Graduate Studies Day 2012
Abstracts

Student Oral Presentations

Katie Beck, Dany MacDonald

An action research approach to understanding important characteristics of physical activity in older adults

It has been observed that as people age, their recreational activity preferences change. Participation transition is often from high intensity with aspects of competition to activities that focus on social relationships and enjoyment. However, it can be very difficult for people to make the move from one activity to another during their senior years. It is the intent of my research to understand which factors affect participation during these years. Recent research has categorized factors according to the following: personal factors (age, sex, socioeconomic class, employment); social and cultural factors (social support of family and friends); and environmental factors (travel costs and time, proximity to activities, cost). Based on these categories, a participatory action research model will be used to aide in the development of an instrument capable of predicting which physical activities are best suited for individuals during the senior years.

Authors affiliation: Department of Applied Human Sciences

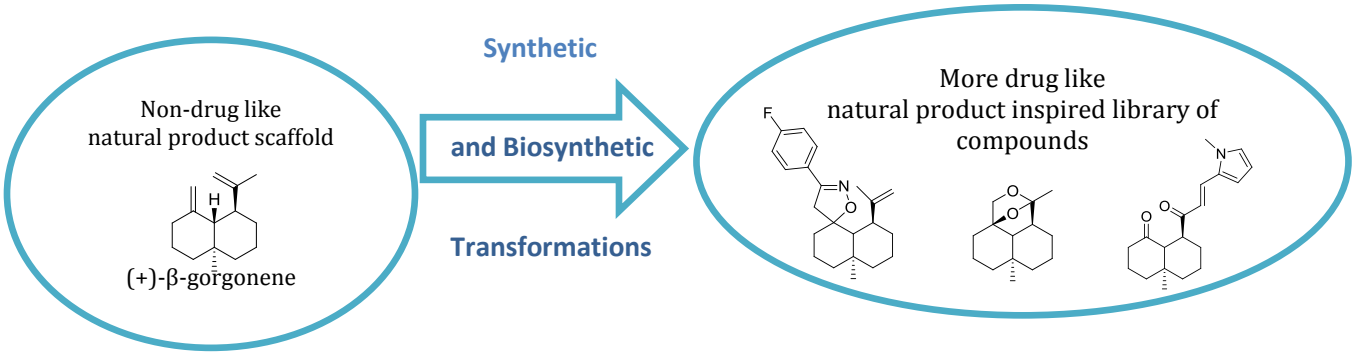
Beth Pearce, Russell Kerr, Malcolm McCulloch

Semi-synthesis of biologically inspired library of natural product mimics, from lipophillic marine natural product ®-gorgonene

Natural products have historically been a valuable source of medicines. They continue to inspire the synthesis of biologically relevant compound libraries, useful for drug discovery. 50 % of drugs approved in the last 30 years have been natural products or natural product derived. Conservation in protein domains throughout nature causes compounds that control biochemical processes in one organism often to produce a biological response in another. Sesquiterpenes are widespread in nature and exhibit a range of notable biological activities including antimicrobial, anti-inflammatory, anti-viral and lipid lowering activity. (ie. Approved drugs Simvastatin and Artemisinin)

Inspired by Ilimaquinone and other biologically active sesquiterpenes, we aim to transform a highly lipophilic, non-drug-like, marine natural product (β-gorgonene) into a library of more-drug-like derivatives. We have access to gorgonene as a byproduct of an industrial scale isolation of pseudopterrosins, and intend to produce value-added products. Our strategy utilizes semi-synthesis and microbial biotransformations to attach suitable substructures such as quinones and lactones to the gorgonene scaffold to increase its drug-likeness and mimic natural product activity in biological systems. Some synthetic techniques being explored are skeletal rearrangement, and 2+3 cycloaddition producing

an isoxazoline containing molecules. A ozonolysis / nulceophillic addition strategy enables incorporation of interesting substructures in a minimum amount of steps. Fungi are being used to selectively oxidize synthetically inaccessible carbons on the saturated backbone expanding the potential positions of attachment.



Authors affliation: Department of Chemistry

Kyle Knysh, Donna Giberson, Michael van den Heuvel

Floral and Faunal Communities of Limnocrene Springs in Eastern PEI under the Influence of Agricultural Land Use

Springs are areas of focused groundwater discharge. Cold springs are the sources of many of the rivers and streams on Prince Edward Island (PEI) Canada , but the fauna of PEI have remained relatively unexplored. The fauna of cold springs in Canada has been poorly reported in relation to other freshwater systems, this being especially true in PEI.Springs contain uniquely adapted organisms that differ from other aquatic systems due to their stable hydraulic, thermal and chemical regimes over time. Groundwater in agricultural areas on PEI can have higher dissolved nutrient levels, especially nitrates, which can affect the diversity and abundance of both primary producer and consumers. To assess the effects of agricultural land use on springs, 20 springs were sampled for water quality parameters, with 10 of those being sampled for biodiversity (primarily plants and arthropods). Half of the sites sampled were in forested regions and had little agricultural influence. Springs in agricultural areas had extremely variables levels of dissolved compounds and a greater diversity of plants than more pristine forested sites. This variability may have a impact on the diversity and abundance of consuming fauna in PEI springs.

Authors affiliation: Department of Biology

Edward Cross, Michael Shaver

Aluminum salen and salan complexes for the living and immortal ring-opening polymerization of rac-®-BL, rac-lactide and ∑- caprolactone

Aluminum-based salen and salan complexes were examined for their ability to mediate the ring-opening polymerization (ROP) of *rac*-β-butyrolactone (*rac*-β-BL), ε-caprolactone and *rac*-lactide. Al-salen complexes showed great control in the ROP of *rac*-β-BL, with excellent correlation between theoretical and experimental molecular weights and narrow molecular weight distributions of < 1.15. Al-salan complexes also showed superb control, with good molecular weight correlations and narrow molecular weight distributions of <1.05, marking the greatest control observed to date by an aluminum complex in the ROP of *rac*-β-BL. All poly(3-hydroxybutyrate) (PHB) isolated using Al-salen and salan complexes contained an atactic microstructure. Kinetic studies of *rac*-β-BL ROP by ^{1}H NMR spectroscopy revealed pseudo-first order reaction kinetics and a linear relationship between molecular weight and percent conversion, indicating living ROP. Al-salan complexes were also shown to mediate the immortal ROP of *rac*-β-BL through the addition of excess benzyl alcohol of up to 50 mol eq. with no loss of control. Screening a novel methyl/adamantyl substituted Al-salen complex showed excellent control in the ROP of *rac*-β-BL and *rac*-lactide, yielding atactic PHB and highly isotactic PLA (92%). All complexes gave only modest control in the ROP of ε-caprolactone, with poor molecular weight correlations and broadened molecular weight distributions.

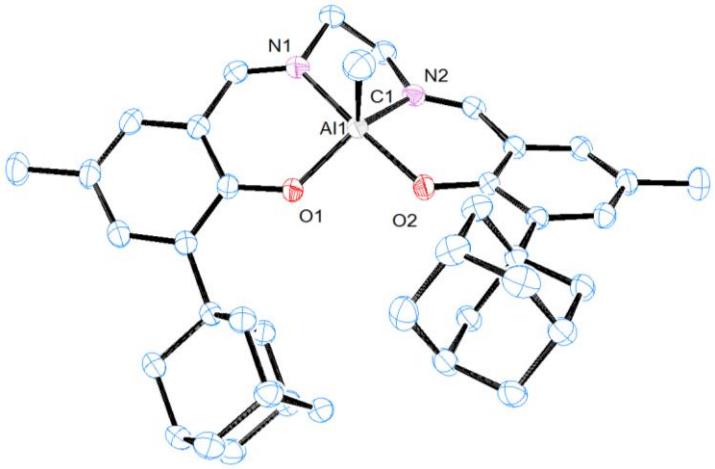


Figure 1. Molecular structure of **4** with thermal ellipsoids drawn at 50% probability and hydrogen atoms omitted for clarity.

Authors affiliation: Department of Chemistry

Krista Gill, Fabrice Berrue, Russell Kerr

Discovery and Isolation of Natural Products Produced by Actinobacteria Isolated from Sediment from Atlantic Canada

The need for new antibiotic treatments is becoming more important with the growing occurrence of pathogenic microbes and antibiotic resistance. Microbes themselves have traditionally been prolific sources of natural products with antimicrobial activity. Actinobacteria is a class of filamentous bacteria that are producers of some of the most diverse and versatile antimicrobial natural products. A library of Actinobacteria

consisting mostly of *Streptomyces sp.*, cultured from marine sediment collected from the Bay of Fundy, New Brunswick, and Bonne Bay, Newfoundland has been developed as a potential source of novel natural products. This library of Actinobacteria is being assessed using biological and chemical screening for production of novel natural products with antimicrobial activity. Bioassay guided fractionation will be used for purification of active compounds from fermentation extracts.

Authors affiliation: Department of Chemistry

Student Poster Presentations

Annie Laderoute, William Whelan
Frequency Analysis of Optoacoustic Signals in Laser Heated Ex-vivo Tissues

Laser thermal therapy involves heating tissue using light to temperatures between 55 °C and 95 °C for several minutes resulting in coagulation and cell death. This treatment method has been under investigation for use as a minimally invasive method for treating solid tumors and cancer cells. Optoacoustic imaging has been proposed as a real-time, noninvasive method for monitoring laser thermal therapy. It involves exposing optically absorbing media to nanosecond pulsed laser light causing rapid heating within the target which induces acoustic waves that can be detected using wideband transducers. In this study, ex-vivo porcine tenderloin samples were heated using a 1000 μm core optical fiber coupled to an 810 nm diode laser at a constant power of 7 W for 10 minutes. Lesions (6-7 mm diameter) were scanned using a prototype reverse-mode optoacoustic system consisting of a pulsed laser coupled to a bifurcated fibre bundle and an 8 element annular array wideband ultrasound transducer with a central frequency ~5 MHz. Tissues were scanned across native and coagulated regions with an energy of 6.5 mJ at a 1064 nm wavelength. Thermal coagulation effects were analyzed using two methods: conventional optoacoustic signal amplitude and a new spectral analysis method. The frequency content of the generated optoacoustic signals has recently been explored for quantitative tissue characterization. It has been shown that the parameters obtained by applying a linear regression to the calibrated optoacoustic spectra (slope, intercept and the midband fit of the regression line) are related to tissue properties. Results from this study show that the signal amplitude and the intercept and midband fit of the power spectrum exhibit interesting differences between native and coagulated tissue states.

Authors affiliation: Department of Physics

Kumarakurubaran (Guru) Selvaraj[a], Kaushik Ghose[a], Marva-Sweeney Nixon[a], Jason McCallum[a], Bourlaye Fofana[b]
Molecular and functional characterization of flax SDG lignan glycosyltransferases

Flax (*Linum usitatissimum.*) is a multi-purpose crop contributing to 1% and 3% of the world's food and fiber production, respectively, and has a wide variety of nutraceutical and health properties. Flax seeds are rich source of secoisolariciresinol diglycoside-(SDG) lignan, a precursor of the mammalian lignans enterolactone and enterodiol. SDG lignans are diphenolic nonsteroidal phytoestrogens having health benefits to human,

especially with antidiabetic and anticancer properties. *In planta*, lignans are naturally found glycosylated and glycosylation affects the molecule's stability, solubility, reactivity, and thereby its bioavailability and bioactivity. Pinolariciresionol reductases (PLRs) and 1-uridine diphosphate glycosyltransferases (UGTs) act as key enzymes in lignan biosynthesis. However, less information is yet available on the flax lignan glycosylation machineries. Here, we report on the identification, molecular and functional characterization of 6 putative flax UGTs. Five of the 6 UGTs were found to be seed specific and the transcript expression patterns of two tested UGTs closely correlated with SDG lignan synthesis and accumulation in developing flax seed. The heterologous expression of these UGTs and their ability to metabolize secoisolariciresinol into SDG is discussed.

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Shiv veer Singh, William Whelan

Synthesis of Gold nanocages and their application as contrast agents for photoacoustic imaging

Gold nanoparticles can potentially be used to facilitate the diagnosis and treatment of cancer due to their attractive optical properties and biocompatibility. Nanocages are a new class of gold nanoparticles characterized by hollow interior and ultrathin porous wall with tunable optical properties in the near infrared region.

Our study involves the synthesis of silver nanocubes (30-40nm) by a polyol process, in which a silver salt is reduced by ethylene glycol in the presence of a capping agent poly (vinylpyrrolidone) (PVP). These silver cubes work as a template for the production of gold nanocages via a redox galvanic replacement reaction. Gold is deposited epitaxially on the surface of the silver nanocubes, adopting their underlying cubic form. Due to this deposition, the interior silver is oxidized and removed, together with alloying and dealloying to produce a hollow and porous structure. Localized Surface Plasmon resonance (LSPR) is a well studied phenomenon in gold nanocages fabrication. We can tune the LSPR of gold nanocages by changing the amount of the metal precursor (chloroauric acid) added to the suspension of silver nanocubes and also in addition to other reaction parameters.

The synthesis and characterization of silver nanocubes will be presented. We have synthesized a number of batches to achieve the required yield (90-95%) of cubes and we have used different techniques for characterizing synthesized silver nanocubes: U-V spectroscopy to determine the absorption spectrum (depends on size and distribution), X-Ray diffraction to check for purity and high resolution transmission electron microscopy (HR-TEM) to confirm size and morphology.

We are interested in synthesizing the gold nanocages to have an optical absorption in the 750-900 nm range, for use as contrast agents in photoacoustic imaging. Photoacoustic imaging, which involves generating ultrasound in tissues using pulsed light, is one of the most promising new techniques for in-vivo imaging of solid tumors. It is a non-invasive technique whereby image contrast is provided by the concentration and distribution of

optical absorbers (e.g. hemoglobin, nanocages) in tissues. Stability of gold nanocages against high energy near infrared laser pulses will also be presented.

Authors affiliation: Department of Physics

Catherine MacNeil, H. Carolyn Peach Brown
Youth livelihood strategies and environmental-decision making in Cameroon

It is necessary to understand how international forest policy to mitigate climate change will affect those who are dependent on those forests for survival. Youth are an important group within communities but are often underrepresented within current research. There is a need for further understanding of the role of youth in management of community forests. The current livelihood strategies of youth and their role in formal and informal decision-making in villages in the East province of Cameroon will be studied. The research will also focus on the contribution of youth in discussions on REDD+ and the barriers that currently prohibit youth from partaking in decision-making at the community level. Using interviews, surveys, and focus groups within these villages, this research aims to understand the role of youth in environmental decision-making in order to understand how they can be better integrated into the REDD+ mechanism. Based on the results, a strategy for including youth in local environmental decision-making and inclusion in REDD+ programs will be suggested.

Authors affiliation: Department of Biology

Gayan Tennekone, Michael Shaver
Cyclodextrin-based Biodegradable Polymer Stars: Degradation and Fluorescence Studies

A unique challenge for drug delivery systems in biomedical sciences is the accurate determination of treatment regimens, specifically the determination of when the treatment cycle is complete. This is commonly measured through invasive techniques which measure bioactive compounds or their metabolites in blood concentrations.

This project involves the development of a polymeric drug delivery system based on a host/ guest core capable of indicating the termination of the treatment cycle by molecular fluorescence. Polymer stars based on a cyclodextrin core and poly(lactic acid) (PLA) arms were successfully synthesized with variation in both the polymer microstructure and arm length. Inclusion of a 7-methoxycoumarin fluorophore which exhibits fluorescence supression upon encapsulation in a cyclodextrin nano-cavity provides a new strategic method to monitor degradation and controlled release characteristics of these novel polymeric systems. The embedding of bioactive molecules in the arms creates a controlled drug delivery vehicle of commercial importance.

Authors affiliation: Department of Chemistry

Teri McComber, Jennifer Taylor, Sarah Sparks

The Association between School Nutrition Policy Implementation and Children's Lunch-Time Food Group Intakes

Background: Overweight and obesity rates have approximately doubled in the past 25 years in Canadian children and youth. Diet has been identified as an important contributor to obesity. Canadian and American surveys have identified that children have poor quality diets with low intakes of fruits and vegetables and milk, with high intakes of sugar and fat. Schools across North America are implementing school nutrition policies (SNP) as a practical and effective means of improving children's dietary intakes, particularly the foods consumed at school, as part of school lunch programs. In Prince Edward Island (PEI), SNPs have been implemented in all elementary schools since 2006 which provides the opportunity to assess changes over time in the dietary quality of children's lunch time intakes associated with the SNP implementation. Although there is evidence regarding the impact on children's nutrient intakes, we know little about the children's lunch time food group intakes. This is important because school based nutrition interventions and national dietary guidance are both food rather than nutrient based.
Purpose:
(a) To describe school children's lunchtime food/food group intakes in 2007 (early SNP implementation), 2010 (4 years after implementation) and 2012 (6 years after implementation).
(b) To describe the median intakes of the CFG (Canada's Food Guide) food groups, and assess changes in intakes from early implementation (2007) to six years post implementation (2012).
(c)To assess the relationship between the length of policy implementation, level of policy adherence and adequacy of school children's lunchtime CFG food group intakes.
Methods: A previously validated lunchtime food record (LFR) has been used to assess one day lunchtime intakes of grade 5 and 6 students in 2007 (n=1980) and in 2010 (n=1642) with 2012 underway presently. All food and beverages recorded on the LFRs were coded using the 2007 version of the Canadian Nutrient File and food groupings based on similar nutrient compositions were created. A total of 60 groupings were created and condensed down to 16 groups to facilitate analysis. These were then recoded to the four Canada's Food Guide (CFG) food groups and a low nutrient dense foods (LNDF) category so that adequacy could be assessed.
Proposed Analysis: Descriptive statistics will be generated for the food group servings. Quality of lunch time food consumption will be assessed by comparing median servings per group with Canada's Food Guide recommendations for age using 1/3 of the daily amount (since lunch should contribute to about 33% of daily food intake). Changes over time in food group intake between 2007 and 2010 and 2012 will be examined with General Linear Modeling (GLM) which will be used to assess changes in the servings the CFG groups and LNDF with SNP adherence level, geographic location (rural/urban), student age, gender and parental education/income as covariates. Changes in the proportion of students consuming adequate levels of CFG food groups will be assessed using logistic regression with students nested in schools. Grade, gender and source will be used as covariates in the regression models.

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Christian Agatemor, Donald Cameron, Michael Shaver

Targeting control of poly(lactic acid) polymer stars and copolymers properties: the effects of tacticity

Aiming at controlling the macroscopic properties of a class of aliphatic polyesters, the tacticity of biodegradable poly(lactic acid) copolymers and polymer stars were varied by the stereochemical control of the ring opening polymerization of rac- and L-lactide. Stereocontrol was achieved by employing Lewis acidic tin and aluminum catalysts in the polymerization of poly(lactic acid) polymer stars supported on a dipentaerythritol core, poly(lactic acid)-co-poly(glycolic acid), and poly(lactic acid)-block-poly(ethylene glycol). Characterization of these polymers by means of 1H NMR spectroscopic, thermogravimetric analysis, differential scanning calorimetry, powder X-ray diffraction and hydrolytic decomposition studies reveals the profound effects of tacticity on polymer properties. Indeed, for the polymer stars, noticeable improvement in the glass transition temperature (Tg) was observed at ≥ 83% isotacticity bias. This approach provides a means of tuning the physical properties of poly(lactic acid) containing polymers.

Author's affiliation: Department of Chemsitry