האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

BIOFILMS IN THE FOOD INDUSTRY - 71908

Last update 18-08-2025

HU Credits: *2*

Degree/Cycle:

Responsible Department: *Biochemistry, Food Science and Nutrition*

Academic year: *0*

Semester:

Teaching Languages: *English*

Campus: *Rehovot*

Course/Module Coordinator: *Dr. Moshe Shemesh*

Coordinator Email: *moshe.shemesh@mail.huji.ac.il*

Coordinator Office Hours: *by Appointment*

Teaching Staff:

Dr. Moshe Shemesh

Course/Module description:

Introduction to biofilms in nature,industry,research and medicine. Study the various stages in biofilms development and the microorganisms involved in their buildup. Molecular control during the various development stages. Methods for studying biofilms. The biofilm as a multi-cellular organism. Damage in fresh agricultural products,processed foods and in the food industry and means for preventing and removing biofilms.

Course/Module aims:

Introduction to the concept of biofilm formation and multicellularity in bacteria. Illustration basic techniques for biofilms' research. Discussions about regulatory mechanisms for its formation as well as developing novel approaches in mitigating its formation.

Learning outcomes - On successful completion of this module, students should be able to:

Conceptual understanding in the subject of biofilm and proficiency in current research methods. applicability of this knowledge for analyzing problems develop creative approaches to dealing with biofilm in general and particularly in the food industry.

Attendance requirements(%):

75

Teaching arrangement and method of instruction: Frontal lecutures with open discussion and student seminars

Course/Module Content:

Following topics will be emphasized during the course:

1. What is the biofilm
2. The nature and significance of the biofilm for the food industry
3. The molecular mechanisms responsible for the biofilm formation
4. Approaches and Research Methods
5. Dealing with the biofilm problem of food industry
6. Novel approaches for mitigating biofilm bacteria in food production environments.

Required Reading:
Will be given during the course

Additional Reading Material:

1.Ghannoun, M., and O'toole, G.A. (Eds). 2004. Microbial Biofilms. ASM Press.
2.Wanner, O., H. Eberl, E. Morgenroth, D. Noguera, C. Picioreanu, B. Rittmann, and M. van Loosdrecht. IWA Task Group on Biofilm Modeling. 2006. Mathematical Modeling of Biofilms. Scientific and Technical Report No. 18. IWA Publishing.
3.Blaschek, H. B., H. H. Wang, and M. E. Agle (Eds). 2007. Biofilms in the Food Environment. IFT Press and Blackwell Publishing. Biofilms in the Food and Beverage Industries.
4.Fratamico, P., B. Annous, and J. Guenther (Eds). 2009. Biofilms in the Food and Beverage Industries. CRC Press, Woodhead Publishing Limited.
5.Simões, M. and F. Mergulhão (Eds). 2013. Biofilms in Bioengineering. Nova Science Publishers Inc., Hauppauge, N.Y.
6.Doyle, M. P., and R. L. Buchanan. 2013. Food Microbiology: Fundamentals and Frontiers, 4th Edition.

Review papers and links for additional reading

Vlamakis, H., et al. 2013. Sticking together: building a biofilm the Bacillus subtilis way. Nature Rev. Microbiol. 11:157-168.
Colvin, K.M., et al. 2011. The Pel Polysaccharide Can Serve a Structural and Protective Role in the Biofilm Matrix of Pseudomonas aeruginosa. PLoS Pathog 7(1): e1001264.
Zhao, K., et al. 2013. Psl trails guide exploration and microcolony formation in Pseudomonas aeruginosa biofilms. Nature. 497, 388–391
Marchand, S. et al. 2012. Biofilm Formation in Milk Production and Processing Environments; Influence on Milk Quality and Safety. Comprehensive Reviews in Food Science and Food Safety. 11:133–147.
Flemming, H. C., and J. Wingender. 2010. The biofilm matrix. Nat. Rev. Microbiol. 8:623-33.
Lopez, D., and R. Kolter. 2010. Extracellular signals that define distinct and coexisting cell fates in Bacillus subtilis. FEMS Microbiol. Rev. 34:134-49.
Simoes, M., L. C. Simoes, and M. J. Vieira. 2010. A review of current and emerging control strategies. LWT - Food Science and Technology. 43:573-583.
Vlamakis, H., Y. Chai, P. Beauregard, R. Losick, and R. Kolter. 2013. Sticking together: building a biofilm the Bacillus subtilis way. Nat. Rev. Microbiol. 11:157-68.
Xiong Y, Liu Y. 2010. Biological control of microbial attachment: a promising alternative for mitigating membrane biofouling. Appl Microbiol Biotechnol.
Landini P, Antoniani D, Burgess JG, Nijland R. 2010. Molecular mechanisms of compounds affecting bacterial biofilm formation and dispersal. Appl Microbiol Biotechnol. Høiby N, Bjarnsholt T, Givskov M, Molin S, Ciofu O. 2010. Antibiotic resistance of bacterial biofilms. Int J Antimicrob Agents.
Filoche S, Wong L, Sissons CH. 2010. Oral biofilms: emerging concepts in microbial

ecology. J Dent Res. 89:8-18.
Downie JA. 2009. The roles of extracellular proteins, polysaccharides and signals in the interactions of rhizobia with legume roots. FEMS Microbiol Rev. 34:150-70.
McBain AJ. 2009. Chapter 4: In vitro biofilm models: an overview. Adv Appl Microbiol. 69:99-132.
Estrela AB, Heck MG, Abraham WR. 2009. Novel approaches to control biofilm infections. Curr Med Chem. 16:1512-30.
Njoroge J, Sperandio V. 2009. Jamming bacterial communication: new approaches for the treatment of infectious diseases. EMBO Mol Med. 1:201-10.
Kearns, D. B. 2008. Division of labour during Bacillus subtilis biofilm formation. Mol Microbiol. 67:229–231.
Danhorn, T., and C. Fuqua. 2007. Biofilm Formation by Plant-Associated Bacteria. Annu. Rev. Microbiol. 61:401–22.
Hansen SK, Rainey PB, Haagensen JA, Molin S. 2007. Evolution of species interactions in a biofilm community. Nature. 445:533-6.
Kolter R, Greenberg EP. 2006. Microbial sciences: the superficial life of microbes. Nature. 441:300-2.
West, S. A., S. P. Diggle, A. Buckling, A. Gardner, and A. S. Griffin. The social lives of microbes. Annu Rev. Ecol. Evol. System. 38:53-77.
Reading, N. C. & V. Sperandio. 2006. Quorum sensing: the many languages of bacteria FEMS Microbiol Lett. 254:1–11.

BiofilmOnline: http://www.biofilmsonline.com

Grading Scheme:

Essay / Project / Final Assignment / Home Exam / Referat 35 %

Presentation / Poster Presentation / Lecture/ Seminar / Pro-seminar / Research proposal 35 %

Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 20 %

Mid-terms exams 10 %

Additional information:

none