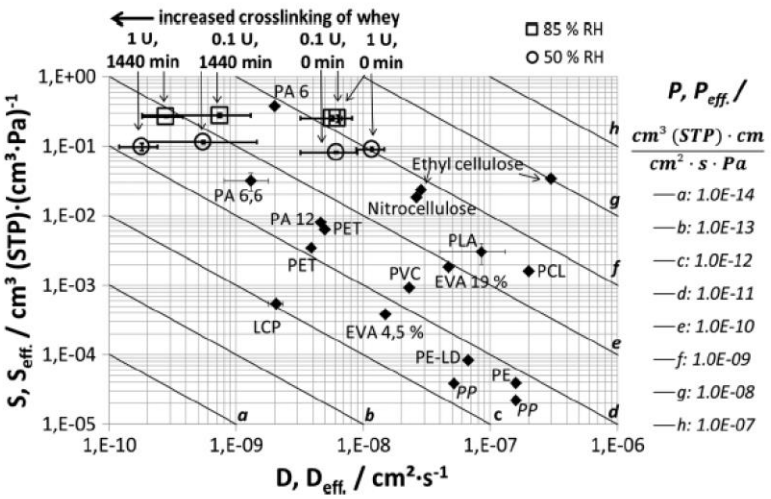

Figure 4. Sorption coefficients, diffusion coefficients, effective sorption coefficients, effective diffusion coefficients for protein films (23 °C) and polymers (20–25 °C); data for water vapour; data derived from Table 5 and Table 3.[75]

Schmid, Packag. Technol. Sci. (2014)

Fraunhofer IVV


Thank you.

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