Food Biotechnology

Wilbert Sybesma, MBA PhD

2025
EPFL Course ENG-436

Only for Teaching Purposes
Personal Copy

Food Biotechnology ENG-436, Class 1, February 21 2025, 1.15h-5.00h pm

- Intro Wilbert Sybesma
- Quiz
- Intro course set up
  - Topics of interest
  - Google Docs
  - Student presentations and planning
- Inspired by Nature – reading article
- Intro Fermentation - slide deck
- Questions and Feedback

Contact

- wilbert.sybesma@epfl.ch
- +41 79 1340 665 (sms, signal, whatsapp, call)

Education

- MSc Molecular Sciences, Wageningen University
- MSc Bioprocess Technology, Wageningen University
- PhD Food Biotechnology, Wageningen University
- Post Academic International and European Law, Free University Brussels
- MBA, Simon School, University of Rochester / University of Bern

Present Positions:

- Owner and Founder of Microbiome Solutions
- Founder at Yoba for Life foundation, Amsterdam/Kampala, NL/Ug
- Lecturer at Technical University Lausanne (EPFL), CH

Previous positions:

- Innovation Manager Gut Health at DSM Nutritional Products
- Senior Expert Host Microbe Interaction at the Nestlé Research Center, Lausanne, CH
- Senior Researcher at the Balgrist University Hospital Zürich, CH
- Head of Science and Technology Nestlé FOOD, Singen, Ge
- Group Leader and Senior Expert Biotransformation, Nestlé Research Centre, Lausanne, CH.
- Production Leader Special Products, Factory Konolfingen, CH
- Biotransformation Network Leader, Nestlé Research, Lausanne, CH
- Group leader fermentation Technology, Nestlé PTC Konolfingen, CH.

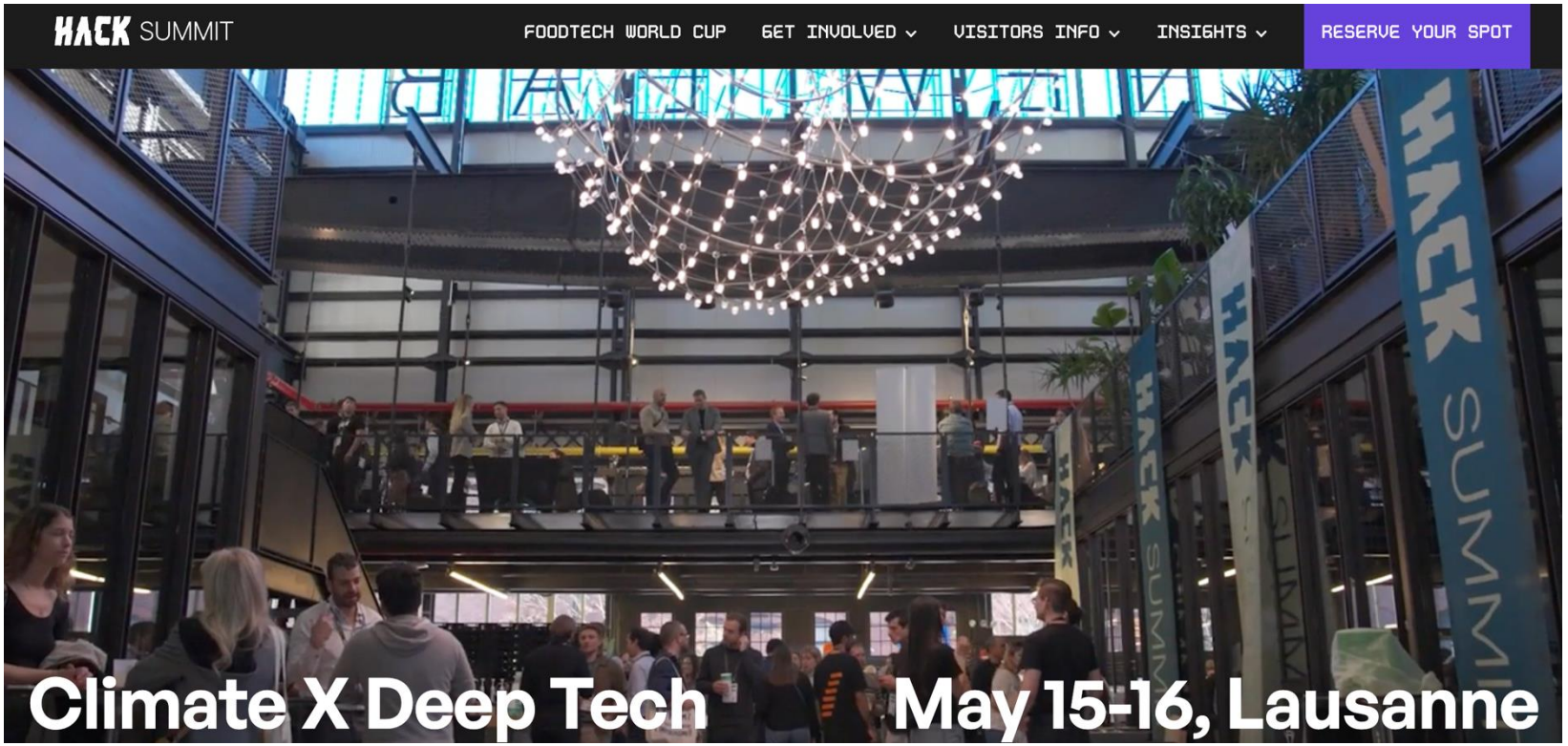
Selected co-authored peer-reviewed publications:

1. **Impact of fibre supplementation on microbiome and resilience in healthy participants: A randomized, placebo-controlled clinical trial.** Nutr Metab Cardiovasc Dis. 2024
2. **The butyrate-producing and spore-forming bacterial genus Coprococcus as a potential biomarker for neurological disorders.** Gut Microbiome 2023
3. **Vitamins for the Gut Microbiome,** Trends in Molecular Medicine 2020
4. **Probiotic Enrichment and Reduction of Aflatoxins in a Traditional African Maize-Based Fermented Food.** Nutrients 2019
5. **Silk Road to the Acceptance and Re-implementation of Bacteriophages.** Antibiotics 2018
6. **Sustainable Food Processing Inspired by Nature.** Trends Biotechnol. 2017
7. **A novel consortium of Lactobacillus rhamnosus and Streptococcus thermophilus for increased access to functional fermented foods.** Microb Cell Fact. 2015
8. **Probiotics for every body..** Trends in Biotechnology. 2012
9. **Safe use of genetically modified lactic acid bacteria in food: Bridging the gap between consumers, green groups, and industry.** Electron. J. Biotechnol. 2006.
10. **Multivitamin production in Lactococcus lactis using metabolic engineering.** 2004.

Course schedule Eng 436, 2024
Friday 1.15 – 5 pm

February	21	EPFL
March	7	EPFL
March	21	EPFL
April	11	Change April 4 with Imre Blanc, Eng 435 EPFL
May	9	EPFL
May	23	EPFL
??		Q&A for exam, On-line
??		Exam

Exam xxxx , 2024 xxx



https://www.hacksummit.co/

Individual Presentations (work in group of 2)

- **Option 1: Select a topic related to food fermentation or food enzyme technology**
- **Option 2: Review one or two recent Food Biotech articles**
- **Option 3: Present a Biotech Start up Company**
- **Option 4: Present something else related to Food Biotech (check with me)**

→ Prepare a good presentation (10 - 15 min)
Be crisp and clear and include your personal opinion

→ Be prepared for a good Q&A (10 min)

The presentation will count 20% (content, way of presenting, and own analysis)

The written exam will count 80%

Individual Presentation

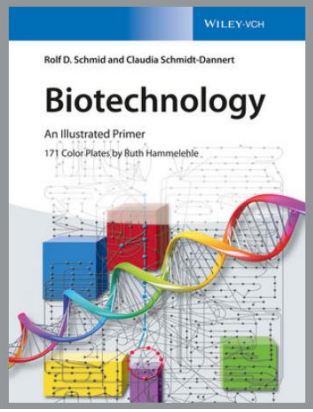
Suggestions

- Fermentation of milk, cereals, vegetables, soy, meat, cocoa
- Asian or African Fermented Food
- Probiotics, nutraceuticals, postbiotics
- Enzymatic processes using lipases, proteases, carbohydrases
- Emerging technologies (cultured meat, hydroponics, Cell Free Technology 'GreenLight Bioscience' , Other relevant topics . E.g. regulatory status fermented foods/probiotics/health claims)

Answer the following questions:

1. What is the basis for this bioprocess (microorganism, enzymes…)?
2. What is the benefit generated (safety, flavor, texture, nutrition, health …)?
3. How is this process/ingredient/benefit translated into a food product?
4. Give your own analysis. How can what you have learned create further innovations? Be realistic.

Course Material



Biotechnology: An Illustrated Primer

Rolf D. Schmid, Claudia Schmidt-Dannert, Ruth Hammelehle (Illustrator)

ISBN: 978-3-527-67747-4

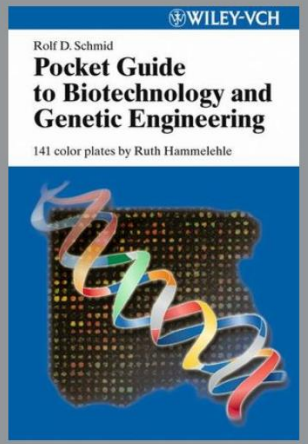
Mar 2016, Wiley-Blackwell

410 pages

- Slides,
- Articles,
- Links,

Not mandatory to buy the books

https://www.wiley-vch.de/de?option=com_eshop&view=product&isbn=9783527335152&title=Biotechnology



Pocket Guide to Biotechnology and Genetic Engineering

Rolf D. Schmid, Ruth Hammelehle (Illustrator)

ISBN: 978-3-527-30895-8

Jan 2003, Wiley-Blackwell

360 pages

Quantity: 1

https://www.wiley.com/en-ch/Pocket+Guide+to+Biotechnology+and+Genetic+Engineering-p-9783527308958

Expectations

Outline

- Food Fermentation Technology
- Food Enzyme Technology
- Industrial Processes (Examples)
- Strain optimization and GM Food
- Probiotics and probiotic technology
- Safety aspects in food fermentation
- Delivering nutrition by fermentation
- Alternative Proteins
- Human Milk Oligosaccharides
- Bacteriophages

Enzymes and microorganisms: Widely applied in Food Products

Enzymes and microorganisms: Widely applied in Food Products

- Infant nutrition, health care nutrition, probiotics, growing up milks, chilled dairy products, skin protection, pet care.
- Cocoa & chocolate, baked products (wafers, biscuits, chilled dough, pizza), malted drinks, pet food, culinary biohydrolysates, mayonnaise & sauces

Biotransformation Product Quiz

Product	Description	Biotransformation
	Hypo-allergenic Infant Formula	Protease treatment of milk
	Growing-up milk (Dry formula with probiotics)	Probiotic Drying & Stability
	Yogurt	Lactic acid fermentation
	Wafer	Xylanase (water release) and Protease (avoid lumps in batter)
	Cocoa	Pulp fermentation. Endogenous enzymes for flavour precursors.
	Malt Beverage	Malting of wheat. Endogenous enzymes
	Soy sauce	Fermentation & enzyme hydrolysis of soy/wheat. Yeast Moroni + MSG
	Mayonnaise	Emulsifying properties of lyso-lecithin by Phospholipase A

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Group Presentations

Date	Group 1 (names and topic)	Group 2 (names and topic)
March 7		
March 21		
April 11	Fill out in Google Working document	
May 9		
May 23		

- Moodles
- Google Drive

https://docs.google.com/document/d/14w9WtCuqcUj37GfzwhhqQyLG1OadWd91g2iuCWT1BJ8/edit?pli=1&tab=t.0

Trends in Biotechnology

CellPress

Science & Society

Sustainable Food Processing Inspired by Nature

Wilbert Sybesma,[1,2,*] Imre Blank,[1,3] and Yuan-Kun Lee[4]

Here, we elaborate on the natural origin and use of enzymes and cultures in sustainable food processing. We also illustrate how enzymatically treated or fermented food can contribute to solving

processing for similar purposes as in nature. Typical natural enzymatic processes involve lipases, carbohydrases, or proteases, such as the germination of grains and the digestion of milk by rennet in young (ruminant) mammals. For centuries, humans have adopted these processes in food preparation: in malting for producing malted beverages and for cheese making, respectively. During enzymatic conversions, nutrients can be released from the raw material and transformed into health-promoting ingredients or into taste- and texture-providing molecules, which reduces the need to use additives.

More specifically, proteases occur in all fatty acids and glycerol, thus reducing the need to add emulsifiers [5].

Cultured Food Inspired by Nature

A specific category of processed food inspired by nature is cultured or fermented food. In nature, microbes, such as yeast and lactic acid bacteria, convert food raw materials into products with a lower energy density, such as ethanol or lactate. At the same time, they can enhance the nutritional value by producing bioactive compounds and vitamins. Cultured food has been part of the human culinary tradition for thousands of years. While originally used as a method of natural food preservation, fermentation is also used today to prepare food products

Health challenge	Enzymatically treated or fermented food and health benefit	Refs
Allergy / Intolerance		
Malnutrition		
Overweight and obesity and other lifestyle diseases		
Ageing		

ealth challenge	Enzymatically treated or fermented food and health benefit	Refs
Allergy / Intolerance	Protease for protein hydrolyzed food to alleviate symptoms of cow milk allergy, gluten intolerance, and/or peanut allergy.	[1]
	Lipases for hydrolysis of natural fats to optimize the release of mono-, diglycerides and fatty acids.	[2]
	Lactases or lactose converting enzymes to reduce symptoms of lactose intolerance, and/or to produce prebiotic lactulose and epilactose by isomerization (cellobiose-epimerase).	[3]
	Probiotics and/or probiotic fermented foods to reduce symptoms for several allergies, including pollen allergy, cedar pollen allergy, and eczema.	[4]
Malnutrition	Amidohydrolase (e.g. asparaginase) to prevent or reduce undesirable food-borne process contaminants like Maillard-generated acrylamide as demonstrated for many food applications (e.g. French fries and bakery products).	[5]
	Phytase and phytic acid complexes to increase bioavailability of iron and zinc.	[6]
	Probiotics and/or probiotics containing fermented foods to prevent and reduce episodes of diarrhea.	[7]
	Cultures for fermenting foods to increase concentration of nutrients like essential amino acids, vitamins, and SCFAs.	[8]
	Cultures for fermented foods to detoxify or degrade undesirable compounds (trypsin inhibitors, mycotoxins, allergens).	[9]
	Probiotics for oral cavity-reduction.	[10]
Overweight and obesity and other lifestyle diseases	Carbohydrases (e.g. glucanotransferases) to produce dietary fibers or slow digestible sugars for lower calories and/or better blood glucose management.	[11]
	Carbohydrases (e.g. glucanotransferases, lactases) to increase sweetness without increasing calories.	[12]
	Lipases for enzymatically catalyzed hydrolysis of natural fats to optimize the release of mono- , diglycerides and fatty acids and as more natural alternative for chemically catalyzed esterification of free fatty acids and glycerol resulting in reduction of added emulsifiers by in-situ formation of emulsifiers.	[2]
	Probiotics and/or probiotic fermented foods interfering lipid and carbohydrate metabolisms to reduce cardiovascular risk factors like hypercholesterolemia, hypertension.	[13], [14]
	Cultures for fermented foods producing exopolysaccharides to reduce fat and calories by in-situ generation of creaminess and texture.	[15]
	Glucose generating (dairy) starter cultures to increase sweetness without increasing calories.	[16]
Ageing	Proteases for protein hydrolysis creating amino acids as flavor precursors or taste-active compounds to increase taste and palatability of food, as solution to reduced appetite. Also to improve digestibility and to balance digestive and absorption problems.	[17]
	Proteases for protein hydrolysis to improve digestibility and to balance digestive and absorption problems.	[17]
	Carbohydrases for controlled degradation of starch by amylases and glucosidases to obtain a defined molecular weight distribution for reducing viscosity and softening of food textures as solution to problems with chewing and dysphagia.	[11]
	Cultures for making fermented foods to increase the level of B, C & K vitamins to support cognitive fitness.	[18]