



Full Syllabus



Course Title

Alternative protein: cultivated and plant-based meat, egg and dairy

בשר מתורבת ותחליפי בשר מהצומח

Lecturer

Prof. Nir Ohad (Life Sciences), Dr. Iftach Nachman (Life Sciences), Prof. Alexander Golberg (Porter School of Environmental Studies)

Semester

Winter

Course requirements

Introductory biology (101, 102, 103), biochemistry, cell biology.
Scientific reading/writing capabilities in English.

Final grade components

80% final exam + 20% 1-2 written assignments

Course Schedule 1st Semester, Monday 12-14 Hall 14 Britannia

Class no. / Date	Subject and Requirements (assignments, reading materials, tasks, etc.)
1 / 24-10-22	Introduction to cultivated meat - Iftach
2 / 31-10-22	Introduction to fermentation (guest lecturer - Michal Halpert, GFI)
3 / 7-11-22	Introduction to plant-based meat - Nir
4 / 14-11-22	Introduction to plant-based (Nir) + Plant Based Meat Raw Materials and optimization - Nir
5 / 21-11-22	Plant Based Meat Raw Materials and optimization - Nir + Cells & cell differentiation - Iftach
6 / 28-11-22	Cell differentiation (cont.) + Cell culture and measurement tools – (Gaya/Michelle)
7 / 5-12-22	Tissue eng. I (guest lecturer – Tom Ben Aryeh, GFI)
8 / 12-12-22	Tissue eng. II + Meat composition and structure (Tom)
9 / 19-12-22*	Plant-based meat regulations, IP, value chain & white space opportunity analyses (guest lecture – Siddarth Biddh, GFI, offline) https://tau.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=37019e7c-acd4-41ea-a349-ac9800cf7a51
10 / 26-12-22*	Plant based meat Texturization technologies, Texture nutrition optimization and regulation - Alex
11 / 2-1-23	Cultivated meat company guest lecture - Aleph Farms
12 / 9-1-23	Invited guest lectures: (1) Plant-based company (Innovopro = chickpea) (2) Next generation plant processing technologies



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13 / 16-1-23

Invited guest lectures: (1) Alt milk/egg company (**ZeroEgg, ReMilk**, ImagineDairy, BioMilk) (2) Plant cultivation for meat alternatives.
(2) State of the industry (Aviv Oren, GFI).

Required course reading

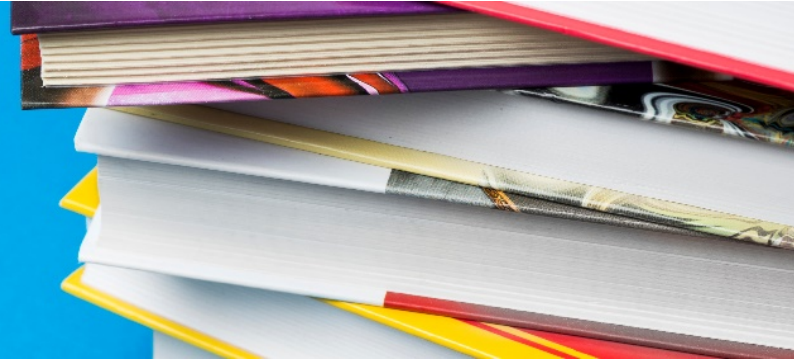
- * Post, M. & van der Weele, C. Chapter 78 - Principles of Tissue Engineering for Food. in Principles of Tissue Engineering (Fourth Edition) (eds. Lanza, R., Langer, R. & Vacanti, J.) 1647–1662 (Academic Press, 2014). doi:10.1016/B978-0-12-398358-9.00078-1
- * Ben-Arye, T. & Levenberg, S. Tissue Engineering for Clean Meat Production. *Front. Sustain. Food Syst.* 3, 89 (2019).
- * Kyriakopoulou, K., Dekkers, B. & van der Goot, A. J. Chapter 6 - Plant-Based Meat Analogues. in Sustainable Meat Production and Processing (ed. Galanakis, C. M.) 103–126 (Academic Press, 2019). doi:10.1016/B978-0-12-814874-7.00006-7

Optional course reading

- * Dey, Tania. Fennema's Food Chemistry, Fourth Edition, Edited by Srinivasan Damodaran, Kirk L. Parkin and Owen R. Fennema. *Journal of Dispersion Science and Technology - J DISPER SCI TECH.* 10.1080/01932691.2011.584482. (2011)
- * Maskan, M. (Ed.), Altan, A. (Ed.). *Advances in Food Extrusion Technology.* Boca Raton: CRC Press, <https://doi.org/10.1201/b11286>. (2012)
- * Specht, E. A., Welch, D. R., Rees Clayton, E. M. & Lagally, C. D. Opportunities for applying biomedical production and manufacturing methods to the development of the clean meat industry. *Biochem. Eng. J.* 132, 161–168 (2018).
- * Specht, L. An analysis of culture medium costs and production volumes for cell-based meat. (2019).
- * Bryant, C. & Barnett, J. Consumer acceptance of cultured meat: A systematic review. *Meat Sci.* 143, 8–17 (2018).
- * Listrat, A. et al. How Muscle Structure and Composition Influence Meat and Flesh Quality. *ScientificWorldJournal* 2016, 3182746 (2016).
- * Flavor of Meat and Meat Products | Fereidoon Shahidi | Springer. Available at: <https://www.springer.com/gp/book/9781461359111>.
- * Du, M., Wang, B., Fu, X., Yang, Q. & Zhu, M.-J. Fetal programming in meat production. *Meat Sci.* 109, 40–47 (2015).
- * Yin, H., Price, F. & Rudnicki, M. A. Satellite cells and the muscle stem cell niche. *Physiol. Rev.* 93, 23–67 (2013).
- * Péault, B. et al. Stem and progenitor cells in skeletal muscle development, maintenance, and therapy. *Mol. Ther.* 15, 867–877 (2007).
- * Hocquette, J. F. et al. Intramuscular fat content in meat-producing animals: development, genetic and nutritional control, and identification of putative markers. *Animal* 4, 303–319 (2010).
- * Mehta, F., Theunissen, R. & Post, M. J. Adipogenesis from Bovine Precursors. in *Myogenesis: Methods and Protocols* (ed. Rønning, S. B.) 111–125 (Springer New York, 2019). doi:10.1007/978-1-4939-8897-6_8
- * Miao, Z. G. et al. Invited review: mesenchymal progenitor cells in intramuscular connective tissue development. *Animal* 10, 75–81 (2016).
- * Grzelkowska-Kowalczyk, K. The Importance of Extracellular Matrix in Skeletal Muscle Development and Function. in *Composition and Function of the Extracellular Matrix in the Human Body* (ed. Travascio, F.) (InTech, 2016). doi:10.5772/62230
- * Qazi, T. H., Mooney, D. J., Pumberger, M., Geissler, S. & Duda, G. N. Biomaterials based strategies for



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skeletal muscle tissue engineering: existing technologies and future trends. *Biomaterials* 53, 502–521 (2015).

* Keeney, M., Han, L.-H., Onyiah, S. & Yang, F. Tissue Engineering: Focus on the Musculoskeletal System. *Biomaterials Science: An Integrated Clinical and Engineering Approach* 191 (2012).

* Xu, J., Towler, M. & Weathers, P. J. Platforms for Plant-Based Protein Production. in *Bioprocessing of Plant In Vitro Systems* (eds. Pavlov, A. & Bley, T.) 1–40 (Springer International Publishing, 2016).

doi:10.1007/978-3-319-32004-5_14-1

* Day, L. Proteins from land plants--potential resources for human nutrition and food security. *Trends Food Sci. Technol.* 32, 25–42 (2013).

*Dey, Tania. Fennema's Food Chemistry, Fourth Edition, Edited by Srinivasan Damodaran, Kirk L. Parkin and Owen R. Fennema. *Journal of Dispersion Science and Technology - J DISPER SCI TECH.*

10.1080/01932691.2011.584482. (2011)

*Maskan, M. (Ed.), Altan, A. (Ed.). *Advances in Food Extrusion Technology*. Boca Raton: CRC Press, <https://doi.org/10.1201/b11286>. 2012

*Osen, R., & Schweiggert-Weisz, U. High-moisture extrusion: meat analogues. In *Reference Module in Food Science* (pp. 1–6). Elsevier Inc. doi:

10.1016/B978-0-08-100596-5.03099-7 . 2016

*Kinney, M.J., Weston, Zak, & Bauman J.D. Plant based meat manufacturing by extrusion. Available at https://www.gfi.org/images/uploads/2019/11/Plant-Based-Meat-Manufacturing-Guide-_GFI.pdf . 2019

*Hadnadjev, Miroslav & Dapčević Hadnađev, Tamara & Pojić, Milica & Šarić, Bojana & Mišan, Aleksandra & Jovanov, Pavle & Sakač, Marijana. Progress in vegetable proteins isolation techniques: A review. *Food and Feed Research*. 44. 11-21. 10.5937/FFR1701011H. 2017

Comments

The course will be in English. Course grade is based on assignments written in pairs and an individual final project, which requires a short literature review and article summary in English.