Christopher Brigham, Ph.D.

Associate Professor
Biological Engineering program, School of Engineering
Wentworth Institute of Technology
Boston, MA 02115
USA

Education and training:

Postdoctoral scholar - Massachusetts Institute of Technology 10/2006 – 01/2013
Advisor: Anthony J. Sinskey, Sc.D.

Ph.D. study – Tufts University School of Medicine 06/1999 – 10/2006
Advisor: Michael H. Malamy, Ph.D.
Field: Molecular Microbiology

Undergraduate (Bachelor of Science, BS) -Villanova University 09/1991 – 08/1995
Field: Chemical Engineering

Positions and Honors:

(2019 – 2021) Biological Engineering Program Coordinator, Wentworth Institute of Technology, Boston, MA
(2018 – present) Associate Professor, Department of Interdisciplinary Engineering, Wentworth Institute of Technology, Boston, MA
(2016 – 2018) Director, University of Massachusetts Dartmouth, BNG/BMEBT "4+1" accelerated masters program
(2014 – 2016) Co-Director, University of Massachusetts Dartmouth Biomedical Engineering and Biotechnology (BMEBT) graduate program
(2013 – 2018) Assistant Professor, Department of Bioengineering, University of Massachusetts Dartmouth, North Dartmouth, MA
(2011 – 2013) Research Scientist, Department of Biology, Massachusetts Institute of Technology, Cambridge, MA

Contributions to science:

Isolation of high-purity chitin from waste lobster shells and development of solvent-cast membranes for medical applications.

Chitin is a natural polysaccharide found in the shells of marine organisms like crab, lobster and shrimp, as well as fungi. Chitin as a polymer has been shown to have favorable mechanical properties, as well as possessing potential antimicrobial properties. Chitin is a very abundant polymer, especially in regions of the world where shellfish processing is a prevalent industry. My group has studied a biologically based chitin extraction process using the shell of the American lobster. With the chitin isolated from these shells, porous and flexible membranes are fabricated by means of solvent casting in ionic liquid. The porosity and inherent physicochemical properties of these membranes show utility in several medical applications, namely as wound dressing or tissue engineering scaffold material. Selected peer reviewed publications are listed below.

1. Chakravarty J, Rabbi MF, Chalivendra V, Ferreira T, **Brigham CJ**. 2019. Mechanical and biological properties of chitin/polylactide (PLA)/hydroxyapatite (HAP) composites cast using ionic liquid solutions. *Int J Biol Macromol*. ePub ahead of print.

2. Chakravarty J, Semerdzhiev D, Silby MW, Ferreira T, **Brigham CJ**. 2019. Properties of solvent-cast chitin membranes and exploration of potential applications. *Materialia*. 8: 100452.

3. Chakravarty J, Rabbi MF, Bach N, Chalivendra V, Yang CL, **Brigham, CJ**. 2018. Fabrication of porous chitin membrane using ionic liquid and subsequent modeling studies. *Carbohydrate Polymers*. 198: 443-451.

4. Chakravarty J Yang CL, Palmer J, **Brigham CJ**. 2018. Chitin extraction from lobster shell waste *using microbial culture-based methods. Appl Food Biotechnol. 5(3): 141-154.*

Optimization of polyhydroxyalkanoates biosynthesis

Polyhydroxyalkanoates (PHAs) are a family of bio-based, biodegradable polymers that have application as biodegradable replacements for traditional plastics. My group has been studying the PHA copolymer poly(hydroxybutyrate-*co*-hydroxyhexanoate) [P(HB-*co*-HHx)] for its favorable thermal and mechanical properties. We utilize optimally engineered strains of the bacterium *Cupriavidus necator* (also called *Ralstonia eutropha*) to synthesize large quantities of P(HB-*co*-HHx) from organic acids and plant oils as the main carbon sources. We have successfully solvent-cast, extruded and electrospun our P(HB-co-HHx) polymer, suggesting that there are many fabrications methods available for this material. Selected co-authored, peer reviewed publications are listed below.

1. Gutschmann B, Bock MCE, Jahns S, Neubauer P, **Brigham CJ**, Riedel SL. 2021. Untargeted metabolomics analysis of *Ralstonia eutropha* during plant oil cultivations reveals the presence of a fucose salvage pathway. *Sci Rep.* 11(1): 14267

2. Yang YH, **Brigham CJ**, Yi DH, Song HS, Jung HR, Yoon JJ, Jeon JM, Bhatia SK, Yang SY, Choi TR, Kim YG. 2019. Poly(3-hydroxybutyrate-*co*-3-hydroxyvalerate-*co*-3-hydroxyhexanoate) terpolymer production from volatile fatty acids using engineered *Ralstonia eutropha. Int J Biol Macromol*. 138: 370-378.

3. Hong YG, Moon YM, Hong JW, Choi TR, Jung HR, Yang SY, Jang DW, Park YR, **Brigham CJ**, Kim JS, Lee YK, Yang YH. 2019. Discarded egg yolk as an alternate source of poly(3-hydroxybutyrate-*co*-hydroxyhexanoate). *J Microbiol Biotechnol*. 29(3): 382-391.

4. Jüngert JR, M Borisova, C Mayer, C Wolz, **CJ Brigham**, AJ Sinskey, D Jendrossek. 2017. Absence of (p)ppGpp leads to increased mobilization of intermediately accumulated poly(3-hydroxybutyrate) (PHB) in *Ralstonia eutropha* H16*. Appl Environ Microbiol*. 83(13): pii: e00755-17.

5. Jeon JM, HJ Kim, BS Kant, C Sung, HM Seo, JH Kim, HY Park, D Lee, **CJ Brigham**, YH Yang. 2017. Application of acetyl-CoA acetyltransferase (AtoAD) in *Escherichia coli* to increase 3-hydroxyvalerate fraction in poly(3-hydroxybutyrate-co-3-hydroxyvalerate). *Bioprocess Biosyst* Eng. 40: 781-789.

Correlation of polyhydroxyalkanoates degradation with changes in mechanical properties.

Our goal application for P(HB-co-HHx) biopolymers is resorbable medical products like sutures, drug delivery implants, surgical meshes, etc. We have evaluated in vitro and in vivo biodegradation of P(HB-co-HHx) and correlated extent of degradation with changes in mechanical properties like strength, elongation, Young's modulus and overall mass of polymer. We are currently developing a mathematical model to correlate these properties and predict behavior of resorbable medical devices made from P(HB-co-HHx). Selected peer reviewed publications are listed below.

1. Kehail A, MF Rabbi, N Bach, V Chalivendra, **CJ Brigham**. 2017. Modeling mechanical properties of polyhydroxyalkanoate during degradation in animal tissue. *Polym Adv Technol*. 28(12) https://doi.org/10.1002/pat.4076.

2. Kehail A and **CJ Brigham**. 2018. Anti-biofilm activity of solvent-cast and electrospun polyhydroxyalkanoate membranes treated with lysozyme. *J Polym Environ*. 26(1): 66-72.

3. Kehail A, V Boominathan, K Fodor, T Ferreira, V Chalivendra, and **CJ Brigham**. 2017. *In Vivo* and *In Vitro* Degradation Studies for Poly(3-hydroxybutyrate-*co*-3-hydroxyhexanoate) Biopolymer. *J Polym Environ.* 25(2): 296-307.

4. **Brigham, CJ**, J Palmer, A Kehail. 2016. *Ralstonia eutropha* and the Production of Value Added Products: Metabolic Background of the Wild-Type Strain and its Role as a Diverse, Genetically-Engineered Biocatalyst Organism. Invited submission for Recent Advances in Biotechnology, Volume 1: Microbial Biopolyester Production, Performance and Processing. (Editor: M. Koller). Bentham Books.

5. Kehail, AA, M Foshey, V Chalivendra, and **CJ Brigham**. 2015. Thermal and mechanical characterization of solvent-cast poly(3-hydroxybutyrate-co-3-hydroxyhexanoate). *J Polym Res*. 22: 216

Research support/scholastic performance:

Previous support:

2018 Wentworth Institute of Technology EPIC Minigrant for faculty; Project title: "Biopropane from *R. eutropha*;" Award = $5,000; C.J. Brigham, PI

2017 National Science Foundation Major Research Instrumentation (NSF MRI); Project title: "MRI: Acquisition of a scanning electron microscope (SEM);" Award = $240,349; C.J. Brigham, PI

2017 Target; Project title: "Blending of nanoparticles with polymers to make flame resistant fibers;" Award = $49,966; C.J. Brigham, PI

2010 – 2013 US Department of Energy ARPA-E Electrofuels division; Project title: "Liquid fuel from bacteria;" Award = $1,770,269; C.J. Brigham, co-PI