



COLLEGE of
BIOLOGICAL SCIENCE

DEPARTMENT OF MOLECULAR
AND CELLULAR BIOLOGY

Announcement:

All interested members of the university community are invited to attend the Final Oral Examination for the degree of **Doctor of Philosophy** of

AVERY ROBINSON

On Wednesday, April 19, 2023 at 1:30 p.m. (SSC 1511)

Thesis Title: The impact of diet on the human gut microbiota in the context of colorectal cancer

Examination Committee:

Dr. Jasmin Lalonde, Dept. of Molecular and Cellular Biology (Exam Chair)
Dr. Emma Allen-Vercoe, Dept. of Molecular and Cellular Biology
Dr. Cezar Khursigara, Dept. of Molecular and Cellular Biology
Dr. Massimo Marcone, Dept. of Food Science
Dr. Susan Bullman, Human Biology Division, Fred Hutchinson Cancer Center (External Examiner)

Advisory Committee:

Dr. Emma Allen-Vercoe (Advisor)
Dr. Cezar Khursigara
Dr. Jennifer Geddes-McAlister
Dr. Brenda Coomber

Abstract: Despite the strong link between the gut microbiota and colorectal cancer (CRC), there is no one microbial signature of the disease. However, gut microbiota function may allow insights into microbe-linked CRC risk. Furthermore, diet influences gut community function, and certain diets (e.g., protein- and fibre-rich) have been associated with CRC risk. The global purpose of this thesis was to characterize potential microbe-microbe and diet-microbe interactions that may influence CRC. To fulfill this purpose, taxonomic composition and metabolic function were characterized for CRC-derived communities, and CRC-relevant virulence determinants were identified in CRC-relevant strains. Protein- and fibre-rich diets were applied to three CRC biopsy- and three healthy fecal donor-derived communities to study diet-linked shifts in community structure and metabolic function. Lastly, dietary protein-representative free amino acid pools (FAAPs) were applied to CRC-linked *Fusobacterium* spp. strains to assess potential diet-influenced differences in fusobacterial growth. The CRC-derived communities were not found to carry known CRC-linked strain-level virulence determinants, nor could CRC-linked metabolites consistently be linked to taxa across the communities. *Fusobacterium nucleatum* subsp. *animalis* isolates co-aggregated with strains of several CRC-relevant species. Protein- and fibre-rich diets enriched for CRC- and colonic health-associated bacterial taxa and metabolites within colonic sample-derived bacterial communities, respectively. Protein-representative FAAPs differentially influenced *Fusobacterium* strain growth, although the amino acid preferences and growth strategies employed by fusobacterial strains were highly heterogeneous. Ultimately, this work underlines the complexity in host-microbiota interactions and serves

as a preliminary step towards holistic characterization of interactions between the human host, the resident gut microbiota, and CRC.

Curriculum Vitae: Avery completed her BSc Honours in Biochemistry with a minor in Microbiology, Co-op at the University of Guelph in Fall 2018. She then began her PhD in Molecular and Cellular Biology under the supervision of Dr. Emma Allen-Vercoe in Winter 2019.

Awards: Board of Governors' Scholarship (2013-2018); Arthur Richmond Memorial Scholarship (2019); Canada Graduate Scholarship – Master's, CIHR (2019-2020); Canada Graduate Scholarship – Doctoral, CIHR (2020-2023).

Publications: Effects of defined gut microbial ecosystem components on virulence determinants of *Clostridioides difficile*. Carlucci C, Jones CS, Oliphant K, Yen S, Daigneault M, Carriero C, **Robinson A**, Petrof EO, Weese JS, Allen-Vercoe E. *Sci Rep*. 2019 Jan 29;9(1):885. (doi: 10.1038/s41598-018-37547-x)

A survey of *Fusobacterium nucleatum* genes modulated by host cell infection. Cochrane K, **Robinson AV**, Holt RA, Allen-Vercoe E. *Microb Genom*. 2020 Feb;6(2):e000300. (doi: 10.1099/mgen.0.000300)

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Bioactive small molecules produced by the human gut microbiome modulate *Vibrio cholerae* sessile and planktonic lifestyles. Pauer H, Teixeira FL, **Robinson AV**, Parente TE, De Melo MAF, Lobo LA, Domingues RMCP, Allen-Vercoe E, Ferreira RBR, Antunes LCM. *Gut Microbes*. 2021 Jan-Dec;13(1):1-19. (doi: 10.1080/19490976.2021.1918993)

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Culturing Human Gut Microbiomes in the Laboratory. Renwick S, Ganobis CM, Elder RA, Gianetto-Hill C, Higgins G, **Robinson AV**, Vancuren SJ, Wilde J, Allen-Vercoe E. *Annu Rev Microbiol*. 2021 Oct 8;75:49-69. (doi: 10.1146/annurev-micro-031021-084116).

Influence of free and immobilized chitosan on a defined human gut microbial ecosystem. Ruiz-Rico M, Renwick S, Vancuren SJ, **Robinson AV**, Gianetto-Hill C, Allen-Vercoe E, Barat JM. *Food Res Int*. 2022 Nov;161:111890. (doi: 10.1016/j.foodres.2022.111890)

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Impact of food preservatives based on immobilized phenolic compounds on an in vitro model of human gut microbiota. Ruiz-Rico M, Renwick S, Vancuren SJ, **Robinson AV**, Gianetto-Hill C, Allen-Vercoe E, Barat JM. *Food Chem*. 2023 Mar 1;403:134363. (doi: 10.1016/j.foodchem.2022.134363)