Antimicrobial resistance profiling of bacteriophage-insensitive *Salmonella enterica* mutants

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Exploitation of bacteriophages (phages) to control foodborne pathogens has shown considerable promise. However, little is currently known regarding bacteriophage-insensitive mutants (BIMs) and their response to other antimicrobials. Objectives of this study were to evaluate the sensitivities of *Salmonella* Agona S5-517 BIMs to tetracycline, a common antibiotic, and chlorine, a commonly used sanitizer in food industry. BIMs (n=5) were isolated by spotting phage SI1 on a lawn of S. Agona and serially culturing resistant colonies that grew in the centers. To test for tetracycline sensitivity, wildtype and BIMs were spectrophotometrically assayed in Mueller-Hinton broth supplemented with varying concentrations of tetracycline for 16 h, followed by a growth curve analysis. For chlorine resistance, wildtype and BIMs were treated with 50 ppm chlorine for five min and spread onto tryptic soy agar for enumeration. Lag phase duration and log reduction values were analyzed with a one-way ANOVA and a post-hoc Tukey's HSD test to compare resistances between isolates (α=0.05). The lag phase of BIMs subjected to 1.28 mg/mL tetracycline significantly increased by 3±0.5 h to 5.5±0.5 h compared to wildtype S. Agona ($p<0.05$), indicating attenuated resistance to tetracycline. Conversely, log reduction values of the BIMs upon chlorine treatment ranged from 6.56±0.77 log CFU/mL to 7.51±0.25 log CFU/mL, compared to 9.96±0.00 log CFU/mL of the wildtype, indicating significantly enhanced resistance of the BIMs to chlorine ($p<0.05$). The results describe the diverse phenotypes of *Salmonella* BIMs. Attenuation or enhancement of antimicrobial resistance should be taken into consideration when designing phage therapies for the food industry.

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Plant-based dietary practices in Canada: Examining definitions, prevalence and determinants of animal source food exclusions in the 2015 Canadian Community Health Survey-Nutrition

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While plant-based dietary practices (PBDPs) have been recommended in the Canadian dietary guidelines to improve both population health and environmental sustainability, no nationally-representative study has described Canadian trends regarding plant-based eating. This study therefore aimed to characterize the PBDPs of Canadians by estimating the prevalence of Canadians who exclude animal source foods and evaluate whether PBDPs were associated with geographic, sociodemographic or lifestyle characteristics. Data on dietary exclusions drawn from the 2015 Canadian Community Health Survey–Nutrition were used to operationalize definitions of PBDPs and examine their prevalence. Bivariate analyses were conducted to examine potential correlates of PBDPs. Respondents' PBDPs were categorized as vegan, vegetarian, pescatarian and meat-excluder. In 2015, approximately 5% of Canadians reported adhering to PBDPs with the majority (2.8%) identifying as meat-excluders, 1.3% as vegetarian, 0.7% as pescatarian and 0.28% as vegan. Respondents were more likely to report following any PBDP if they were female ($p=0.038$), had a university degree ($p<0.001$), lived in an urban location ($p=0.027$), were an immigrant ($p<0.001$), and were less likely to self-identify as "White" ($p<0.001$). Canadians reporting PBDPs were more likely to have taken a supplement in the last month ($p=0.012$) and less likely to smoke cigarettes ($p<0.001$). Other variables such as age and income were not associated with reporting PBDPs. Despite growing public discourse around PBDPs, few Canadians reported total exclusion of animal products. PBDPs were associated with several sociodemographic characteristics and health-related practices. Understanding factors shaping adherence to PBDPs among Canadians is valuable for informing strategies promoting environmentally sustainable diets.

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Using a mini-ethnographic case study to understand livestock stakeholders' perspectives on animal welfare in a large-scale Chinese pig farm

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China currently produces and consumes half of the world's pigs. To satisfying growing demands, agribusinesses with industrial farms housing more than 3000 pigs are becoming increasingly popular. Numerous livestock stakeholders are involved in agribusinesses (e.g. business owners, managers, and farm workers) but little is known about their perspectives on pig welfare. To improve pig welfare, we need to understand livestock stakeholders' perspectives, since their decisions directly impact the welfare of their animals. Though surveys have been used to understand stakeholder attitudes and perceptions about pig welfare, there is an existing gap in determining whether stakeholders' intentions to improve animal welfare translates to actual improvements. To address this gap, I will use a mini-ethnographic case study design to gain a deeper understanding of stakeholders on a large-scale Chinese pig farm where there is expressed intention for animal welfare improvements. I will purposively sample one Chinese pork agribusiness, then conduct in-depth interviews to understand various stakeholders' perceptions of the current and ideal animal welfare situation on farm, and use on-farm participant observations to see the current animal husbandry practices on the farm. Mini-ethnographies involve living and participating in farm activities, which will allow me to observe practices which are not easily accessible through surveys or shorter farm visits. Living on farm also enables me to establish trust with stakeholders and gain better insight into their views. This study will help improve understanding of Chinese pork agribusinesses and identify practical strategies for improving pig welfare.

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Regulations of omega-3 fatty acids in foods for adults and children: USA and Canada

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Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are major omega-3 fatty acids that are derived from marine sources, and they play crucial health roles, which include cardiovascular health, joint health, fetal and infant brain development in children. The regulations of food supplemented with these polyunsaturated fatty acids for adults and children in the United States and Canada will be a subject of this presentation. Health claim and nutrient content claim pertaining to the foods are also discussed. More so, the mechanisms of the hypolipidemic effect of omega-3 fatty acids, as well as the combination of these bioactives with other nutraceuticals such as phytosterols to enhance the lowering the risk of coronary heart disease, will be also addressed. This presentation provides recommendation that for future regulations the law makers should consider not only EPA and DHA but also inclusion of plant sterols from a healthy heart perspective.

Identifying barriers preventing successful dairy cow transition management

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Many dairy cows become ill in the weeks after calving, a period when cows also experience numerous environmental and physiological changes. This period is referred to as the 'transition period' and most of the research to date has focused on biological factors including nutrition, immunology, and physiology, but little work has examined sociological factors affecting how farmers care for their cows. The aim of the current study was to describe the barriers preventing the adoption of more successful management practices. We used individual and group interviews, paired with photo elicitation, to understand the perspectives of farmers (n=11) and veterinarians (n=8) living and working in the lower Fraser Valley of British Columbia, Canada. Participants viewed transition period management as difficult. The lack of a single definition of 'transition period' emerged as an important barrier to improvement; providing a clear and consistent definition for the transition period may be an important first step as farmers and veterinarians work together to improve practices on dairy farms. The participants also identified other barriers that may hinder improvement, including variation in farmer management style, farmer-veterinarian communication, stocking density of cows, and nutrition management. Barriers to improved practices varied by farm suggesting that an individualized approach is required.

Controllability as a protective factor against restraint stress in dairy cattle

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Restraint is routinely used on farms for a variety of management practices. When restrained, animals typically experience no control, which can trigger an intense stress response characterized by high reactivity and physiological activation (including increased heart rate and cortisol levels). Different methods can be used to try to mitigate the aversiveness of restraint, including habituation through repeated exposures. In addition, animals can also be trained to voluntarily enter restraint using operant conditioning. This latter method positively associates the restraint with a reward. No previous research has assessed the effect of controllability on cattle responses to restraint. This study tested if providing controllability would reduce stress responses in dairy cattle during restraint for an injection. Heifers trained to enter a restraint chute for a food reward (n=8) were compared with a control group that was simply habituated to the chute through repeated exposure (n=8), and a second control group with no previous exposure to the chute (n=7). Stress responses to the restraint and injection were monitored using behavioural (time to enter the chute and reactivity scores) and physiological (eye temperature) measures. We predicted that heifers trained to enter the chute voluntarily would display shorter entrance times, lower eye temperatures during restraint, and lower reactivity scores.

Funding source: NSERC Discovery grant awarded to Daniel M. Weary

Antibiotic resistance phenotyping and genotyping of Verocytotoxigenic *Escherichia coli* isolated from irrigation water in British Columbia, Canada and their susceptibility to bacteriophages

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The presence of antibiotic resistant verocytotoxigenic *Escherichia coli* (VTEC) in irrigation water may be a threat to human health. Bacteriophages have been proposed as a biocontrol method against VTEC. To compare the antibiotic resistance profiles of VTEC isolates from irrigation water in the Lower Mainland of British Columbia, Canada based on phenotyping and DNA sequencing, and to examine their susceptibility to bacteriophages. VTEC isolates (n=15) were screened for antibiotic resistance using the broth microdilution method and resistance breakpoints as outlined by the CLSI. VTEC whole genome sequences were queried against antibiotic resistance gene databases to identify antibiotic resistance genes. Fifteen bacteriophages were isolated from sewage using VTEC as an enrichment host, and their ability to lyse VTEC isolates was tested by spotting phage lysate on bacterial lawns. Results showed that 100% of isolates were susceptible to the antibiotics ceftriaxone, chloramphenicol, gentamicin and nalidixic acid. Six isolates were resistant to one or more of the following antibiotics: ampicillin, streptomycin, tetracycline, and trimethoprim-sulfamethoxazole, but nine isolates were susceptible to all eight tested antibiotics. Analysis of the VTEC genomes show that resistant strains have corresponding known acquired resistance genes, except for two ampicillin-resistant isolates. Spot tests show that 87% of the bacteriophages were capable of lysing 73% of the VTEC isolates, including 50% of the antibiotic resistant isolates. Antibiotic resistant VTEC with acquired antibiotic resistance genes may indicate horizontal gene transfer in the environment of British Columbia. Bacteriophages have lysing capabilities against VTEC, indicating their potential for biocontrol.

Funding sources: NSERC and UBC

Numerical modeling, simulation and microbial validation of a continuous pulsed light food processing system

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The undesirable effects of heating on food nutrients and general reluctance towards use of any preservative have led the food industry to explore alternative strategies for food safety. Recently, pulsed light (PL) technology was introduced, which employs high intensity short-duration pulses of broad spectrum light (200-1200 nm) ranging from UV-visible-IR region that can inactivate microorganisms while having no significant effects on nutrients. The overall objective of the proposed research is to develop and characterize a continuous PL food processing system. Firstly, an annular cylindrical treatment chamber will be designed wherein the liquid food will be treated by a PL lamp at the axis. Swirling of liquid in the chamber will be done to develop turbulent flow regimes. By varying equipment, process and product parameters a fluid flow-radiation based numerical model would be developed using hydrodynamics (Particle image velocimetry), fluence (Pulse frequency, time), microbial death kinetics (D, z-value) approach and simulated using computational fluid dynamics (CFD) modules. Real food products like fruit juices, milk etc. would be treated after inoculation with pathogenic microorganisms surrogates (*E. coli* K12, *Listeria innocua*) to verify process lethality. Nutritional and bioactive compounds like vitamins, proteins, lipid oxidation (milk) and polyphenols (TPC), antioxidants (DPPH) (juice) would be analyzed. Based on the microbial destruction and nutrient retention, the PL process would be optimized using appropriate experimental design and response surface methodology (RSM).

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Is iron supplementation harmful in populations where iron deficiency is not the cause of anemia? Protocol for a 12 week RCT in Cambodia

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In 2016, the World Health Organization set a global policy recommending daily iron supplementation (60 mg iron) for women living in countries with anemia prevalence >40%, such as in Cambodia. However, recent studies have shown the prevalence of iron deficiency to be low in Cambodia. Iron supplementation may be harmful in women with genetic hemoglobin disorders, which are common in Cambodia, as they are already at an increased risk of iron overload. The risks may increase as iron absorption from the most common form of supplementation, ferrous sulfate, is low. Less than 20% is absorbed in the gut; the remaining 80% passes unabsorbed into the colon, increasing the risk of pathogen growth and gut inflammation. Alternatively, ferrous bisglycinate is a newer form of iron that has 2-4x higher bioavailability than ferrous sulfate. My research objectives are: to assess the non-inferiority of 18 mg iron as ferrous bisglycinate as compared to 60 mg iron as ferrous sulfate on mean ferritin concentrations; and to determine if ferrous sulfate increases gut inflammation and gut pathogen abundance, as compared to placebo or ferrous bisglycinate. We will undertake a double-blind three-arm RCT in Cambodia. 480 non-pregnant women (18-45 years) will be recruited and randomized to receive ferrous sulfate, ferrous bisglycinate, or placebo, for 12 weeks. We will measure calprotectin, a marker of gut inflammation; gut pathogen abundance; and hemoglobin and ferritin concentrations at baseline and 12 weeks. Findings will contribute to the evidence for safe and effective iron supplementation for women worldwide.

Funding source: Canadian Institutes of Health Research 2018 Project Grant

Hot weather increases competition between dairy cows at the drinker

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Heat stressed dairy cows will compete for resources that aid cooling, but it is not known how heat stress affects the competition for water by indoor housed cows. The objective was to evaluate how heat stress affects behaviour of indoor-housed dairy cows at the drinker. For 3 weeks after calving, cows were housed in a dynamic group (n = 20) in a pen equipped with 12 electronic feed bins, 2 electronic water bins, and 24 freestalls. A total of 68 cows were enrolled over a 59-d period. The electronic water bins recorded drinking time, frequency, intake, and competitive events for 24 h/d. Heat stress was determined by calculating the temperature humidity index (THI) recorded by the local weather station. A THI $\geq$ 68 or 72 was used as the cut-off to indicate heat stress conditions. THI parameters examined were daily mean, minimum, maximum, and number of h $\geq$ 68 or 72. To determine if there was a lag effect of weather on drinking behaviour, we compared THI parameters measured on the day of behavioural recordings and THI spanning the previous 1 to 3 d. We found that, as the number of hours with a THI $\geq$ 72 in a 3-d period increases, cows drank more water, spent more time drinking, made more drinking visits, and engaged in more competition at the drinker. These results indicate that behaviour at the drinker could be a useful sign of heat stress that can be monitored electronically.

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How an Indigenous worldview changes ecological restoration: Values based land healing as an act of reconciliation to protect food security and food sovereignty in a changing climate

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Indigenous perspectives on invasive species are largely unknown. Informed by Western science, the specific impacts of invasive species are often generalized and not well understood. Common approaches to ecological restoration are rooted is the native versus non-native dichotomy which equates native species with evolutionary fitness. Food insecurity is one of the most significant challenges facing Indigenous communities. Traditional foods are nutritionally superior making their availability important. Integration of Indigenous ecological knowledge in land management while increasingly popular, may not provide the full benefit that the application of the Indigenous world view can. Integration may provide valuable information but is often context specific. The goal of this study is to answer the question, "What does the application of an Indigenous worldview to ecological restoration tell us about the impacts of current land management approaches on Indigenous food security and food sovereignty in the context of our changing climate?" Working with Cowichan Tribes on the restoration of their ancient village site, Ye'yumnuts, as well as other traditional knowledge holders, we gathered oral histories, stories, and perspectives pertaining to invasive species and our role in managing the natural environment. The application of Indigenous research methodology to this complicated field of study revealed new insights into species assessment and ecological restoration. The acknowledgement of values and relationality played a vital role in developing a framework to guide land management decisions that reflect an Indigenous worldview. This has allowed us to redefine and reclaim practices that protect food security and sovereignty for generations to come.

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Individual differences in response to social stress in dairy heifers

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Farm animals are frequently regrouped, altering the social structure. Regrouping is a known stressor in cattle that can compromise welfare, health and production. Regrouped individuals show changes in feeding and resting behaviours and increased aggressive interactions. Individuals differ in their response to stressors: some have a proactive coping style (i.e. active response, high aggressiveness), and others a reactive coping style (i.e. high immobility, low aggressiveness), but these individual differences have not been studied in the context of social stress in dairy cattle. The aim of this study was to describe the individual coping strategies of heifers subjected to regrouping. Activity, synchronization, social proximity, and aggressiveness were measured. We predicted that heifers would either adopt a proactive coping style, displaying more aggressive behaviours but synchronizing faster with the group, or a reactive coping style, characterized by low aggressiveness and higher desynchrony. Over the three days of the regrouping event, heifers progressively increased time spent feeding and resting, and spent less time standing. They also increased synchronization and interacted with more neighbours. Individual variation was found in the aggressive behaviours received and initiated by the regrouped heifer, reflecting different coping strategies. Proactive heifers were better able to cope with this social stressor, as indicated by less of an effect on activity and greater synchronization compared to reactive individuals.

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Day and night temperature regimes affect flavonoid accumulation in 'Merlot' (*Vitis vinifera L.*) grapes

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Grape flavonoids impart color and mouthfeel to grapes and wine. Two growth chamber experiments investigating the effect of day and night temperature on flavonoid accumulation in grapes were conducted in 2017 and 2018. Five temperature treatments were imposed to Merlot grapevines from véraison (the onset of ripening) to harvest. Low temperature treatments showed the highest anthocyanin and flavonoid accumulation in the berry, while berries from high temperature treatments had the lowest. Interestingly, high temperature treatments induced the relative concentration of 3'4'5'-substituted anthocyanins and flavonols, as well as methoxylated anthocyanins at harvest. Delta temperature between day and night had minor effects on flavonoid accumulation and profiles, contrarily to what is anecdotally believed by the industry. Gene expression analyses of critical anthocyanin and flavonol biosynthetic pathway genes indicated that changes in *VviCHI1* and *VviLDOX* expression level had high correlation with anthocyanin content, while *VviFLS4* and *VviMybF1* expression level was correlated with flavonol content. An increased *VviF3'5'H* to *VviF3'H* determined the observed increase in the 3'4'5'- to 3'4'-substituted anthocyanin and flavonol ratio. The results revealed that temperature treatments greatly affected flavonoid accumulation and profile, partially through the regulation at transcriptional level. These will support the grape and wine industry of British Columbia in identifying the best sites for optimizing berry and wine quality.

International comparison of sustainability consideration in food-based dietary guidelines

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International appeals from the United Nations and a growing group of nutrition, policy, and environmental experts have called for integration of sustainability into national food policies. Fifteen countries now have sustainability considerations in their food-based dietary guidelines (FBDG) or supporting documentation, yet little scholarship has examined sustainability framing within these guidelines. This study examined sustainability inclusion and framing in international FBDG. Qualitative content analysis was used to analyze 11 documents used by 15 countries that were identified by the United Nations as having considered sustainability. Based on these analyses, a proposed framework was developed to examine how sustainability has been included in dietary guidelines. Sustainability concepts were more prevalent in FBDG that focused on food-based rather than nutrient-focused recommendations. All documents examined had a core focus on health but incorporated sustainability elements from myriad stakeholders. Analyzed documents informed development of a framework based on previous food policy literature to understand the interconnected use of sustainability concepts in FBDG. This framework has five core domains: health and nutrition, food security and agriculture, markets and value chains, sociocultural and political, and environment and ecosystems. Several governments have expanded the scope of their FBDG beyond health and nutrition to include sustainability-related sociocultural, economic, and environmental considerations. The framework developed here can be used to compare and examine how sustainability considerations are integrated into emerging FBDG, including upcoming Canadian guidelines. Future studies should assess how sustainability in FBDG influences individual dietary practices and future food policy.

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Analysis of Ecuador's "traffic light" labelling and its little effect on the country's main nutrition problems

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Ecuador introduced new labelling regulations in 2014. One of them was the mandatory "traffic light" (TL) incorporation in all the prepackaged foods, which displays the amount of risk ingredients linked with obesity and overweight (sugar, salt and fat) in each product. In this presentation, the effectiveness, focus and industry adaptation of the TL labelling will be reviewed. Firstly, TL labelling showed not to be effective in re-shaping the consumers shopping habits. Secondly, statistics exhibited that Ecuador's main nutrition problem is not overweight, but malnutrition, which is not the focus of TL labelling regulations. Finally, industry stakeholders have opposed strongly to the new regulations, while still adapting to the measurement. It was consequently concluded that TL labelling did not address the country's malnutrition issue. Therefore, a positive TL regulation which grades the healthy-nutrient density of the product is proposed. A positive TL labelling can explain in a simple way the amount of proteins, minerals and vitamins that a product has and consumers with scarce resources can choose the most nutrient-dense option for their budget. Furthermore, the portfolio of nutrient dense raw food available in Ecuador could be better exploited with the incentive of producing these kinds of foods. Similarly, the industry adapts better to regulations that display their product as healthy, as shown by their support to the health-claims labelling regulations. It is suggested to incorporate both labelling systems, since they could compliment each other.

Identification of epigenetically regulated enhancer DNA regions in response to dietary polyphenols in breast cancer cells

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Epigenetic modifications, which include DNA methylation, covalent histone modifications and non-coding RNA mechanisms, play important roles in regulation of gene expression. DNA methylation, in particular, has attracted a lot of attention in terms of disease prevention and treatment. During carcinogenesis, tumor suppressor genes are methylated in their regulatory regions and silenced, whereas oncogenes lose methylation and become actively transcribed. In this study, we focus on enhancer regions, which are intensively studied gene regulatory regions, and investigate how dietary bioactive compounds, specifically resveratrol from grapes, change epigenetic makeup at enhancers of oncogenes and thereby attenuate cancer development. Human breast cancer cell lines, non-invasive MCF10CA1h and invasive MCF10CA1a, were treated with resveratrol at 15 μM concentration for 9 days. The effect of the treatment on the DNA methylation patterns was determined using Illumina-450K methylation microarray. We found 1,751 and 1,803 differentially methylated CpG sites ($0.05 \geq$differential methylation≤ -0.05, $p<0.05$) located in enhancers upon resveratrol treatment in MCF10CA1h and MCF10CA1a cells, respectively, as compared with vehicle treated cells. Functions, biological processes, and signaling pathways of genes corresponding to differentially methylated sites were analyzed using bioinformatics tools. We further identified 103 genes that are hypermethylated targets in both breast cancer cell lines and discovered that majority of them is linked to oncogenic functions. Our results confirm a potential role of dietary polyphenols in regulation of DNA methylation at enhancer regions which may result in silencing of genes with oncogenic functions and may contribute to anti-cancer action of these compounds.

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Impact of "Playpens" on laboratory rat welfare

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Laboratory rats (Rattus norvegicus) are typically housed in small, simple cages that compromise their welfare. Specifically, standard laboratory housing restricts rats' ability to express a suite of natural behaviours, and research has shown that this negatively affects their well-being. The purpose of this study was to assess whether the welfare of standard-housed laboratory rats is improved by providing rats with regular access to larger, enriched "playpens", where they were able to engage in natural behaviours such as play, exploration, burrowing and running. The advantage of playpens is that they are relatively convenient and inexpensive to implement. This project recorded the occurrence of behaviours associated with positive welfare (play and affiliative behaviours) and negative welfare (aggression and sleep fragmentation) in standard-housed laboratory rats who had access to playpens for one hour per day, four days per week, compared to a control group who had access only to another standard cage. Rats were filmed in their home cages and videos were scored by a blind observer for the above behavioural parameters. We hypothesize that rats with access to the playpen will display more behaviours associated with positive welfare and fewer behaviours associated with negative welfare in their home cages compared to control rats. If the hypothesis is well-supported, this study would provide evidence that providing rats with regular access to playpens is a worthwhile endeavor that could improve their welfare in laboratory settings.

Hurdle enhancement of antimicrobial efficacy of acidic electrolyzed water on *Bacillus cereus* spores using ultrasonication

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Bacillus cereus spores have tough and metabolically inert structures and their formation is a strategy for this bacterium to survive in the unfavorable environment. It is of significant concern to food industry because it produces two thermostable toxins and causes massive foodborne diseases. Thus, it is critical to develop an effective technology to inactive bacterial spores. This study evaluated the inactivation effect of ultrasonic treatment combined with acidic electrolyzed water (AEW) on *B. cereus* spores. *B. cereus* spores were treated with ultrasound and AEW separately and combined, followed by the investigation of antimicrobial effects. AEW treatment induced 1.05-1.37 log (CFU/mL) reduction of *B. cereus* spores while the sporicidal effect of ultrasound was minor. In comparison, simultaneous ultrasonic and AEW treatment for 30 min reduced 2.29 log of spores and determined to be a synergistic effect. Moreover, simultaneous antimicrobial treatment was validated to be more effective to inactivate spores than the successive antimicrobial treatment. Flow cytometry combined with SYTO 16/PI staining analysis revealed that ultrasound hydrolyzed the cortex and AEW partially damaged the integrity of the inner membrane of spores. We also identified that ultrasound promoted the detachment of exosporium and destroyed spore structure (e.g., cortex) that subsequently decreased the resistance of spores by electron microscopy. Electron density of spores appeared to be heterogeneous after AEW treatment. Combining ultrasound with AEW had a significant sporicidal effect on *B. cereus* spores and validated to be a promising sterilization technology used in food industry.

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Is natural folate as effective as synthetic folic acid in maintaining serum and red blood cell folate concentrations during pregnancy? A proof-of-concept pilot study

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Health Canada recommends 0.4 mg/day folic acid, 2-3 months before conception and throughout pregnancy for primary prevention of neural tube defects (NTDs). Recent evidence suggests that humans may not have the capacity to metabolize such large doses, and in folic acid >0.2 mg/day, unmetabolized folic acid (UMFA) may be detected in circulation. A natural form of folate (5-MTHF) may be safer because it does not require metabolism and won't produce UMFA. 5-MTHF is currently used in some prenatal vitamins but has yet to be evaluated in pregnancy. Trial objectives are to assess whether 5-MTHF is as effective as folic acid in maintaining serum and red blood cell (RBC) folate during pregnancy, while resulting in lower UMFA. This randomized double blinded trial will include 60 pregnant women aged 19-40 years. Women will be randomized to either 0.6 mg/day folic acid or an equimolar dose (0.625 mg/day) 5-MTHF for 16-weeks. The trial will be initiated at 18-22 weeks gestation (after the neural tube closure). Baseline and endline blood samples will be collected to measure serum/RBC folate and UMFA. Dietary folate equivalents will be assessed using a validated food frequency questionnaire. Demographic data, medical and nutrition history will be gathered via a baseline questionnaire. Adherence to the study protocol will be assessed with capsule counts and a supplement diary. This trial will provide the proof-of-principle that 5-MTHF is an effective alternative to synthetic folic acid during pregnancy. These findings will inform a definitive trial to determine the safest form of perinatal folate supplementation.

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Chlorogenic Acids modulate catalase-induced pro-inflammatory response in raw 264.7 cells

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Catalase, is an essential redox regulating enzyme that is central to regulating cellular oxidative balance by decomposing of hydrogen peroxide to less-reactive gaseous oxygen and water molecules. Catalase can also be involved in prooxidation reactions by altering intracellular available iron concentration, or as a producer of oxygen from the degradation of hydrogen peroxide to water. In this study, we use catalase to trigger an alteration in cellular redox to monitor its effect on subsequent pro-inflammatory responses in Raw 264.7 cells. We characterized the pro-inflammatory response in Raw 264.7 cells induced by catalase, and then used the model to test the activity of chlorogenic acid, a common dietary polyphenol found in many fruits, beverages and vegetables, to modify the pro-inflammatory actin of catalase in Raw 264.7 cells. Our study showed that catalase pre-treatment triggered early activation of NF-κB signaling pathway in a concentration dependent manner. Subsequent inducible nitric oxide synthase (iNOS) expression measured after 24h catalase exposure was dependent on catalase concentration. Catalase treatment also induced a Cox-2 response. Chlorogenic acids mitigated the catalase induced NF-κB signaling pathway, reduced both Cox-2 and iNOS upregulation, as well as NO production. Our results suggest that chlorogenic acids can mitigate a pro-inflammatory response triggered by a catalase-induced redox unbalance. This work was supported by a NSERC-Discovery grant to DDK.

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Differential growth of *Listeria monocytogenes* in soft ripened cheese at refrigerated temperatures

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Illnesses and outbreaks of listeriosis in Canada and the United States have been associated with soft ripened cheese (SRC). Relative to harder cheeses, SRCs, such as Brie, provide a favourable environment for the growth of *Listeria monocytogenes* due to a higher moisture content and lower acidity. The objective of this study was to compare the growth of *L. monocytogenes* in four SRCs of different origin. The growth of *L. monocytogenes* in four SRCs stored at 8°C was monitored daily through spread plating on PALCAM agar. Two SRCs each from Canada and France were tested and included cheeses made from both pasteurized (n=2) and non-pasteurized milk (n=2). *Streptococci*, *Lactobacilli*, and total aerobic bacteria in each cheese were measured concurrently on selective agars. Across the four SRCs, *L. monocytogenes* grew at an average rate of 0.29±0.6 $\log CFU g^{-1} day^{-1}$ to achieve an average maximum density of 7.2±0.5 $\log CFU g^{-1}$ after ten days of incubation at 8°C (n=4). Area under the curve analysis revealed the Canadian pasteurized milk cheese to have significantly higher growth of *L. monocytogenes* than the other three cheeses (Tukey's HSD; $p<0.002$). Interestingly, this same cheese showed a lack of quantifiable *Lactobacillus* ($<10^3$ CFU/g) whereas the other three cheeses had concentrations of *Lactobacillus* ranging from 10^6–10^7 CFU/g. These results confirm that *L. monocytogenes* grows readily in SRC at refrigerated temperatures. The growth potential, however, appears to differ between different SRCs and may be related to the density, and possibly the composition, of the native microflora.

The identification of the drought signal transduction pathway by meta-analysis of RNA-Seq data from *Arabidopsis thaliana*

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As a result of global warming, many agricultural regions in the world are facing more frequent drought events. These new conditions are challenging scientists to look for more drought tolerant crop varieties and/or new agronomical practices that improve the productivity of crops under drought. The better understanding of the molecular mechanisms involved in the plant response to drought would benefit breeding programs and/or the development new techniques to cope with drought issue. Literature shows that plants respond to drought via abscisic acid (ABA)-dependent and ABA-independent pathways; however, the drought signal transduction pathway still remains partially unclear. The goal of this study is to further explore the molecular elements involved in the signaling pathway by a meta-analysis of RNA-Seq data from *Arabidopsis thaliana*. Step 1, ABA-responsive genes were ranked (in the order of expression fold change) by performing a meta-analysis of RNA-Seq data produced from experiments where the exogenous applications of ABA on the transcriptome was tested. Step 2, similarly as above, drought-responsive genes were ranked by performing a meta-analysis of RNA-Seq data produced from drought experiments. Step 3, the two lists of ranked genes were compared to find drought/ABA-specific genes and also common genes that are both responses to ABA and drought. Weighted gene co-expression network analysis (WGCNA) and cis-regulatory element analysis was conducted to discover the signaling transduction pathway. This study will identify candidate genes of the ABA-dependent and ABA-independent signaling pathways and provide new knowledge on the signaling transduction pathway involved in the plant response to drought events.

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Physicochemical properties of yoghurts fortified with vitamin B12-producing probiotics

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Yoghurt is a widely consumed dairy product and may be an ideal food vehicle for vitamin B12 (B12) fortification, because B12 seems best absorbed from dairy products. Currently employed yoghurt cultures are B12-consuming bacteria; thus, adding B12-producing bacteria, e.g., *Propionibacterium freudenreichii* (PF), may be a novel strategy for B12 fortification of yoghurt. We aimed to determine the effect of PF on food quality, appearance, and B12 content of yoghurt. In this first phase, we tested the physicochemical properties of yoghurts fortified with two different strains, PF W200 (W200) and PF 50 (PF50) over a 4-week shelf-life experiment. Yoghurt was produced by two methods including a control. W200 was added post-fermentation; PF50 was inoculated with starter culture. At $week_1$, $week_2$ and $week_4$, samples were removed from refrigerated storage (4^{o}C) and analyzed for pH, apparent viscosity, and colour via colorimetry. While pH decreased significantly ($p<0.05$) from baseline to $week_4$, no significant differences were detectable between yoghurts at $week_4$. Apparent viscosity did not differ between yoghurts at baseline and at $week_4$ (both $p>0.05$). In regards to colour, there was a gradual transition from off-white to milky-white with yellow hues; however, no significant differences in colour parameters were identified at each timepoint. The addition of B12-producing probiotics has minimal impact on the physicochemical properties of yoghurt compared to a control yoghurt, and may be a viable alternative for natural B12 fortification in yoghurts. The efficacy of these probiotics to increase B12 content in yoghurt will be determined in the next phase of this research.

Funding sources: Dairy Farmers of Canada

Determination of in vitro intestinal bioavailability of glucosamine-sulfate

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Glucosamine is a commonly used amino-sugar to improve joint health in arthritis (Kwoh et al., 2014). It is currently used by consumers in dietary forms that include specialized supplements. These supplements contain potentially chemically active components as a matrix to complex the compound and prevent both chemical or microbiological alteration. The primary objective of this study was to evaluate the in vitro bioaccessibility and bioavailability of commercial glucosamine-sulphate (GS) supplement formulated with mineral clay using a modified Unified Bioaaccessibility method (UBM) with specific oral (UBM-O), gastric (UBM-G) and gastrointestinal (UBM-GI) digestion. Bioaccessibility was followed by a bioavailability assay, using an intestinal cell (e.g. Caco-2) permeability test. Recovery of glucosamine was similar, reaching 90% from all digestive conditions indicating that the level of bioaccessiblity of the GS supplement was similar to pure glucosamine and not influenced by the cationic mineral matrix. Furthermore, bioavailability of GS, estimates using human intestinal cells (e.g. Caco-2) was similar for both pure GS standard as well as the GS-mineral mixture; averaging approximately 10%. This quantification of in vitro bioavailability of GS was not different to literature values (e.g. 12%) obtained from in vivo, using canine species. We conclude that the in vitro UBM-digestion to mimic bioaccessibility of GS, followed by Caco-2 cell bioavailability, enabled us to assess both bioaccessiblity and bioavailablity, without relying on in vivo animal models. Hence, an alternative method has been developed to replace the use of laboratory animals commonly used to assess digestibility and bioavailablity of nutrients.

Condition of cull dairy cows at farms and before slaughter

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Cull dairy cows are regularly removed from dairy herds and enter the marketing system which often involves transportation to livestock markets and then to an abattoir. Many cull dairy cows are removed from the herds because of health reasons and their ability to withstand transportation may vary. The objectives of this study were to follow cull cows from farm to abattoir and monitor changes in the cows' condition. From May 2017 to March 2018, data were collected from 20 dairy farms, 2 auction markets and at 6 abattoirs in British Columbia, Alberta, and the USA. The dairy farms were visited regularly before cows were shipped and a researcher scored the animals for body condition, lameness and udder condition. Trained assessors at the abattoirs also assessed cows' condition at arrival. During the study, 1,171 cull cows were removed from participating farms and 714 of those animals were observed at one of the participating abattoirs. After leaving the farms, cows spent on average 82 hours in the marketing system until being processed. Including delays at auctions or assembly yards, about 41% of cows were in transit for 4-5 days and 11% for 6-16 days. Regarding distance, around 11% were transported 1,100 km from farm to abattoir. The percentage of thin cows increased from 8% at the farm of origin to 22% at the abattoir. Lameness did not change, but transport increased the development of acute milk accumulation and udder inflammation from 8% at farm of origin to 41% at the abattoir.

A socioecological systems analysis of smallholder resilience in the Philippines: Identifying multi-scalar barriers and pathways to resilience

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Climate change poses serious threats to agriculture. The Philippines is one of the foremost countries impacted by climate change. Many smallholders are struggling to cope with intensified typhoons, changing rain patterns, floods, droughts, and temperature, as well as sea-level rise. As a primary staple crop embedded in the socioecological fabric of the Philippines, rice systems are of particular significance to resilience building efforts. Drawing on fieldwork conducted between August-December 2016, this presentation shares the results of a socioecological analysis of the Philippine rice sector, identifying multi-scalar barriers and pathways to building resilience. My findings suggest that organic rice systems are more climate resilient than their conventional counterparts. Yet, despite increased institutional support for organic agriculture, institutional arrangements remain largely oriented toward promoting green revolution technologies; both obstructing the speed and scale to which Philippine smallholders transition to organic agriculture and limiting their capacities for building resilience. To overcome such adverse socioecological conditions, resource poor farmers have organized into a polycentric network to implement food sovereignty initiatives centred on increasing farmer control over agricultural resources. Such a polycentric food sovereignty development approach has helped smallholders across the Philippines transition to diversified organic systems and enhanced local capacities for resilience building. The evidence presented here suggests that the potential for organic transition to enhance resilience in the Philippines will depend on the organic movement's ability to support such polycentric food sovereignty initiatives and improve the social, ecological, and economic conditions of farmers.

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Sugar intake reduction: Macro trend impacting food and beverage innovation

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Recent years witnessed mega companies' massive investment in healthy food brands. A good research endeavor will be to evaluate if consumers are more health-conscious about products they buy? Are the industries prepared to adapt their portfolio to this new trend? With the recent shift in consumers preference towards more healthy products, this is an unfortunate news for large food corporations as this could result to loss of sales or rise of smaller companies to usurp the forefront of healthy eating. Recently, some new brands are shaking up the grocery scene due to their use of healthy ingredients, innovative and smart packaging, and implementation of sustainable and fair practices. This observed shift in consumers' preference will be the subject of this presentation. Further, its impact on recent innovation in the food and beverage industries will be explored. Ultimately, this presentation will provide recommendations for start-ups and established agribusinesses to keep up with the advances in the food industry.

Toxicity across food webs: Effects of plant botanical extracts on tri-trophic interactions in tomato

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Greenhouse whiteflies *Trialuerodes vaporareorum* (Westwood, 1856) are considered as important plant pest especially in horticultural, greenhouse grown crops. Currently, synthetic insecticides are heavily used to control pest infestations and the direct or indirect effects that those outbreaks could cause on the greenhouse crops, but as a side effect, such applications are also affecting the lifecycle and performance of the natural predators and parasitoids that contribute to control pest populations either due to their natural presence in the agricultural ecosystem or to their planed inclusion as control agents in integrated pest management programs. Several strategies have been developed to increase the use of alternative pest management programs in productive systems. Those strategies include the application of botanical extract formulations to alter the plant-pest interaction, and the release of different species of predators and parasitoids which consistently could reduce the number of insects affecting the growth and development of several crops. It has been stated that the application of plant derivatives and the release of predator/parasitoids can effectively control pest on greenhouse crops, but there is a lack of detailed information about the effect of botanical extract applications on the whiteflies adults mortality, repellency, egg laying behavior and nymph stages development, and further, which would be the effect of such variables on the pest parasitism and predatory rate. I evaluated the effect of a botanical extract application and the tomato genotypic variation on a three trophic level system including tomato plants (*Solanum lycopersicum*), whiteflies (*T. vaporareorum*), and parasitoid wasps (*Encarsia Formosa*).

Current regulations on the safety of genetically modified foods in the United States and the European Union: A review

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Genetically modified organisms (GMOs) are created by means of modern biotechnology and may include plants, animals, and microorganisms, and consequently food and food ingredients. While these techniques may benefit the food and agriculture industry, for example by increasing the production yield and enhancing crop protection, GM food products may potentially lead to toxicity, allergenicity, and other unintended consequences. While government regulations are essential for ensuring food safety, labelling of GM foods may have particular importance to consumers. Therefore, the objective of this project is to review the legislative frameworks regarding GM foods labelling among the European Union (EU), the United States (US), and Canada and to discuss the implications and values of GM foods labelling to consumers. The EU has established strict legislation and mandates the labelling of GM foods. The US regulates GM foods and their conventional counterparts under the same regulations, although mandatory labelling of GM food is now approved but still in the early stages of implementation. In Canada, voluntary labelling is encouraged by the government and generally accepted by the industry. These differences may reflect various regulatory approaches and distinct consumer perceptions of GM foods. While the newly approved labelling rule for GMOs and GM foods in the US may significantly influence the overall regulatory framework and consumers' interests regarding GM foods in the US, Canadian food producers may also experience significant impacts.

Characterization of vineyard-associated *Saccharomyces* sp. and phenolic profiles of Pinot Noir grapes in the Okanagan Valley

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Wine is a product of grape juice fermentation by yeast. *Terroir* is a growing popular topic among wine scientists, which describes environmental factors involved in creating a distinctive aroma profile for the resulting wine. Consequently, researchers have sparked interest in the regional-specific native wine yeasts strains (*Saccharomyces* sp.) and the geographically differential phenotypes of wine grapes. Since the Okanagan Valley (OV) is a major winemaking region in British Columbia (BC), Canada, my project focuses on identifying the distribution of vineyard-associated wine yeast strains and identifying the phenolic profile of Pinot Noir grapes across three sub-regions of the OV (Kelowna, Naramata-Penticton, Oliver-Osoyoos) in the 2017 vintage. Using microsatellite analysis, 10 commercial and 22 potentially indigenous *Saccharomyces cerevisiae* strains were identified from a sample size of 1,200 colonies. Over 94% of the strains were unique to a particular sub-region. Moreover, *Saccharomyces uvarum* was found in several vineyards and the microsatellite profiles did not overlap between sub-regions. The identification of unique *Saccharomyces* strains in OV sub-regions suggests the existence of regional-specific wine yeasts. The influence of terroir on the phenolic profile of Pinot Noir grapes was assessed by analyzing tannin and anthocyanin content of over 2,000 berries by UV-vis spectrophotometer and HPLC-UV/Vis-MS/MS, respectively. This research may identify distinctive phenolic features of BC grapes that can be used by local winemakers to produce regional-specialty Pinot Noir wine. The indigenous wine yeast strains will be further investigated to create inoculates in the future that guarantee predictable yet regional-specific wine fermentation.

Funding sources: British Columbia Wine Grape Council and Mitacs Accelerate

Inflammation-induced epigenetic changes in an *in vivo* model of colorectal carcinogenesis are mitigated in response to pterostilbene

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Aberrant DNA methylation patterns have been linked to chronic inflammation and consequently shown to trigger cancer. A hallmark of inflammation is activation of the oncogenic Notch circuit. We have recently shown a link between altered DNA methylation and activation of oncogenic signaling. Interestingly, certain dietary compounds such as polyphenols suppress oncogenic signals which might be mediated by epigenetic mechanisms. In the present study, we use pterostilbene (PTS), a blueberry polyphenol, in a *Min* mouse model of inflammation-driven tumorigenesis to reverse inflammation-induced epigenetic changes and reduce colon tumor formation. Infection of mice with enterotoxigenic *Bacteroides fragilis* (ETBF) causes acute inflammation followed by chronic colitis. Infected mice develop microadenomas and tumours at sites of initial inflammation. Tissues collected after 8-week PTS exposure were subjected to the analysis of DNA methylation and gene expression. We found the Notch pathway was activated in inflammation-induced tumors vs. healthy epithelium as indicated by increase in expression of Notch target genes. Strong 3-fold overexpression of *Maml2*, a co-activator of Notch target genes, may explain the observed Notch activation. A regulatory region of *Maml2* showed 30% lower DNA methylation in tumors vs. healthy epithelium, which would suggest epigenetic mechanisms of *Maml2* upregulation. Indeed, exposure to PTS led to re-methylation of *Maml2* and *Maml2* silencing. Notch target genes were downregulated, indicating inhibition of Notch pathway upon PTS treatment. These molecular changes were associated with robust 6-fold reduction in number of tumours. These findings demonstrate a role for stilbenoid-mediated epigenetic-targeting strategies as a promising approach in inflammation-driven cancers.

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Positive and negative aspects of the new GM labelling regulation in the US

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The controversies surrounding genetically modified (GM) products labelling have existed for a long time. The United States (US) government established a new amendment on mandatory GM labelling in July of 2018, which motivated the reassessment of positive and negative impacts of GM food products for different stakeholders. The mandatory labelling regulation protects the consumers' rights to know about the GM status of products. Thus, consumers can make informed choices which are protective of their religious or ethical rights depending on the information. Based on evidence from China and Europe, approved labelling on GM food products would increase retail food prices and increase the probability of food fraud as well. As a significant number of consumers have stereotype images of GM products, the new labelling required by regulation may misadvise consumption choices because of its confusing symbols and words. Mandatory labelling of GM products is the final outcome throughout the development of genetically modified organisms worldwide. However, a unified traceability system should be also considered at the regional level to monitor risk management of GM products on health and the environment.

Biochemical riboflavin (vitamin B_2) status and its predictors in older adult women in Metro Vancouver

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Riboflavin status has been inversely associated with the risk of cardiovascular disease and cancer. Riboflavin functions as a coenzyme and is essential for adequate cell growth. Studies in the UK and Taiwan reported a high prevalence of biochemical riboflavin deficiency but a low prevalence of dietary inadequacy in adults aged ≥65 years. In Canada, 3% of older adult women (aged 51-70 years) had inadequate dietary riboflavin intake; however, data are lacking on biochemical status. We aimed to determine the biochemical riboflavin status and to identify predictors of riboflavin status in older adult women residing in Metro Vancouver. This secondary analysis used data and biospecimens from a cross-sectional study with a convenience sample of 223 older adult women; a fasting blood sample, sociodemographic, anthropometric and dietary intake data had been collected during a single-day study visit. Riboflavin status was measured using the erythrocyte glutathione reductase activation coefficient (EGRac). Of these women, 29% had EGRac levels indicating riboflavin deficiency (EGRac ≥1.4) and 22% had suboptimal status (EGRac ≥1.3 and <1.4). However, only 4.7% did not meet their dietary riboflavin requirements. Riboflavin intake, supplement use, Chinese ethnicity and education level were significant predictors of riboflavin status. This study is the first to determine biochemical riboflavin status in free-living older adult women in Metro Vancouver and Canada. It provides new information and preliminary data for future research including information on possible predictors of riboflavin deficiency in this population group. The discrepancy between the diagnosis of biochemical riboflavin deficiency and dietary inadequacy warrants more research.

Risk factors for health deterioration in male dairy calves undergoing long distance transportation

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In Canada, many male dairy calves are sold and transported to grower facilities at a young age when they are vulnerable to health and welfare problems. The study objectives were to determine if male dairy calf health deteriorated after long-distance transportation and investigate potential risk factors. From October 2017 to March 2018, 161 calves from 11 dairy farms in British Columbia were assessed by a veterinarian within 24 hours before being shipped. Measures included age, heart girth circumference, a quantification of calf attitude, respiratory and enteric health, and body temperature. Serum total protein was measured, and failure of transfer of passive immunity (FTPI) was defined as values < 5.2 g/dL. Calves were assessed again at a calf grower facility after transportation. Health change was evaluated using a Mcnemar test, and logistic regression was used to assess risk factors associated with health deterioration. Before being shipped, some calves displayed pneumonia (2%), diarrhea (18%), fever (4%), navel disease (9%), or a depressed attitude (16%), and were a mean (± SD) age of 4.6 (± 2.6) days. On arrival, more calves (9%) displayed fever (P=0.04), and fewer (7.5%) showed evidence of diarrhea (P=0.03), likely because of dehydration. Twelve percent of calves had FTPI and these calves had higher odds of developing a depressed attitude (OR 5.1, P= 0.004). In conclusion, some calves were shipped at a young age with suboptimal health which deteriorated during transportation. Improvements in calf health and management at the dairy farm could improve their welfare during and after transport.

Funding sources: Growing Forward-2, Animal Welfare Program

Characterization of spray-dried vitamin B12 microparticles encapsulated with food-grade polymers

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Vitamin B12 (B12) is an essential nutrient and critical for cell growth and brain health across the lifespan. B12 deficiency was classified as a public health problem in most countries that completed nation-wide surveys. The World Health Organization has identified food fortification as one of the top strategies to combat micronutrient malnutrition. Microencapsulation may be an ideal strategy to enhance B12 stability during processing and storage of B12-fortified foods. We aimed to develop microparticles containing natural and synthetic B12 by spray-drying process using sodium alginate (SA) and EUDRAGUARD Natural (EN) as food-grade coating materials, and to structurally and chemically characterize the microparticles. Microparticles were prepared by spray-drying polymeric solutions containing 1% (w/V) methylcobalamin (MeCB) or cyanocobalamin (CnCB). Presence in and release of B12 from microparticles were determined using UV-Vis-spectrophotometry and simulated gastrointestinal digestion. Physical structure and chemical composition of microparticles were characterized using Scanning Electron Microscope (SEM) and Fourier Transform Infrared Spectroscopy. Simulated gastrointestinal digestion showed a maximal release of B12 at pH 4 (EN: 103%, SA: 112% recovery). EN-containing microparticles possessed higher B12 concentrations (10.9µg/mL for EN-CnCB and 6.4µg/mL for EN-MeCB) than SA (9.1µg/mL for SA-CnCB and 4.6µg/mL for SA-MeCB). Imaging from SEM evidenced no cracks on the surface of the microparticles, indicating that B12 was well encapsulated by the polymers. Spectral qualitative analysis of microparticles revealed EN to better encapsulate both MeCB and CnCB, compared to SA. There is potential for B12 to be encapsulated by food-grade natural polymers, with EN being superior in encapsulating both B12 forms.

Funding sources: NSERC Undergraduate Student Research Award

Impact of Codex Alimentarius regulations on the developing countries of the Pacific Rim

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The international organization, Codex Alimentarius Commission, has given a set of global food standards and associated documents with the intention to facilitate international trade and ensure public health. Member countries in the world have been under significant pressure to harmonize their national food standards with these international standards. The paper discusses the economic impact of harmonizing national standards with those laid out by Codex Alimentarius on the developing countries of the Pacific Rim, focusing on the member countries of the Association of Southeast Asian Nations. Case studies involving some of these countries were reviewed and analyzed. Furthermore, the works challenging the authenticity of the Codex Alimentarius Commission were compared with those supporting its activities. The impact of Codex regulations on developing countries is both, positive and negative. While the higher standards set by Codex provide the countries with a better standing in the global food market, the resources required to reach these standards of quality significantly drain the countries of their economic reserves. With the appropriate help from the Codex body, harmonization of standards can continue steadily but surely. The importance of these regulations should be studied in detail to gauge their effectiveness and to ensure that the end justifies the means.

Infrastructure development, deforestation, and biodiversity in India: Evidence from the eBird citizen science app

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India's infrastructure spending has boomed in the last decade as it seeks to maintain its status among the world's fastest growing economies. Whereas economists tote this as a means to economic growth and poverty reduction, land-use change associated with large infrastructure projects puts pressure on biodiverse ecosystems. India is especially prone to ecological damage since these projects (e.g. mines, power plants, etc.) are often located in mineral-rich regions with high forest cover. Research on the development-biodiversity tradeoff is often constrained by geographic scope and data limitations. My research overcomes this by assembling a comprehensive dataset combining details of every infrastructure project (n=26,000) requiring deforestation with diary data of 10 million bird sightings from users of the eBird app for all 640 districts of India from 2014-2018. I estimate a fixed effects model to control for unobserved spatial and temporal differences in birding locations to isolate the causal impact of industrial development in forests on bird species diversity. Preliminary results show that a 1 km^2 tract of forest cleared for infrastructure causes a 5% reduction ($p<0.05$) in the Shannon index compared to districts with no development. These estimates are robust to alternative species diversity measures. To investigate mechanisms, I estimate the same model using infrastructure development in non-forested areas as the explanatory variable. Results show no effect on bird species diversity, suggesting that deforestation is the primary mechanism behind the declining species diversity. Whereas the preliminary results highlight the downside of India's recent spell of rapid development, the next stage is to estimate productivity gains. The resulting cost-benefit framework will be important for both policymakers and ecologists.

Funding sources: The Wildlife and Conservation Economics Lab, UBC

Effects of vacuum microwave dehydration on the off-flavour intensity, functionality and nutritional properties of pea and soy protein isolates

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Plant-based foods are increasingly preferred in lieu of animal-based foods, driving Canadian food industry to incorporate plant proteins into food formulations. However, raw plant proteins may have grassy off-flavours, and their functional and nutritional properties are often inferior to those of animal-based proteins. Direct steam injection may reduce the off-flavour intensity of plant proteins, but may impart a cooked off-flavour and decrease nutrient content, hence an alternative must be investigated. Thus, my research will explore vacuum microwave dehydration, as the efficient volumetric heating of microwaves, coupled with a large vapour pressure differential caused by the vacuum, may remove the off-flavour causing volatiles with little to no thermal deterioration. The overall objective of my research is to develop a vacuum microwave dehydration process for removal of off-flavours and improvement of functional and nutritional properties of pea and soy protein isolates used in non-dairy yogurts. Moisture content, microwave power and vacuum pressure will be adjusted according to a 3 factor, 5 level central composite rotatable design. Organoleptic properties (off-flavour intensity), functionality (solubility, emulsifying capacity/stability, sulphur group content, surface hydrophobicity) and nutritional properties (protein content, amino acid composition) of the plant protein isolates will be optimized using response surface methodology. Three optimal samples will be incorporated into non-dairy yogurts and subjected to accelerated shelf-life testing and sensory evaluation. By using vacuum microwave dehydration, off-flavours may be removed with no deleterious effects on quality. Thus, more high-protein, plant-based products can be produced, improving consumer health, augmenting agricultural sustainability, while bolstering the Canadian plant-based market.

Funding source: Daiya Foods Inc.

Measurements of greenhouse gas exchange above a conventionally managed blueberry field in the Fraser River Delta, BC, Canada

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Agricultural soils are a significant source of greenhouse gas (GHG) emissions, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and are of concern for climate change. In comparison to CO_2, fluxes of CH_4 and N_2O are difficult to characterize as they can be smaller in magnitude and complicated to describe empirically. Recent advances in instrumentation have allowed for measurements of non-CO_2 fluxes like N_2O and CH_4 using the eddy-covariance (EC) method. In Canada, N_2O emissions from croplands comprise an increasing proportion of agricultural GHG emissions, largely due to increases in nitrogen fertilizer application. Recent studies have measured GHG emissions from a variety of agricultural systems, but are limited to Ontario, Quebec and the Prairies. Few continuous measurements of GHG emissions are available in British Columbia, especially for high-value cropping systems including highbush blueberries. The objective of this study was to quantify year-round measurements of CO_2, CH_4 and N_2O exchange from a highbush blueberry field in the Lower Fraser Valley and evaluate its global warming potential in CO_2 equivalents (CO_2e) using EC. The field was a net source and emitted $173.1\ \mathrm{g\ CO_2 - C\ m^{-2}}$ $0.71\ \mathrm{g\ CH_4 - C\ m^{-2}}$ and $3.56\ \mathrm{kg\ N_2O - N\ ha^{-1}}$, totalling $811\ \mathrm{g\ CO_2e\ m^{-2}}$ annually. Increased N_2O emissions were associated with nitrogen fertilization and fall precipitation. The field was a small source of N_2O and CH_4 but the GHG balance was dominated by CO_2 exchange.

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