K-State Graduate Research, Arts, and Discovery (GRAD) Forum

Program Booklet

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K-State Student Union Courtyard

Sponsored by:
Graduate Student Council
Graduate School
Office of the Vice President for Research
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The K-State Graduate Research, Arts, and Discovery (K-GRAD) forum is an annual showcase of K-State graduate student research, scholarly work, and discovery. This on-campus event provides graduate students from all disciplines an opportunity to share their work with the K-State community and to gain experience presenting their work in a professional setting.

The 2020 K-GRAD forum was canceled as part of Kansas State University's limited campus operations in response to the COVID-19 pandemic.

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Oral Presentation Abstracts

Agricultural Sciences

IDENTIFYING SMALL RNAS OF EXOSOMES ISOLATED FROM A DIABROTICA CELL

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BACKGROUND AND PURPOSE: Exosomes are tiny membrane-bound vesicles produced by cells, which contain cargoes of RNAs and proteins. Depending on the tissue of origin, exosomes can carry specific cargoes, particularly small RNAs that profoundly affect the function of target cells. Recently, exosomes have shown promise as an important area of biomedical research because of their roles in intercellular communication, development, and immunity; however most research to date has focused on the roles of exosomes in mammalian systems and their potential as diagnostic markers or delivery vehicles for therapeutic purposes. In contrast, very little is known about insect exosomes. **METHOD:** In an effort to enhance our understanding of insect exosomes, we have isolated RNAs from a cultured cell line originating from southern corn rootworm (*Diabrotica undecimpunctata*, SCR) as well as RNAs from exosomes isolated from this cell line. **RESULTS/FINDINGS:** Analysis of the sequences of the RNAs revealed that the SCR cell line expresses a variety of small RNAs with similarity to those previously identified in another beetle, the red flour beetle (*Tribolium castaneum*). Only a subset of these small RNAs, however, were detected in exosoome preparations, and ranged in size from 17 to 50 bases in length. **CONCLUSION:** Our efforts in identifying and characterizing small RNAs produced by the SCR cell line and carried in exosomes are enhancing out understanding of the roles of exosomes in intercellular communication in insects. Further, this work provides a greater appreciation for the importance of exosomes in insect survival and opens opportunities for developing new strategies for insect pest control.

DETECTING INHIBITORS OF RNAI IN A LIVESTOCK PEST

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BACKGROUND AND PURPOSE: The biting midge *Culicoides sonorensis* is a vector of livestock pathogens that are detrimental to herd health and impact animal trade. Insecticides have typically been used to control these pests, but insecticide resistance, as well as off-target effects on beneficial insects and aquatic ecosystems, are constant worries for commerical livestock farmers and the public alike. RNA interference (RNAi) is a new insecticidal technology that has the potential for use in highly specific, environmentally benign control methods to supplement those already in place for livestock pests. Unfortunately, the efficiency of RNAi is limited in many insect groups, including biting midges, and a better understanding of mechanisms that limit the efficiency of RNAi are needed. In particular, degredation of the double-stranded RNA (dsRNA) starting material that is necessary to illicit an RNAi response has yet to be examined in *C. sonorensis*. **METHOD:** Enzymes that may contribute to dsRNA degredation in *C. sonorensis* were identified using bioinformatics. Midges were harvested from a laboratory colony at the USDA in Manhattan and were analyzed for the expression of dsRNA degrading enzymes using molecular techniques. **RESULTS/FINDINGS:** Three suspected enzymes were detected and were confirmed to be expressed in the laboratory colony. The expression profile of each enzyme differed between different life stages of the midge (e.g., larva, pupa, adult). **CONCLUSION:** The detection and differential expression of these potential dsRNA-degrading enzymes inform future work that seeks to develop RNAi as a control strategy for *C. sonorensis*. This work also provides a foundation for developing similar strategies in other pest insects.

SUCEPTIBILITY AND ATTACTION OF STORED PRODUCT PESTS TO FUNAL MYCOTOXINS

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BACKGROUND AND PURPOSE: Deoxynivalenol (DON) and diacetoxyscirpenol (DAS) are mycotoxins that commonly infest stored grains. These mycotoxins have negative impacts on human and animal health, however stored product pests actively feed on moldy products. These mycotoxins resist decontamination, so understanding the interactions between mycotoxins and stored product pests can help to determine if they have a capacity to degrade the toxins. **METHOD:** To determine whether these pests can withstand DON and DAS, we performed bioassays on species that commonly feed in high moisture environments, including *Tribolium castaneum, Typhaea stercorea, Rhyzopertha dominica, Sitophilus oryzae, Sitophilus zeamais*, and *Tyrophagus putrescentiae* and observed mortality and progeny production. In addition, we tested for attraction to trichodiene, which is a volatile produced in the synthesis of mycotoxins. Because trichodiene is emitted at high levels by fungi during mycotoxin production, we also measured behavioral responses to this compound alone or in combination with food and/or pheromone in a wind tunnel study. **RESULTS/FINDINGS:** Our results suggest that some stored product pests have resistance to DON and DAS and that trichodiene is attractive to *Tribolium castaneum*. **CONCLUSION:** Analysis of biotransformation products will allow us to determine how mycotoxins are metabolized, which could lead to the discovery of enzymes that can be used to treat mycotoxin-contaminated grain.

MICROBIAL CARRIAGE OF HOUSEFLIES FROM CONFINED CATTLE OPERATIONS IN NORTHEAST KANSAS

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BACKGROUND AND PURPOSE: Houseflies thrive in urban and rural environments worldwide. Their adaptability to different environments and dependence on microbe-rich materials (e.g. manure) to develop and reproduce make houseflies ideal vectors of bacterial pathogens. Multiple studies have identified and isolated pathogens from houseflies in urban and rural environments, including antimicrobial resistant (AMR) bacteria. Based on this information, we attempted to determine what factors influence the bacterial carriage of houseflies in natural environments. **METHOD:** Houseflies were collected biweekly from August to October at six confined cattle operations in northeast Kansas. Homogenated flies were then plated on nonselective media to quantify overall bacterial colony forming units (CFUs) from the flies. These fly homogenates were also grown on selective media to determine the CFUs of coliforms, or gram-negative bacteria indicative of sanitary quality. **RESULTS/FINDINGS:** Higher CFUs of overall bacteria and coliforms were observed more frequently on female houseflies than males. Further investigations are being conducted to determine the effect of site, climate, and other environmental factors. **CONCLUSION:** Our present findings indicate bacterial densities vary by housefly sex and suggest females are more efficient harborers of bacteria. Understanding the factors influencing bacterial carriage of houseflies may help to develop improved preventative measures for human and animal health.

EFFECT OF SEQUENTIAL ANTIMICROBIAL TREATMENTS ON *LISTERIA MONOCYTOGENES* BIOFILM- FORMING ABILITY AND SURVIVABILITY

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INTRODUCTION: *Listeria monocytogenes* has the ability to adapt and proliferate in a variety of environments. This pathogen has shown niche adaptation and its ability to form biofilm is a hurdle for food safety. After the biofilm is formed, it becomes difficult to disrupt. Chemical sanitizers combined with non-thermal processing technologies might represent an effective way to control *L. monocytogenes* biofilm formation. **PURPOSE:** The objective of this research was to understand the effect of several chemical sanitizers alone or in combination with UV light on the phenotypic response of *L. monocytogenes* biofilm forming ability and survivability. **METHODS:** A CDC Reactor was used to grow 4-days-old *L. monocytogenes* biofilms on stainless steel coupons. Biofilm survivability was investigated after 10 min exposure to lactic acid (4%), peracid (200 ppm), quaternary-ammonium (400 ppm) alone or in combination with UV light (254 nm) for 15 or 30 min. Sequential treatments effect was also evaluated. **RESULTS:** *L. monocytogenes* biofilms reached 6 log CFU/cm^2 after 4-days. When biofilms were exposed to peracid, a reduction of 4.2 log CFU/cm^2 (P<0.05) was observed. A maximum reduction of 1.8 log CFU/cm^2 (P<0.05) was recorded after UV treatment alone for 30 min. The sequence of antimicrobial treatments was significant only when UV was preceded by lactic acid (P<0.05), while no difference was observed for peracid and quaternary ammonium. **SIGNIFICANCE:** The results obtained in this research offer a preliminary understanding of *L. monocytogenes* biofilm response to chemical sanitizers and support the development of effective intervention strategies to control this pathogen in food processing environment.

FROM FARM-TO-FORK: ANTIMICROBIAL RESISTANT BACTERIA IN FEED MILL ENVIRONMENTS

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BACKGROUND AND PURPOSE: Antimicrobial (antibiotics and metal) compounds (e.g. copper, zinc, and arsenic) are commonly used in the animal industry as feed additives for growth promotion. Some of these compounds can persist in the environment and there is evidence of antibiotic and metal resistance co-occurrence in exposed organisms. The rise of antimicrobial resistant microorganisms is an increasing public health concern. Whole-genome sequencing (WGS) allows better characterization, including identification of resistance genes, of bacterial isolates. The goal of this study was to use WGS to identify resistance genes present among the isolates. **METHOD:** This study included 27 *Salmonella enterica* and 16 *E. coli* strains isolated from swine feed mills between 2018 and 2019. WGS of isolates was done with Illumina sequencer and their genomes utilized for the identification of antibiotic and heavy metal resistance genes through the Resistance Gene Identifier and BLASTn search engines. **RESULTS/FINDINGS:** Several genes conferring resistance to antibiotics were identified: 33% of *Salmonella* and 13% of *E. coli* isolates displayed resistance to three or more antibiotics, including cephalosporin, streptomycin, and tetracycline. Metal resistance genes were identified in all isolates. Eighty one percent of *Salmonella* and 19% of *E. coli* isolates showed resistance to three or more metals. **CONCLUSION:** This study shows the distribution of resistance genes and indicates the potential role of feed mills as an entry route of AMR into the food chain. Future research should determine phenotypical expression of resistance and correlation with the genetic pattern in the same isolates.

ENHANCING ACETYL-TAG SYNTHESIS THROUGH METABOLIC ENGINEERING OF THE OILSEED CROP *CAMELINA SATIVA*

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BACKGROUND AND PURPOSE: Many *Euonymus* species produce unusual structured triacylglycerol (TAG) molecules referred to as acetyl-TAGs. Acetyl-TAGs possess an acetate group at the *sn*-3 position instead of a long chain fatty acid present in regular TAGs of vegetable oil. The presence of the *sn*-3 acetate group gives acetyl-TAG unique physical properties such as reduced viscosity and superior cold temperature properties, facilitating its potential use as emulsifiers, lubricants, and improved diesel 'drop-in' replacements. **METHODS:** A new acetyltransferase enzyme (*Ef*DAcT) isolated from the seeds of *Euonymus fortunei*, shown to possess higher *in vitro* activity and *in vivo* acetyl-TAG levels compared to the previously used enzyme (*Ea*DAcT), is expressed in camelina seeds. *Ef*DAcT expression is combined with the RNAi-mediated suppression of the endogenous TAG competing enzyme (DGAT1). Agronomic properties of the seeds were analyzed to examine the effect of accumulating high levels of acetyl-TAG. **RESULTS/FINDINGS:** *Ef*DAcT expression increased acetyl-TAG accumulation by 20 mol%. Suppression of DGAT1 further enhanced acetyl-TAG accumulation to 90 mol% in selected transgenic lines. Accumulation of high levels of acetyl-TAG exhibited a two-day delay in germination compared to wild-type seed with little or no impact on seed size, weight, and fatty acid content. **CONCLUSION:** Our results show that acetyl-TAG successfully accumulates to levels beyond those reported with any modified oil content in an engineered oilseed crop, with only minor impacts on key seed properties. The results further provide new insights into the factors limiting acetyl-TAG accumulation in transgenic camelina seeds.

SEROTYPE CHARACTERIZATION OF *SALMONELLA* ISOLATES FROM TRADITIONAL WET MARKETS FROM CAMBODIA THROUGH WHOLE-GENOME SEQUENCING

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INTRODUCTION: Traditional wet (informal) vegetable markets are an important part of the Cambodian culture and economy. However, vegetables can potentially be contaminated by pathogens due to lack of hygiene and sanitary practices, food safety regulations, and basic infrastructure. **PURPOSE:** The overall objectives of this study were to i) isolate *Salmonella* from food contact and non-food contact surfaces, ii) perform whole-genome sequencing (WGS), and iii) assess serotype abundance. **METHODS:** Samples collected from two informal markets in Battambang, Cambodia were screened for *Salmonella enterica* according to USDA-FSIS guidelines. Isolates were confirmed by PCR. Genomic DNA was extracted from 81 isolates with a commercial kit (Qiagen). The NCBI Pathogen Detection database (https://ncbi.nlm.nih.gov/pathogens), was used to determine the antimicrobial resistance (AMR) profiles for each isolate. **RESULTS:** Sixteen *Salmonella enterica* serotypes were detected across multiple surfaces. The most common serotypes were Rissen (n=18), Hvittingfoss (n=11), Corvallis (n=10), Krefeld (n=8), Weltevreden (n=6), and Altona (n=6). *Salmonella* I 4,[5],12:i:- was recovered from a single sample. A total of 23 AMR genes were detected overall. At least one AMR gene was carried in 53% of the strains. **SIGNIFICANCE:** The analyzed isolates have the potential to be pathogenic, posing a public health concern. Given our data, informal markets can be an important source of pathogen contamination for the vegetable value-chain in Cambodia.

PEPTIDE DESIGN FOR CANCER IMMUNOTHERAPY

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BACKGROUND AND PURPOSE: Immunotherapy activates the patient's own immune system to treat cancer. Immune cells recognize a threat and get rid of it. But unfortunately, cancer cells often evolve to evade the immune system. An immune checkpoint protein Cytotoxic T-Lymphocyte Associated protein-4 (CTLA-4) on T-cell surface makes a friendly bond with cancer cell by connecting with B-7 family proteins presents on cancer cells. This prevents T-cell activation against the cancer cell. Hence, the blocking of this friendly bond helps to trigger the immune response against cancer cells. **METHOD:** We investigated the X-ray crystal structure of the CTLA-4 and B7-2 protein complex using VMD and identified key residues on CTLA-4 protein where the B7-2 protein binds. From this, we designed *de novo* cyclic inhibitor peptides that bind to the CTLA-4 protein exactly where the B7-2 protein binds, using the FlexPepDock module of the Rosetta molecular modeling suite. **RESULTS/FINDINGS:** These *de novo* cyclic peptides showed the ability to stay bound with the CTLA-4 protein for microseconds of molecular dynamics simulation, which is longer than the B7-2 protein stays bound to CTLA-4. Additionally, the binding free energy calculated for these peptides (–33 kcal/mol and –26 kcal/mol) to CTLA-4 was more favorable than that of the B7-2 protein to CTLA-4 (–24 kcal/mol). **CONCLUSION:** In conclusion, the results from the computational experiments suggest that the peptides that we developed are potential candidates to inhibit complex formation between CTLA-4 and B-7 family proteins and, consequently, may reactivate the immune response against cancer cells.

QUICK WAY TO DETECT, DISCRIMINATE AND QUANTIFY SIDEROPHORES BY FLUORESCENCE ASSAY

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BACKGROUND: Iron is vital for bacteria, as it plays a central role in energy production, intermediate metabolism, DNA synthesis etc. Bacteria secrete siderophores that specifically chelate iron and actively transport this ferric siderophore complex. Siderophore production and ferric siderophore acquisition are frequently associated with microbial infections. To survive in hosts, pathogenic bacteria obtain iron with TonB dependent ferric siderophore transport systems. For example, the outer membrane protein FepA actively transports the iron complex ferric enterobactin (FeEnt), and the inner membrane protein TonB provides the energy for this uptake reaction. I created fluorescent sensors that monitor high affinity binding reactions, and used them to detect, discriminate and quantify ferric siderophores, as either isolated iron complexes or in complex mixture of metabolites and other biochemicals. **METHOD:** By introducing site-directed Cys residues in bacterial iron transporters and modifying them with maleimide fluorophores, we generated living cells that bind but do not transport target compound. By cloning, genetically engineering and fluoresceinating ferric siderophore transporters, we created specific sensors for the native, degraded and glucosylated forms of the catecholate ferric enterobactin, for the hydroximates ferric aerobactin, ferrichrome and ferrioxamine B, for the porphyrins hemin and vitamin B_{12}. **RESULT AND DISCUSSION:** When employed in spectroscopic analysis, these constructs sensitively detected ferric siderophores, and measured their concentrations in solutions. Sensitive Assays of Biochemical specificity, affinity, and capacity are valuable for both basic research and drug discovery. The sensors, which we created monitored production of siderophores by the pathogens, each of which manifested a particular profile of iron chelator production.

DEVELOPMENT OF A RAPID AND QUANTITATIVE REPORTER ASSAY TO MONITOR HOST SHUTOFF IN REAL-TIME

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BACKGROUND AND PURPOSE: Viruses are obligate intracellular parasites, and viral protein synthesis depends on host cellular translation machinery. Viruses have evolved various strategies to redirect cellular resources to synthesize viral proteins. One strategy used by many viruses is to shut down host protein synthesis globally, a phenomenon often termed "host shutoff." Virus-induced host shutoff not only frees up cellular translation machinery for viral protein synthesis but has also been shown to facilitate immune evasion by reducing the production of innate immune signaling proteins. Pulse-chase analysis is a widely adopted tool that allows for studying host shutoff, which involves radioactive or non-radioactive labeling of amino acids that are incorporated into newly synthesized proteins. This process is time-consuming and labor intensive. The objective of our research is to develop a rapid, quantitative, and non-radioactive method to monitor host shutoff in real-time. **METHOD:** We utilized a naturally secreted bioluminescent *Gaussia* luciferase that allows for the live cell monitoring of luciferase reporter activity. Stable cells lines expressing the gene encoding for Gaussia luciferase under the control of a constitutive cellular promoter were generated. **RESULTS/FINDINGS:** Vaccinia virus, known to induce profound and rapid host shutoff, was used to evaluate the utility of these stable cell lines. **CONCLUSION:** Because host shutoff also occurs in many other physiologically relevant stress conditions, we expect this method can be widely used to screen and study the molecular mechanisms of host shutoff.

THE CANINE HOST APPEARS TO SERVE AS A SENTINEL SPECIES FOR TICK-BORNE DISEASES CAUSED BY *ANAPLASMA, EHRLICHIA* AND *BORRELIA* PATHOGENS IMPACTING HUMAN HEALTH IN THE USA

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INTRODUCTION: Tick-borne diseases continue to threaten the health of people and dogs. In the USA, human Lyme disease cases, caused by *Borrelia burgdorferi*, are the highest followed by diseases resulting from *Ehrlichia* and *Anaplasma* species. We investigated the prevalence of these diseases in dogs and then compared with human data. **METHODS:** Blood samples collected from clinically suspected dogs from across the US were assessed for antibodies for four pathogens. An ELISA assay was performed for *B. burgdorferi*, while indirect immunofluorescence assay (IFA) was carried out for *E. chaffeensis, E. canis and A. phagocytophilum.* **RESULTS/DISCUSSION:** A total of 503, 347 and 496 samples were assessed for *A. phagocytophilum, Ehrlichia* species and *B. burgdorferi*, respectively. A total of 185 (37%) samples tested positive for *A. phagocytophilum*, 155 (45%) for both *E. chaffeensis* and *E. canis* and 233 samples (47%) for *B. burgdorferi*. Some of the *Ehrlichia* positives are the result of extensive antigenic cross-reactions between the two species. Similarly, some *A. phagocytophilum* positives may represent *A. platys* infections. Co-infection with both *Anaplasma* and *Ehrlichia* species was observed in 21 dogs; 25 dogs were double-positive for *Anaplasma* and *Borrelia*; 11 for *Ehrlichia* and *Borrelia*; and three dogs positive for all three species. We observed a significant overlap in the geographical distribution of these diseases in dogs with that documented in people. **CONCLUSION:** Our data suggest the occurrence of tick-borne diseases in dogs is very similar to that of humans; thus, monitoring canine infections has important implications for both human and companion animal health.

VACCINIA VIRUS GROWTH FACTOR-MEDIATED ACTIVATION OF STAT3 PATHWAY IS IMPORTANT FOR EFFICIENT VIRAL REPLICATION

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BACKGROUND AND PURPOSE: Poxviruses pose a serious threat to human and animal health despite the eradication of Smallpox; the deadliest infectious disease in human history. Vaccinia virus (VACV), the prototypic member of *poxviridae* family is used as a model to study diseases caused by poxviruses. It is also used as a tool to develop novel cancer therapy and recombinant vaccines against other infectious diseases. VACV relies on and modifies several host cell functions for efficient replication. Our objective is to identify cellular signaling pathways and viral factors important for VACV replication. **METHOD:** We screened 3228 Selleck bioactives and FDA-approved drugs with known cellular targets for their effects on VACV replication using a gaussia luciferase assay. We also generated a recombinant VACV with deletion of viral growth factor (VGF) to test its effect on modulating host cell signaling. **RESULTS:** Inhibitors of STAT3 and its upstream pathway were among the most highly represented inhibitors of VACV replication based on our high-throughput screening. We also found that VACV infection induces non-canonical STAT3 activation, which was abolished upon deletion of VGF. **CONCLUSIONS:** We identified STAT3 signaling as a host pathway important for VACV replication. We also identified VGF as a viral factor required to activate STAT3 pathway upon VACV infection. These findings will help develop novel strategies for poxvirus infection management and facilitate the development of poxviruses-based tools, vaccine vectors, and cancer treatment.

DEVELOPMENT AND EVALUATION OF A RABIES ENZYME-LINKED IMMUNOSORBENT ASSAY (ELISA) TARGETING IGM AND IGG IN HUMAN SERA

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BACKGROUND AND PURPOSE: Immunity from rabies depends on rabies virus neutralizing antibodies (RVNA) induced after immunization, however the main protective antibody isotype remains unclear. This becomes particularly relevant after the World Health Organization supported elective rabies vaccine regimens that may influence the development of RVNA classes/subclasses, consequently affecting the timing/effectiveness of RVNA IgG levels with ability to infiltrate to the site of the bite/exposure for neutralization of the virus. This study aimed to develop and validate a rapid and reliable assay for quantifying anti-rabies antibodies IgM/IgG class-switch in human plasma/serum directed against rabies virus glycoproteins based on an indirect ELISA technique. **METHOD:** Immune response was tracked in eleven individuals naïve to rabies licensed vaccine by quantifying serum titers developed at days D0, D7, D14, D21, D28, D42 post-immunization using the reference Rapid Fluorescent Focus Inhibition Test (RFFIT) and ELISA IgM/IgG assays. **RESULTS/FINDINGS:** RVNA levels quantified in sera (IU/mL) were at D0 ($\leq$ 0.1); D14 (0.6 to 17.5); D21 (1.2 to 23.9); D28 (1.2 to 106.8) and on D42 (2.9 to 84.7). Specific IgM antibody to rabies glycoprotein (EU/mL) peaked from D7 (0.69 to 1.64) to D21 (1.74 to 16.38) post-vaccination. In contrast, IgG antibody (EU/mL) predominated from D28 (3.25 to 19.14) to D42 (5.85 to 20.58) post-vaccination. **CONCLUSION:** These findings show that levels of anti-rabies virus glycoproteins IgM/IgG at D28 appeared to characterize the immune response class-switch. This validated assay can reliably determine RVNA's potency and monitor IgG/IgM responses strengthening the diagnostic repertoire for making sound decisions about vaccine regimens and processes related to PrEP/PEP.

ROUTE OF ANTIBIOTIC ADMINISTRATIONS AND ITS EFFECT ON THE ANTIMICROBIAL SUSCEPTIBILITIES OF CAMPYLOBACTER AND SALMONELLA ISOLATED FROM FECES OF PIGLETS.

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INTRODUCTION: *Campylobacter* and *Salmonella* are common foodborne pathogens in the gut of pigs that are shed in feces with the potential to get transmitted to humans. In pigs, oral route, either *in-feed* or *in-water*, is by far the most common route of administration of antibiotics. Because the distribution of the antibiotic in the gut and the dosage are different, a study was conducted to compare *in-feed* vs. *in-water* administrations of tiamulin and chlortetracycline (CTC) on AMR profiles of *Campylobacter* and *Salmonella.* **METHODS:** A total of 1,296 weaned piglets, allocated into 48 pens (27 piglets per pen), were assigned randomly to six treatment groups: Control, in-feed CTC, in-water CTC, in-feed tiamulin, in-water tiamulin, or in-feed CTC and tiamulin. Fecal samples were collected randomly from 5 piglets from each pen during pre-treatment (days -7, 0), treatment (days 7, 14) and post-treatment (days 21, 28) phases. Bacterial isolations and species identifications were done by culture method and PCR, respectively. The microbroth dilution method using Sensititre plates were used to determine antimicrobial susceptibilities of *Campylobacter* and *Salmonella.* **RESULTS AND CONCLUSIONS:** Overall prevalence of *Campylobacter and Salmonella* were 18.2% (262/1,440) and 4.2% (60/1,440) respectively. Speciation of *Campylobacter* isolates indicated *C. hyointestinalis* (17.9%; 258/1,440) and *C. coli* (0.3%; 4/1,440). *Campylobacter* isolates were mainly resistant to tetracycline (98.5%), ciprofloxacin (89.3%), and nalidixic acid (60.3%). *Salmonella* isolates were resistant to ampicillin, streptomycin, sulfisoxazole, and tetracycline. Neither antibiotic nor route of administration had an effect ($P > 0.05$) on the occurrence of resistant *Campylobacter* or *Salmonella* in the feces of piglets.

PEPTIDE INDUCED ACTIVE TRANSPORT OF DRUG TO TUMOR

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BACKGROUND AND PURPOSE: Cancer microenvironment and molecular heterogeneity in tumors pose a great challenge to deliver anticancer drugs precisely to the intended site. Therefore, current cancer management is moving to the era of targeting tumor-specific receptors to maximize drug-transport using a nanoscale delivery system. Along this line, many nanoscale drugs called nanomedicines are approved to treat many cancers. However, due to the cancer heterogeneity and its evolution during treatment, it is important to develop new strategies for cancer management. Herein, we approach to engineer tumor-seeking peptides having specificity to p32 receptor on cancer cell surface, integrated polymeric-nanoparticle to significantly enhance the delivery of its cargo *via* receptor-mediated interaction, thereby limiting off-target toxicities. **METHOD:** We engineered peptide-conjugated lipid-polymer nanoparticles using bioconjugation chemistry and nanoprecipitation. The designed nanoconstruct is composed of poly(lactide-co-glycolic acid) as a skeleton and drug-reservoir, phospholipid with polyethylene-glycol as a stabilizer, and LyP-1 peptide as a targeting motif. LyP-1 nanoparticle was studied for cellular-interaction and targeting ability by accessing full-spectrum of biodistribution using imaging tracer in an osteosarcoma tumor-model. **RESULTS/FINDINGS:** LyP-1 nanoparticles are uniform, monodispersed, and highly stable in physiological conditions with hydrodynamic size of 79±3nm and zeta potential of -39±4mV. Furthermore, these nanoparticles showed excellent biocompatibility while significantly higher uptake *in-vitro* and nearly three-fold enhancement in tumor accumulation *in-vivo* compared to its non-targeted counterparts. **CONCLUSION:** We describe a simple and versatile nanoformulation strategy for targeted drug delivery and imaging in a single session. Considering the overexpression of p32 in many cancers, the proposed nanoconstruct could hold promise in the therapeutic planning of many tumors.

TEMPORAL ANALYSIS OF PHENOMETRICS AND LONG-TERM VEGETATION TRENDS FOR THE GREAT PLAINS ECOREGION

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BACKGROUND: Grasslands are one of the largest, productive and most biodiverse terrestrial biomes but receive very low levels of protection. The US temperate grasslands are one of the most threatened grassland ecosystems. Annually, an area equivalent to the State of Kansas is converted for agricultural use. Rising temperatures and drought are also significant climatic disturbances alongside other management practices. The impact of the factors mentioned above on grassland in the Great Plains is still unknown. Our research investigates the long-term variability of grassland greenness and phenology in the US Great Plains from 2001 to 2017. **METHOD:** A time-series analysis of Moderate Resolution Imaging Spectrometer vegetation indices data was used to explore differences in vegetation phenology and to assess long-term trends in grassland vegetation greenness across the region. Using the program TIMESAT to extract key measures of vegetation phenological development (season length, start of growing season, end of growing season) from 2001 to 2017. Also using the Breaks for Additive Season and Trend (BFAST) decomposition method to derive spatially explicit estimates of gradual interannual change. **RESULTS:** Results show more 'greening' trends than 'browning' and 'no change' trends in the region during the study period. There is an expected large variation in phenology: longer growing seasons, an earlier start of growing season, and delayed end of growing season. **CONCLUSION:** Patterns shown in the results will be the basis for the valuation of ecosystem services provided by grasslands in the region to demonstrate the influence of climate and other key regional anthropogenic factors on shaping long-term vegetation dynamics.

BISON GRAZING AND FIRE IMPACT TALLGRASS PRAIRIE SOIL MICROBIAL CARBON AND NITROGEN CYCLING

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BACKGROUND AND PURPOSE: It is estimated that prairies now cover less than 5% of their native range in North America and are thereore a high conservation concern. Grazing by large herbivores and periodic fires are processes that historically maintained prairies and are therefore important modern conservation management practices. Knowledge on how plant communities respond to manipulation of these processes has been well studied, but less attention has focused on soil microbial communities and the ecosystem functions they mediate. The purpose of our research was to understand how soil microbes repond to different fire frequencies and bison grazing in prairies. **METHOD:** We sampled soil from long-term landscape scale fire and grazing treatments at Konza Prairie Biological Station during the summer of 2018, focusing on annually burned vs. 20 year burned and bison grazed vs. ungrazed treatments, and from other bison-grazed prairies across the Great Plains. From these soil samples we measured microbial community compostion, soil chemistry, and microbial carbon and nitrogen cycling using lab assays. **RESULTS/FINDINGS:** We found that microbial communites respond strongly to fire and grazing treatments. Specifically, both carbon and nitrogen cycling is enhanced when watersheds are not burned for 20 years even though the amount of availible soil nitrogen is higher with bison grazing. **CONCLUSION:** Our results show that changing fire and grazing regimes change the way nutrients are cycled in prairies and this may result from changes in soil microbial communities. Understanding belowground responses to management will lead to more effective conservation and restoration of prairie ecosystems.

DIFFERNTIAL RECOVERY OF SOIL MICROBIAL FUNCTIONAL GROUPS AND ECOSYSTEM FUNCTIONS FOLLOWING CESSATION OF CHRONIC FERTILIZATION

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BACKGROUND AND PURPOSE: Globally, nitrogen (N) availability has increased, primarily through atmospheric deposition and N fertilization. Changes to fire disturbance has also resulted in altered N dynamics, with fire suppression allowing for N accumulation. Augmented N availability typically changes the composition of soil microbial communities and promotes the loss of N from ecosystems, yet how microbial communities and N processing respond to fertilizer cessation remains unclear. N-reliant functional groups were expected to recover from chronic fertilization more quickly than the whole microbial community. **METHOD:** Soils were collected montly from April-September 2017 from a 30-y plot-scale experiment at Konza Prairie that manipulated available N through annual burning (or no burning) and annual N fertilizer application until 2017 when fertilization ended. The population size of N-cycling microbial functional groups, N processing, and microbial community composition were measured. **RESULTS/FINDINGS:** During the first growing season without N fertilization in 30 years, total inorganic N available for plants and microbes declined with NH_4^+ concentrations similar to reference control soils. Ammonia-oxidizing bacteria had recovered fully, while the archaea did not, and the denitrifying bacterial populations had contrasting responses. Nitrification potentials dropped to reference controls, and the denitrification potentials fell albeit remained high. Fertilizer cessation did not change the microbial community composition. **CONCLUSION:** How microorganisms recover from long-term fertilization appears to depend on how directly the organisms' metabolism relies on supplemental N, yet functionally-similar populations recover differently. Fire aids minimally to microbial recovery during the first year of fertilizer cessation, but soil N loss is driven by both denitrification and burning aboveground biomass.

EFFECTS OF ABIOTIC STRESS ACROSS POPULATION IN WILD FOXTAIL MILLET *SETARIA VIRIDIS*

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BACKGROUND AND PURPOSE: Environmental sources of stress, including drought, cold, and salinity, can substantially affect plant fitness and survival. This poses a significant threat to conservation, economic activities, and agriculture as climate change increases the variability of temperature, precipitation, and availability of fresh water. Stress tolerance can vary widely between species and across differently adapted populations within a species. Environmental stress can decrease photosynthesis, diminish vegetative growth, and reduce reproductive output, each of which has serious consequences for agricultural and bio-energy crops. This research examines physiological and transcriptomic responses to environmental stress across populations in the wild foxtail millet, *Setaria viridis*, a close relative of the agriculturally important foxtail millet, *Setaria italica*. **METHODS**: We assessed differences in response to cold, drought, and salinity stress between two populations of *S. viridis* (one from China and one from Chile) in controlled greenhouse and cold room environments. **RESULTS:** Physiological responses to drought stress, measured by photosynthetic rate, differed significantly between populations. Preliminary results indicate that plant response to cold stress at -5 degrees Celsius did not differ based on prior cold acclimation or population. We are currently analyzing sequencing data which will allow us to compare transcriptomic and phenotypic responses by quantifying up and down regulation of genes across treatment and population. Gene ontology analyses will be used to determine the function of genes that are significantly up or down regulated between groups. **CONCLUSIONS:** Ultimately, this research will help determine effects of population adaptation on environmental stress response in a close relative of an important agricultural crop.

PROTEINS INVOLVED IN PLANT EPIDERMAL DEVELOPMENT ARE CONTROLLED BY POST-TRANSLATIONAL MODIFICATION

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BACKGROUND AND PURPOSE: Homeodomain proteins are key regulators of development in eukaryotes. Homeodomain leucine-zipper (HD-Zip) transcription factors play an important role in differentiation of outer cell layers of plants which protect against pathogens and abiotic stresses. In eukaryotic systems, ubiquitination, sumoylation and phosphorylation serve as post-translational marks for a protein's subcellular localization, turnover, and activity. However, a mechanism to control the levels of these transcription factors has not been identified to date. The goal of this project is to identify and characterize post-translational modifications affecting the stability of HD-Zip transcription factors. **METHOD:** Bioinformatics analysis of HD-Zip transcription factors was performed to predict sites for post-translational modifications such as ubiquitination and sumoylation. The candidate amino acids were then mutated for GLABRA2 (GL2), a representative HD-Zip protein from *Arabidopsis*. Cycloheximide assays in conjunction with proteasome inhibitor were used to determine the GL2 protein half-life in wild-type and several mutants. **RESULTS/FINDINGS:** Use of web-based tools revealed multiple lysine conjugation sites within the 65-amino acid dimerization (ZLZ) domain of GL2. In ZLZ deletion mutants, the stability of the protein was enhanced, consistent with the hypothesis that this domain regulates protein degradation. Additionally, mutations in lipid binding domain of GL2 protein resulted in reduced protein stability. **CONCLUSION:** Taken together, degradation by Ubiquitin/ Proteasome System likely contributes to levels of HD-Zip proteins. Follow-up studies to verify these results will include protein-protein interaction assays. Outcomes of this work will provide mechanistic information on how HD-Zip proteins may be engineered for enhanced stress resistance and productivity of agriculturally important plants.

PANICUM VIRGATUM TISSUE ASSOCIATED MICROBIOMES DIVERGE FROM SOIL INOCULUM IN THE COURSE OF A GROWING SEASON

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BACKGROUND AND PURPOSE: Plant-associated microbiomes are important for health and performance of the plant. Recent studies suggest that plant microbiome composition can be affected by various abiotic and biotic factors and can change in their functionality in very short periods of time. However, only limited information is available about the seasonal dynamics of the microbiome during the growing season and development of the plant. We focused on the perennial, warm season biofuel C4 grass – Panicum virgatum (a.k.a switchgrass) – grown under conservation agriculture management in Mississippi. Under these environmental conditions, switchgrass undergoes a dramatic change in appearance during the growing season: from the leaf emergence in the late February, it can grow up to 2.4m tall by mid-July at the peak of the growing season and senesce to dry residue in the late November at the end of the growing season. **METHOD:**We sampled leaves, roots and soils of four switchgrass varieties approximating a log2 time series for a total of six times during one growing season. We extracted DNA and MiSeq-sequenced bacterial and fungal metabarcode PCR-amplicons. We identified total and core communities and compared community compositions at each time point as well as the effects of switchgrass varieties and two planting densities. **RESULTS/FINDINGS:** Our data show that total and core communities occupying the leaves, roots and soils diverge in composition over time. Moreover, planting densities and cultivars differ in community assembly in the course of the growing season. **CONCLUSION:** These data improve our understanding of microbiome seasonal dynamics as well as the effects of management choices conservation agriculture.

AN INTEGRATED POPULATION MODEL FOR SPATIAL CAPTURE-RECAPTURE AND DISTANCE SAMPLING DATA

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BACKGROUND AND PURPOSE: Classical capture-recapture (CR) models are widely used to estimate the apparent survival of species in ecology. However, classical CR models are unable to accommodate spatially explicit processes and thus do not account for the spatial distribution of individuals. The development of spatial capture-recapture (SCR) models incorporate an explicit model for the spatial distribution allowing the ecologists to test hypotheses, including spatial information that is inherent in ecological studies. Recent developments include integrating SCR and other ecological survey data into a unified modeling framework to obtain useful inferences on demographic parameters with reduced uncertainty and enhanced statistical power. Distance sampling (DS) is a common source of ecological survey data where distances of the objects are surveyed from randomly placed lines or point transects. **METHOD:** Our approach introduces a unified modeling framework integrating SCR and DS by incorporating the spatial distribution. **RESULTS/FINDINGS:** We evaluate the performance of the proposed approach using both simulated data and real data on grasshopper sparrows in Konza Prairie Biological Station, Kansas. Currently, we are in the process of assessing the simulation experimental work and the application.

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EVALUATING INDIVIDUAL TRAINING ADAPTATIONS WITH HEART RATE VARIABILITY FOLLOWING HIGH INTENSITY FUNCTIONAL TRAINING

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BACKGROUND: Monitoring heart rate variability (HRV) and its variability are thought to reflect the degree of individual adaptation and recovery to exercise training programs. However, it is unclear if HRV responses are indicative of change in aerobic capacity (VO_{2max}) and strength in high intensity functional training (HIFT). **PURPOSE**: To evaluate if increases in VO_{2max} and strength are mediated by increased change in HRV following 6-weeks of HIFT. **METHODS:** Recreationally active men (n=26; age=22.6±4.3 years) and women (n=29; age=23.7±4.3 years) participated in six weeks (5 d·week^{-1}) of HIFT. At baseline and posttest, VO_{2max} and one-repetition maximum for squat, deadlift and overhead press were totaled (CFT) to serve as training outcomes. Daily HRV was measured upon waking via a smartphone photoplethysmography application throughout. **RESULTS:** VO_{2max} increased in two HRV response profiles while CFT increases occurred regardless of profile. There was a significant inverse relationship between ΔHRV and ΔCV (r=-0.46, p<0.05). The relationship scatterplot between ΔHRV and ΔCV was used to classify participants into four unique HRV response profiles, HRV_{up}/CV_{up}, HRV_{up}/CV_{dn}, HRV_{dn}/CV_{dn} and HRV_{dn}/CV_{up}. One-way MANOVA with a Tukey post-hoc test revealed significant differences in ΔVO_{2max} ($F_{370,3}$ =2.5, p<0.05) between HRV response profiles. HRV_{up}/CV_{dn} profile increased VO_{2max} compared to the HRV_{dn}/CV_{dn} profile (mean difference=7.5%, 1.0-14.1%; p<0.05). Further, VO_{2max} decreased in the HRV_{dn}/CV_{dn} profile compared to the HRV_{up}/CV_{up} profile (mean difference= -7.8%, -15.0-0.50%; p<0.05). **CONCLUSION:** Improving multiple training outcomes is desired in HIFT, so HRV decreases may identify low responders with decreases in their VO_{2max}.

HIGH-INTENSITY TRAINING AND PROSTATE CANCER-INDUCED CARDIAC ATROPHY

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BACKGROUND: Prostate cancer is the most common type of non-skin cancer found in men with ~175,000 estimated diagnoses in 2020. Recent evidence suggests prostate cancer independent of treatment has atrophic effects on cardiac mass associated with fatigue. We tested the hypothesis that exercise training will mitigate prostate cancer-induced cardiac atrophy and improve left ventricle (LV) function versus sedentary tumor-bearing counterparts. **METHODS:** Dunning R-3327 AT-1 prostate cancer cells were injected in the ventral lobe of 5-6-month-old male immunocompetent Copenhagen rats (n=24), and randomized into 2 groups, tumor-bearing exercise (TBEX, n=15) or tumor bearing sedentary (TBS, n=9). Five days after surgery, TBEX animals began exercise on a treadmill at 25m/min with a 15o incline for 45-60 min/day for 18±2 days. Pre-surgery (Pre), and post-exercise training (Post) animals underwent echocardiographic imaging for assessment of morphological changes. Markers of protein degradation were semi-quantified via Western Blot. **RESULTS:** There were no significant differences in tumor mass between groups (TBEX 3.4±0.7g, TBS 2.8±0.6g, p=0.31). Heart-to-body mass ratio was lower in TBS group compared to TBEX (2.3±0.1mg/g, 2.5±0.1mg/g, p<0.05). LV-to-body mass ratio was also lower in the TBS group (1.6±0.1mg/g, 1.8±0.1mg/g, p<0.05). From Pre-Post, TBEX had significant increases in SV (0.63±0.04ml, 0.77±0.05ml, p=0.03) while TBS had no significant difference (0.68±0.02ml, 0.67±0.05ml, p=0.86). **CONCLUSION:** This study suggests that high-intensity exercise can improve LV function and increase LV mass concurrent with prostate cancer development, versus sedentary counterparts. Given cardiac dysfunction often manifests with conventional anti-cancer treatments, a short-term high-intensity training program, prior to treatment, may improve cardiac function and fatigue resistance in cancer patients.

THERAPEUTIC ROLE OF DIETARY NITRATES ON CARDIORESPIRATORY FUNCTION IN CANCER SURVIVORS

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BACKGROUND AND PURPOSE: Anticancer therapy can result in direct injury to the cardiovascular and cardiorespiratory systems. Thus, individuals undergoing chemotherapy are at an increased risk of cardiovascular disease as well as functional complications with their cardiorespiratory system. Previous work has demonstrated that dietary nitrate supplementation can improve cardiac, vascular, and cardiorespiratory exercise parameters thus highlighting its potential therapeutic use in clinical populations such as cancer patients and survivors. Therefore, we hypothesized that nitrate supplementation would improve both cadiac performance and cardiorespiratory function in cancer survivors. **METHOD:** To date, we have tested 5 cancer survivors who have undergone chemotherapy by administering nitrate supplementation, in the form of beet root juice consumption, as well as blackcurrant juice which served as the control condition. We then had the patients perform two exercise protocols on a cycle ergometer which allowed us to take cardiorespiratory measurements. One week later, this protocol was repeated for each patient except under the opposing condition which allowed us to see the changes induced under nitrate supplementation. **RESULTS/CONCLUSION:** After a single-dose of inorganic nitrate supplementation, we observed a significant decrease in muscle oxygen consumption under the nitrate condition compared to control. Cancer survivors had an enhanced exercise efficiency as they were able to perform the same amount of work on a cycle ergometer under their control condition but with their cardiorespiratory systems having to work less. Thus, implementing inorganic nitrate supplementation to patients currently undergoing chemotherapy treatment may mitigate the adverse cardiovascular and cardiorespiratory effects from the anticancer therapy itself.

PATELLA TENDON CHARACTERISTICS IN YOUNG RESISTANCE-TRAINED AND UNTRAINED MALES

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BACKGROUND: Evaluation of passive mechanical tendon characteristics may provide information into resistance training adaptations and the potential risk of tendinopathies. Previous investigations of tendon mechanical properties revealed increased tendon stiffness in resistance-trained individuals. However, few investigations have evaluated differences in mechanical tension and elasticity between trained and untrained males. **PURPOSE**: To evaluate patella tendon tension (oscillation frequency) and elasticity (relaxation time and creep) in resistance-trained and untrained young males using a hand-held digital palpation device. **METHODS**: Seventeen males (7 trained/10 untrained; mean ± SD: age = 22 ± 3 years) were tested. A hand-held digital palpation device was used to measure oscillation frequency, relaxation time, and creep of the right patella tendon for both groups. Participants were asked to lay in a rested supine position on a cushioned plinth with a bolster underneath their right knee (~10° of knee flexion). The mean of two consecutive measurements were used for further analysis. Separate independent sample T-tests were used to analyze all passive mechanical measures. **RESULTS**: Creep values were observed to be significantly greater in the untrained group ($P=0.033$) compared to the resistance-trained group. No significant differences were observed for oscillation frequency or relaxation time between groups ($P>0.05$). **CONCLUSION**: These results indicate that tendon tension is similar regardless of training status. However, the greater efficiency of response to gradual tissue elongation (creep) observed in resistance-trained individuals may indicate a reduced risk of tendinopathies when compared to untrained individuals.

SKIN BLOOD VESSEL RESPONSES FOLLOWING 5-FLUOROURACIL CHEMOTHERAPY ADMINISTRATION

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BACKGROUND AND PURPOSE: 5-Fluorouracil (5-FU) chemotherapy is associated with the second highest rate of cardiovascular toxicity among cancer chemotherapies, and is generally manifested through the occurrence of chest pain, ECG abnormalities, and in severe cases, heart failure or death. Despite this, the mechanisms by which these toxicities occur are not well understood, but alterations in blood vessel function have been implicated and are a known precursor to adverse cardiovascular events. As such, non-invasive measurements of the small blood vessels of the skin may also provide insight, as others have demonstrated skin blood vessel health is reflective of that of the coronary circulation. Therefore, we tested the hypothesis that cancer patients treated with 5-FU would exhibit lower measurements of skin blood flow following administration of acetylcholine (ACh) and localized heating when compared to age matched controls. **METHODS:** 15 5-FU patients (5-FU) and 12 age matched controls (CON) were recruited for this study. Blood flow was measured in the right forearm via Laser Doppler Flowmetry. Baseline to peak blood flow responses following localized heating and administration of ACh were calculated to asses skin blood vessel function. **RESULTS:** 5-FU exhibited a significant reduction in the blood flow response to localized heating (178 ± 148 %) compared to CON (578 ± 379 %) whereas no differences were found between groups in response to ACh (5-FU 762 ± 442 %; CON 814 ± 425 %). **DISCUSSION**: To date, our findings suggest 5-FU induces alterations in skin blood vessel function, perhaps, through mechanisms involving nitric oxide production.

ANTICANCER THERAPY-RELATED INCREASES IN ARTERIAL STIFFNESS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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BACKGROUND AND PURPOSE: Cardio-oncology is a clinical discipline focused primarily on the early detection of chemotherapy-related cardiovascular disease. Most research to date has focused on the adverse consequences to the heart and how to manage decreases in cardiac performance, but evidence has shown this is extended to the blood vessels. Additionally, there are no clinical guidelines or strategies for monitoring blood vessel toxicity in these patients. Blood vessel stiffness, known as arterial stiffness, is a recognized surrogate endpoint for cardiovascular disease and may be an important vascular outcome to monitor. The aim of this systematic review and meta-analysis was to summarize evidence of increased arterial stiffness within current cancer patients and after chemotherapy. **METHODS:** Nineteen longitudinal and cross-sectional studies that evaluated arterial stiffness both during and following chemotherapy were identified using multiple databases. Two separate analyses were performed, baseline before treatment to follow-up (12 studies) and control vs. patient groups (10 studies). Standard mean differences (SMDs) were calculated using random effects models. **RESULTS/FINDINGS:** Significant increases in arterial stiffness were identified from baseline to follow-up (SMD=0.905, 95%CI= 0.479-1.332, P=<0.0001) and in patient vs. control groups (SMD=0.860, 95%CI=0.402-1.318, P=.0002). **CONCLUSION:** Our findings support the use of arterial stiffness as part of a targeted vascular imaging strategy for identification of early cardiovascular injury during treatment and for detection of long-term cardiovascular injury in cancer survivors.

PASSIVE MECHANICAL PROPERTIES OF THE MEDIAL GASTROCNEMIUS AND THE PROXIMAL ACHILLES TENDON

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BACKGROUND AND PURPOSE: Muscle and tendon function together to facilitate locomotion through a cycle of energy storage and dissipation. Passive mechanical properties such as stiffness, stress-relaxation time, creep, elasticity, and oscillation frequency (ST;RX;CR;EL;FQ) are associated with the energy exchange between muscle and tendon. **METHOD:** Ten male (mean±SD: age =20.7±1 year) participants laid in a prone position with their ankle at 90°. Achilles tendon (AT) regions of interest were identify and mark at 4cm (AT4) and 6cm (AT6) proximal to calcaneus. The medial gastrocnemius (MG) muscle belly was identified as the medial 1/3 of the girth of the low leg at the widest point. Passive mechanical properties of the MG and the AT4 and AT6 were measured via a noninvasive myotonometry device. Pearson product-moment correlation coefficients (*r*) were used to examine the relationships between the AT4 and MG and the AT6 and MG passive mechanical values. Level of significance was identify as a p-value of ≤ 0.05. **RESULTS/FINDINGS:** Significant, negative correlations were found between AT6 FQ and MG CR (r =-0.666;R^2=0.443;p=0.035) and MG RX (r =-0.654;R^2 =0.428;p=0.040). However, there were no significant relationships observed between any passive mechanical properties of AT4 and MG ($p = \geq 0.05$). **CONCLUSION:** These results highlight that as proximal tendon tone is increased MG stress-relaxation time and creep decrease. In other terms, as proximal tendon intrinsic tension (AT6 FQ) increased, the MG recovers from mechanical (RX) and tensile (CR) stress faster. It appears that the proximal region of the AT is more influential on MG passive mechanical properties than the distal region.

INTEGRATING PROCESS-BASED MODELING AND RAPID DATA COLLECTION FOR HARMFUL ALGAL BLOOM PREDICTION

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BACKGROUND AND PURPOSE: Cyanobacterial Harmful Algal Blooms (CyanoHAB) are considered one of the threatening issues for fresh water ecology across the world. Periodic blooms in larger reservoirs, lakes, and small ponds have potential to produce toxins and taste-and-odor compounds that may cause substantial economic, public health, and environmental concerns in the United States. Predictive tools are needed to better manage CyanoHAB outbreaks; this includes predictive simulation models, fine-scale remote sensing data, and bacteria detection floating devices. **METHOD:** In this study we attempted to develop a mechanistic modeling framework considering watershed modeling of contributing catchment, process-based modeling of cyanobacteria growth in a lake, and integrating with rapid lake assessment. Multiyear daily dataset from Cheney Reservoir, Kansas, was used to statistically correlate cyanobacteria concentration with environmental parameters, such as water temperature, turbidity, dissolved oxygen, phosphorus, and nitrogen concentrations. We consider a physical process based non-linear dynamic model including growth factors (phosphorus, nitrogen, temperature, and irradiation) and biological interactions (growth and decay rate) to forecast bloom events. An autonomous floating sampling device was manufactured and utilized for detection of spatial distribution of cyanobacteria and other factors in the lake. **RESULTS/FINDINGS:** We have used the modeling approach for Cheney reservoir using available historical data to forecast cyanobacteria abundance in 15 days prior. **CONCLUSION:** This forecasting tool linking with climate and reservoir watershed model would help to conceptualize future CyanoHAB prevention strategies, and its relation with climatic change, watershed condition, and nutrient abundance in the lake.

WATER AND CARBON FOOTPRINTS OF ELECTRICITY ARE SENSITIVE TO ATTRIBUTION METHOD

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BACKGROUND AND PURPOSE: Environmental footprinting methods provide a means to relate the environmental externalities of electricity production to electricity consumers. Though several methods have been developed to connect the environmental footprint of electricity generation to end users, these methods are inherently uncertain due to the impossibility of actually tracing electricity from the point of generation to utilization. Previous studies rarely quantify this uncertainty, even though it may fundamentally alter their findings and recommendations. **METHOD:** Here, we evaluate the uncertainty associated with seven commonly used methods to attribute water and carbon footprints of electricity production to end users. We assess how sensitive water and carbon electricity footprint estimates are to attribution method, how these estimates change over time, and the main factors contributing to the variability between methods. We evaluate and make available the water and carbon footprints of electricity consumption for every city across the contiguous United States for all assessed methods. **RESULTS/FINDINGS:** We find significant but spatially heterogeneous variability in water and carbon footprint estimates across attribution methods. No method consistently overestimated or underestimated water and carbon footprints for every city. **CONCLUSION:** The variation between attribution methods suggest future studies need to consider the uncertainty in attributing environmental impacts through the electrical grid.

ENTERINFORMATION EXTRACTION FROM SCIENTIFIC LITERATURE: END-TO-END SYSTEM

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BACKGROUND: This work addresses an end-to-end system for metadata information extraction from scientific literature document with deep learning technology. **PURPOSE**: There are two main aspects: 1. document layout *physical* and *logical* structure analysis of scientific literature with object detection method; 2. content recognition from object detection result. The end-to-end system integrates these two aspects together, and it only needs to be trained once. **METHOD**: We used object detection and context recognition technics of computer vision in this project for training the system. **RESULTS**: The highest average precision of object detection of the system is 82.66%, which is an acceptable result; content recognition part is using Tesseract, which is a pre-trained tool in our system. The overall result shows that the system meets our requirements. **CONCLUSION**: The inputs of system are PDF files, and the system can output different sections of the scientific literature document in the form of plaint text, such as title section, author section, and abstract section, etc.

TRACTIVE PERFORMANCE OF SMALL TRACKED GROUND AUTONOMOUS VEHICLE ON VARYING SLOPES

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BACKGOUND: In 12 Great Plains states, a total of 116,000 km^2 area is currently under shrubs, unprotected or too steep slopes ranging from 6° to 25° which are considered as marginal. Farming on these hills & uneven terrain is unsafe with large, conventional agricultural equipment's. Therefore, the project aims to design a fleet of small ground autonomous vehicles (GAV) which will safely perform on hills and uneven terrain for agricultural operations ranging from sowing to harvesting. **PURPOSE:** A primary objective of this study is to understand how the GAV functions on varying slopes under variable load and operating speed, specifically focusing on traction parameters, drawbar power, travel reduction and power consumption. **METHODS:** GAV is small tracked vehicle, fits in a typical 30 inch (0.762 m) crop row and fitted with an on board NI-myrio device in conjunction with load cell, encoders, current and voltage sensors for data compilation. In this study, the tractive performance of GAV was evaluated on slope ranging up to 30^0 at varying operating speed (20 to 100% duty cycle). The following parameters were observed; drawbar force, power usage, tractive efficiency, travel reduction, soil bulk density, cone index and moisture content. **RESULTS AND CONCLUSION:** These parameter will be used for energy optimization, simulations, vehicle mobility, design and route-optimization models for sloped land.

GENERALIZED GROUP-BASED EPIDEMIC MODEL FOR SPREADING PROCESSES ON NETWORKS

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BACKGROUND AND PURPOSE: Epidemic spreading processes over complex networks is an important topic for different research fields. In this current information age, large complex networks are evolving with millions of nodes. Existing network models are not sufficient to understate the local dynamics of any spreading phenomenon in these large networks. **METHOD:** To overcome this limitation. We develop a general group-based continuous-time Markov epidemic model (GgroupEM) framework for any compartmental epidemic model (e.g., susceptible-infected-susceptible, susceptible-infected-recovered, susceptible-exposed-infected-recovered). Here, a group consists of a collection of individual nodes of a network. This model can be used to understand the important dynamic characteristics of a stochastic epidemic spreading over large complex networks while being informative about the state of groups. We also develop a mean-field approximation of this framework to further reduce the state-space size. Finally, we extend the GgroupEM to multilayer networks. **RESULTS/FINDINGS:** Aggregating nodes by groups, the state space becomes smaller than the individual-based approach at the cost of an aggregation error, which is bounded by the well-known isoperimetric inequality. **CONCLUSION:** Since the group-based framework is computationally less expensive and faster than an individual-based framework, this framework becomes useful when simulation time is important.

SMARTPHONE USAGE ASSOCIATION WITH FEELINGS OF LONELINESS AND FEAR OF MISSING OUT (FOMO)

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BACKGROUND AND PURPOSE: Technology and information revolutions have been changing the way we live, and new psychopathology-related constructs such as Fear of Missing Out (FOMO) are arising from this younger generation that grew up with smartphones. Even though very connected, people are feeling very lonely. This research explores how individual differences such as personality traits might predict these effects considering technology and social media utilization. **METHOD:** Participants were recruted from an engineering class and answered to an initial survey to assess personality traits, self-esteem, loneliness and FOMO. To track time spent on smartphone, subjects were instructed to activate screen time tracker embedded in iOS phones or download a free app with the same interface and data tracking system. During four weeks, subjects reported average smartphone usage and most used apps. Linear regression analysis and backwards elimination were used to find possible predictors of loneliness and FOMO. **RESULTS:** Average smartphone daily use was of 4.34 hours, with social networking being the most used app category for more than 70% of subjects. Smartphone usage was not a significant predictor of FOMO and was also not significant to predict loneliness after controlling for personality traits, self-esteem and FOMO. Future studies will evalute if positive or negative feelings after using social media will better explain loneliness and FOMO levels along with daily use and personality traits. **CONCLUSION:** With loneliness and anxiety epidemics and suicide rates going up, understanding the impacts on mental health from technology usage can help designing better guidelines for its utilization considering individual differences and perceptions.

FACILE AND SIZE CONTROLLED SYNTHESIS OF IRON OXIDE NANOPARTICLES BY INDUCTIVE HEATING TECHNIQUE

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BACKGROUND AND PURPOSE: Colloidal magnetic iron oxide nanoparticles have received significant attention because of their numerous advantages ranging from ease of synthesis, physical and chemical stability, use in diagnostic imaging, biosensors, to electronic devices for data storage. However, the most used industrial methods such as hot injection and thermal decomposition are limited by longer reaction time, high amount of starting material, broader size distribution, and inhomogeneous growth during reaction. Therefore, there is an unmet need for alternative approach to prepare colloidal iron oxide particles rapidly with narrow size distribution, controlled growth, and high crystallinity. Herein, we explore the use of inductive heating to address the shortcomings of commercial methods as a potential alternative. **METHOD:** In this work, the unique inductive heating synthetic method is applied to produce iron oxide nanoparticles and characterized using transmission electron microscopy, X-ray diffraction, and a superconducting quantum interference device. Various solvents, precursor, and reaction time conditions were applied for nanoparticle synthesis. **RESULTS/FINDINGS:** The resulting nanoparticle size ranges from 3-11nm in diameter depending on the reaction time and type of solvent used in synthesis. They also exhibit strong magnetic behavior. **CONCLUSION:** We have demonstrated a simple and safe inductive heating method that has potential to provide industrial level scale-up synthesis.

ROLE OF THREE-DIMENSIONAL CARBON MATERIAL AS A CATALYST SUPPORT IN LOW-TEMPERATURE FUEL CELLS

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BACKGROUND AND PURPOSE: Low-temperature fuel cells (LTFCs) can be an alternative energy source to address the global energy demand. The cathode and anode reactions of LTFCs have sluggish kinetics and require catalysts with high Platinum (Pt) loading to achieve better performance. However, the high cost of Pt and its poor durability, susceptibility to methanol crossover and CO poisoning pose severe challenges for the broader applications of LTFCs. This study focuses on exploring vertically aligned carbon nanofiber (VACNF) arrays as a unique three-dimensional carbon-based catalyst support for Pt catalyst, with an emphasis on understanding its fundamental electrocatalytic properties. **METHOD:** Pt was sputter-deposited on the VACNF arrays to enable effective catalyst utilization. The electrocatalytic properties of the catalysts were evaluated using different electrochemical techniques and Density Functional Theory (DFT) studies. **RESULTS:** The structural characterizations indicated that the in-house prepared VACNFs were different from the conventional carbon nanotubes/carbon nanofibers with high-density graphitic edge sites on the sidewall. The Pt NPs deposited on these graphitic edges were found to have stronger interactions with the carbon support, which enables to improve the overall durability of the catalyst. Pt/VACNF shows excellent tolerance to methanol oxidation and improved capability to recover rapidly from CO poisoning. We found that Pt/VACNF could be employed as a bifunctional electrocatalyst depending on the reaction environment. **CONCLUSION:** These results offer new insights into the critical roles of 3D nanostructured carbon supports and their graphitic microstructures on the fundamental electrocatalytic properties of the catalyst. It could help develop future high-performance electrocatalyst supports.

UNDER THE INFLUENCE: THE RELATIONSHIP BETWEEN GENDER, ETHNICITY, AND CREDIBILITY OF INSTAGRAM ADVERTISING

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BACKGROUND AND PURPOSE: With over one billion monthly users, most of which fall in the spend-happy target age range 18-29, Instagram has begun to blur the lines between social media and social marketing. Due to Instagram's visual appeal, advertisers have majorly staked their marketing on this platform. Through both organic and paid (sponsored) means, there are two million Instagram advertisements monthly (West, 2019). The present research addresses the issue of perceived credibility of a message advertised on Instagram. This study seeks to fill the gap in literature surrounding the true power of celebrity influencer and scientific recommendations in advertising perception**. METHOD:** Participants in this study were recruited using MTurk and were randomly assigned to fictitious Instagram posts from either a social media influencer (a recognizable celebrity) or a scientist/doctor. Both the influencer and the scientist categories advertised Crest toothpaste. All participants were screened to ensure they were Instagram users. **RESULTS/FINDINGS:** The findings of this study offer an exploratory examination of the effects of influencer and scientist advertising on consumer purchase intention and perceived credibility. Overall, condition did not make a difference on purchase intentions, but did make a statistical difference in terms of source and post credibility. **CONCLUSION:** Advertisers can benefit practically from the Instagram uses and gratifications findings of this study. Self-promotion was found to affect users' purchase intentions and perceptions of credibility in this study. Since self-promotion on Instagram was found to be both credible and affect purchase intention, advertisers could use more user-generated campaigns on Instagram to feed the users' need of self-promotion.

STRAWBERRY OR PLAIN YOGURT? PRODUCT LINE EXPANSION AND MANUFACTURER'S BARGAINING POWER

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BACKGROUND AND PURPOSE: New product introductions, mainly product line extensions, become a very popular strategy of product managers. In new product line extensions, firms can either choose to introduce or expand the product lines to extract consumer surplus. In the yogurt industry, each manufacturer carries several lines and offers different flavors under each line. For instance, General Mills carries Yoplait Light, Yoplait Original, Liberte, Mountain High. These product lines differ in quality (due to the changes in protein content, probiotics or yogurt style) and price; they are vertically differentiated. Within each line, items are horizontally differentiated- different flavors are almost offered by the same price. In this study, we asses how offering different product lines and many flavors under a given line impact the manufacturer's bargaining power. **METHOD:** We estimate a structural econometric model of demand and supply, and recover the manufacturer-retailer bargaining power**. RESULTS AND CONCLUSION:** We have found that bargaining power varies depending on the identity of the manufacturer-retailer pair. From the manufacturer's side, providing a variety of product lines can increase its bargaining power, thus the slice of the pie that is shared with retailers. On the contrary, flavor attributes under a given product line seem to hurt the manufacturer's bargaining power. These findings show that manufacturers should focus on the product line expansion to increase their margins rather than flavor attributes within a product line.

DOES CAMPUS BIODVIERSTIY MATTER FOR STUDENTS' PSYCHOLOGICAL WELLBEING?

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BACKGROUND AND PURPOSE: Many previous studies find that there is a positive association between campus green space and psychological wellbeing among students. However, few attempts have been made in exploring the association with biodiversity in green space. This study investigates how two different levels of biodiversity (Low biodiversity, High biodiversity) in the campus environment are related to the student's attention restoration and psychological wellbeing. **METHOD:** 2x2 factorial design experimental research was conducted to examine the effect of biodiversity in green space on psychological wellbeing. Participants are randomly assigned to one of the two different environments (Low/High biodiversity) with sound and no sound by using Virtual Reality (VR) simulation for five minutes. One is a place with high biodiversity environment, consisting of native tall grasses and meadow plants with sound and no sound. The other is a place with low biodiversity environment with sound and no sound, comprising simple lawn yards. The survey was conducted to measure perceived restorative attention and psychological wellbeing. **RESULTS/FINDINGS:** The result shows that students with high biodiversity environment had a higher restorative effect and psychological wellbeing, compared to those not, but the nature sound can amplify psychological effectiveness. **CONCLUSION:** The result suggests that high biodiversity in the campus environment has a better effect on attention restoration and psychological wellbeing, but nature sound is also important with visual effects. Campus planners should consider planning and designing a healthier green environment for the better mental wellbeing of students.

GENERAL SELF-EFFICACY AS A PREDICTOR OF FORGIVENESS IN EMERGING ADULTS

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BACKGROUND AND PURPOSE: General self-efficacy can be defined as individuals' perceived ability to perform tasks across various situations (Judge, Erez, & Bono, 1998). This notion of general self-efficacy has the ability to influence an individual's ability to forgive a transgressor in any given situation. The familial background an individual was raised in may also influence a person's ability to forgive. This is important, as forgiveness has been associated with positive individual and interpersonal health outcomes (Toussaint, Worthington, & Williams, 2015). **METHOD:** Data from the K-State Relationship Survey was used. Participants were recruited during an undergraduate human sciences class. A subsample of $N = 100$ participants currently in romantic relationships were assessed using a multiple regression analysis. General self-efficacy was analyzed as a predictor of forgiveness while controlling for gender, relationship length, and parent relationship during childhood. **RESULTS:** Higher levels of general self-efficacy significantly predicted higher levels of reported willingness to forgive, while controlling for race, relationship length, and parent relationship during childhood. **CONCLUSION:** Forgiveness can be difficult and those that have higher levels of general self-efficacy may have the ability to separate themselves from a situation when thinking about forgiveness as opposed to letting their emotions do the thinking for them. Forgiveness is difficult to define and execute and there may be situations where individuals feel forgiveness is unnecessary. Therapists and other clinicians can use this information by helping individuals define what forgiveness is and when it is appropriate.

CULTURE AND COGNITION IN FILM VIEWING: THE INFLUENCE OF INDIVIDUAL FACTORS AND COGNITIVE DEMAND ON ATTENTION

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BACKGROUD AND PURPOSE: Research has shown cultural differences in attentional selection using static images, but not in film viewing. Research using film, but not investigating culture, shows that film produces little-to-no effect of top-down influences (i.e., experiences, goals, culture, etc.) and a large effect of bottom-up influences (i.e., color, motion, etc.). The question for this study was, can cultural differences in attentional selection override such stimulus control in film? We also investigated the role of cognitive load to identify if both cultures were being equally impacted by additional cognitive load while viewing film. **METHOD:** Participants from Kansas, USA, and Kyoto, Japan, were eye-tracked while watching 8 short film clips, while performing two tasks, under differing cognitive-load levels. Participants' primary task was either to watch a film clip for comprehension or to build a spatial representation of the scenery. Participants had a secondary cognitive-load task on half the trials. **RESULTS/FINDINGS:** We found that an increased cognitive load during film was cognitively demanding for both cultures, but Kyoto participants seemed to be more drastically impacted (i.e., decreased spread of eye-movements, suggesting more difficult task for participants). Furthermore, we found cultural differences in attention while watching film, like viewing still images. Both results show the individual's role in choosing what to attend to while watching film, and cognitive and cultural influences in shaping that. **CONCLUSION:** These results that in an educational setting, cultural differences should be considered in attentional tasks because they are being drawn to differing material depending on their culture.

THE EFFECTS OF MIND MAPS ON COMPUTATIONAL THINKING

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BACKGROUND AND PURPOSE: Mind Maps (MM) have proven to be a practical approach that promotes meaningful learning in various domains. However, very little research understands how mind maps can aid the overall experience of teaching computational thinking concepts. The purpose of the study is to understand better the impact of teaching computational thinking concepts using mind map techniques.**METHOD:** We developed a MM approach - named Storyboard-tree - to transform "Standard/traditional" slides (SS) to the MM structure. Storyboard-tree associates the information by creating a story that chains the data with ideas and concepts which lead from the first to next and so on. The applied materials are two models in an Introduction to Computer Science (CS) course. The study utilizes two sections: one is taught with MM, and the other with SS. Data collected through classroom observation and pre/post-tests of the students. **RESULTS/FINDINGS:** The observed academic results, CT self-efficiency scores, and the acceptance rate of the students were encouraging. The assessment results have confirmed that MM is a promising approach with students. MM with freshman show statically significant self-efficiency scores with an approximate 50% better performance than with SS in the Algorithm concept, while all students show a statistically similar trend in the knowledge gained as well as the fondness of the approach through the self-efficiency scores. **CONCLUSION:**The investigation concludes that the Mind Map is a feasible way to deliver CT concepts, thereby it is a practical approach to integrate CT into the curriculum.

Poster Abstracts

DETECTION OF VERTICAL FIBER HIDE DEFECT IN BEEF CATTLE

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BACKGROUND AND PURPOSE: Vertical fiber hide defect (VFHD) is a genetic disorder that affects the collagen structure of Hereford cattle hide by reducing fiber interlacing and causing hides to tear during tanning. Thus, it results in increased cost during leather good production. Previous literature reports that VFHD affects ~13% of Hereford cattle and heritability estimates are high (0.85), however contemporary data is scarce. Previous research suggests that efforts to improve beef tenderness may have simultaneously produced VFHD-affected hides. The primary purpose of this study is to obtain a modern estimate of VFHD prevalence. **METHOD:** Hide biopsies collected from 22 Hereford cattle at the KSU Purebred Unit, according to IACUC protocol #4066, were sliced to a thickness of 10μm, mounted on slides, and dyed with Masson's trichrome stain. Fiber direction was examined microscopically. Normal hide collagen is interwoven at an angle of 50-60°, but vertical fibers have a weave angle between 60-90°. The disorder is recognized when most of the sample is comprised of vertical fibers. **RESULTS/FINDINGS:** Preliminary analysis has not revealed any incidence of VFHD. However, due to small sample sizes and limited pedigrees, a larger number of samples needs to be tested. **CONCLUSION:** Additional samples from different herds and ancestry need to be tested to determine VFHD prevalence, and additional sampling is currently being pursued. VFHD has significant implications for the beef and leather industries and current prevalence estimates will determine whether identification of markers or causal mutations for genomic testing or other strategies may be required for practical identification and control of this condition.

LIVING ON THE EDGE: DETERMINING THE POTENTIAL OF MULTIPURPOSE PERENNIAL

CROPS AS HABITAT FOR NATIVE POLLINATORS AND NATURAL ENEMIES

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BACKGROUND AND PURPOSE: Perennial flowering plants provide excellent resources for natural enemies and pollinators. By growing them near agricultural fields, farmers may support agriculturally beneficial insects (such as pollinators and natural enemies) diversity and abundance while maximizing the benefits of ecosystem services. We tested different border crops to see if some crops attract more beneficial insects than others. **METHOD:** To answer this question, we tested six different border crops, with each crop having four sampling plots. In these plots, we sampled for pollinator and natural enemy use separately. For the pollinator sampling, each plot was visited once a month if the flowering crop was in bloom. For ten minutes in each plot, we caught any pollinator that landed on the crop, using a net or bug-vacuum. To measure crop utilization by natural enemies, we placed two pitfall traps in each plot and collected the traps after 48 hours to identify the insects we caught. This was done once a month as well. **RESULTS:** We found that both mixed prairie and silflower crops had significantly higher pollinator abundance and richness, and no significant effect on natural enemies. **CONCLUSION:** Our findings indicate that a monoculture of a flowering native, perennial border crop can provide the same benefits of a diverse prairie. Because of this, native perennial border crops may be easily adopted into mainstream agricultural practices.

EATING YOUR GREENBUGS WITH A SIDE OF VEGGIES: A DIVERSE DIET IMPROVES THE REPRODUCTIVE PERFORMANCE AND LIFE HISTORY OF *HIPPODAMIA CONVERGENS* (COLEOPTERA: COCCINELLIDAE).

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BACKGROUND AND PURPOSE: Predatory insects encounter various animal prey and plant resources in the field but are often reared on monotypic diets in the laboratory. This is important as the diet regimen of insect predators influences development, growth and reproduction. Our objective was to understand how diet diversity effects a beneficial insect predator, the convergent lady beetle (*Hippodamia convergens* Guerin-Meneville). We hypothesized that nutrient variety in mixed diets would result in higher individual fitness and improved life history parameters, such as increased fecundity and fertility, and that these benefits would be more pronounced with reproductive diapause. **METHOD:** We assessed a monotypic diet (greenbugs, *Schizaphis graminum* Rondani) for development and reproduction of *H. convergens* in comparison to a mixed diet including greenbugs, wheat leaves, moth eggs, sunflower stems, bee pollen and diluted honey, combined appropriately for different life stages to simulate the range of resources available to larvae and adults during their spring generation. In addition, adults from each larval treatment were split into diapausing and non-diapausing treatments as first-generation adults may spend extended periods in reproductive diapause. Fecundity and fertility were recorded for 21 days and data were analyzed as planned pairwise comparisons between treatments. **RESULTS:** We found that diet compensation during reproductive diapause increased fecundity in diet restricted treatments such that no lasting effect on fecundity of the diapausing treatments was observed relative to continuous mixed diet treatments. **CONCLUSION:** This result suggests that monotypic diet decreases fecundity in *H. convergens*, but adult diet compensation can overcome negative impacts of larval diet restriction.

THE FUTURE OF ELECTRONICS COOLING IS 3-D PRINTED

Christopher Bailey and Scott M. Thompson
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BACKGROUND AND PURPOSE: The continual development of integrated circuitry has resulted in their rapid miniaturization; this, however, presents a problem. Limits in circuit size and cost reduction have nearly been reached due to the production of excessive amounts of heat. In order to solve this problem, the heat from increasingly smaller circuits must be addressed. This research aims to design vapor chambers (VCs), which are two-phase heat spreaders for distributing heat from a very concentrated area to a larger area, and oscillating heat pipes (OHPs), which expel extreme heat. The combination of these two components essentially spreads and eliminates heat in extremely high temperature applications, thus providing the cooling necessary for increasingly powerful electronics. Until very recently, the only way to produce VCs and OHPs involved expensive and time-consuming machining. However, it is now possible to 3-D print both components which saves a significant amount of time and money while also providing a means to more easily experiment with different, unique designs. **METHODS:** The effectiveness of new 3-D printed VCs and OHPs will be assessed using computer simulations while also considering 3-D printing limitations. **RESULTS:** The expected results of this research will improve the effectiveness of VC/OHP cooling combinations on high heat producing circuitry. By experimenting with different designs, the desired outcome is to effectively cool a circuit producing a heat flux of 1 kW/cm^2. **CONCLUSION:** This research can impact the future size and cost of integrated circuitry without sacrificing their effectiveness due to extreme levels of residual heat.

GENERATIVE VERSUS SAMPLING-BASED APPROACHES TO ADDRESS CLASS IMBALANCE IN VISUAL ANOMALY DETECTION

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BACKGROUND AND PURPOSE: Anomaly detection is the task of identifying or classifying unusual observations from data. Due to the infrequent occurrence of anomalous events, data sets available for anomaly detection are inherently imbalanced. Nowadays, in visual anomaly detection, it is usual to artificially generate additional anomalous images to reduce the imbalance. Images generated by different techniques vary in quality and have different effects on the classifier. Previous works on generative models demonstrated the superiority of Generative Adversarial Network (GAN) based approach for class imbalance on simple structured image data sets but presented a doubt in case of complicated and critical data domain. We attempt to investigate the possibility of using GAN-based models for critical visual anomaly detection tasks like classifying healthy and infected tomato plant leaves where the anomaly lies in the surface level. **METHOD:** We carried out an experiment to analyze the training phase and the final classifier performance when the imbalanced data set is augmented using different approaches to achieve a higher data ratio. We identified the classification on imbalanced data set as baseline and compared the performance of the classifier on data sets augmented by simple oversampling, an adaptation of Synthetic Minority Over-sampling Technique (SMOTE), and a GAN-based generative model. **RESULTS AND CONCLUSION:** We conducted 5-fold cross-validation and the Student's t-test to show significant performance difference exists between the GAN-based approach and the baseline. We conclude that a GAN-based generative approach can produce more clear and meaningful image samples, and could be implemented as image generator to compensate the skewed data distribution.

FUNCTIONAL/STRUCTURAL IMPORTANCE IN BIOLOGICAL PHASE TRANSITION

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BACKGROUND AND PURPOSE: There are numerous membraneless organelles, also called cellular bodies, in an eukaryotic cell. They are formed by spontaneous condensation of biomolecules into liquid states. Since the discovery of these liquid states, further studies have revealed a broadening diversity of condensed states within the cell. The frequency of this organization motif leads to a question about how the physics driving these separated states affect the biomolecular function of the resulting droplet. We know that main components of cellular body, *Scaffolds*, drive the phase separation of cellular body whereas the remaining components, *Clients*, provide functionality but we do not know more since traditional methods of structural biology do not work on disordered system. **METHOD:** We use theory to determine how droplet is put together and what that means for its functionality. We apply theory to a model system of SUMO/SIM proteins. **RESULTS/FINDINGS:** Theory rules out crosslinked phase for SUMO/SIM system. System is composed of zipper like filaments. This finding explains the curious non-monotonic trends of client binding in scaffold assemblies. **CONCLUSION:** Biological mechanisms may regulate the body composition and the change in body compostion may dictate the change in body function. Microscopic structure of the condensed states imparts the important biochemical properties for the function and responsiveness to stumuli.

BEHAVIOR FEEDBACK & NEED FOR COGNITION: FACTORS AFFECTING COFFEE BEVERAGE CONSUMPTION

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BACKGROUND AND PURPOSE: Despite similar levels of caffeine, there are large differences in price and amount of calories when comparing traditional coffee drinks, like brewed and iced coffee, to what we have coined "specialty" coffee drinks, such as lattes and frappes. Namely, these specialty drinks cost double the amount of money and contain nearly ten times as many calories. Accordingly, significant health and financial consequences are associated with frequent consumption of these drinks. **STUDY 1 METHODS**: We examined how certain tailored persuasive health messages, i.e., generic and personalized behavior feedback messages, affected participants' future intent to consume specialty coffee drinks. **STUDY 1 RESULTS**: Those who viewed one of the two feedback health messages intended to consume fewer specialty drinks than those who viewed no message; however, we found no difference between the two feedback messages. **STUDY 2 METHODS (in progress)**: To probe this lack of difference, we will create and implement a new, similar generic feedback message. We will also measure participants' tendency and willingness to engage in critical thinking, i.e., Need for Cognition (NFC), to see if this individual difference factor moderates how participants read and process the persuasive information provided to them.

ANTICIPATED EMOTIONAL AND BEHAVIORAL RESPONSES TO AMBIGUOUS REJECTION BY SPECIFIC OTHERS

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BACKGROUND AND PURPOSE: Although there is an extensive literature on interpersonal rejection, individual studies that have examined peoples' emotional and behavioral responses to rejection have tended to limit their scope to a specific category of rejector (e.g., acquaintances). As a result, prior research has failed to systematically investigate whether individuals' emotional and behavioral responses to perceived rejection differ as a function of the role of the potential rejector. Given the dyadic nature of interpersonal rejection, such investigations are needed. **METHOD:** A total of 481 participants, rated their anticipated emotional and behavioral responses to scenarios in which rejection by a specific individual (i.e., significant other, friend, or acquaintance) was ambiguous. **RESULTS/FINDINGS:** The participants anticipated experiencing stronger emotional responses (e.g., anger, sadness) when the potential rejector was a significant other than a friend or acquaintance. With regard to their anticipated behavioral responses, the participants indicated that they would be (a) more likely to avoid an acquaintance than a friend, but more likely to avoid a friend than a significant other, (b) more likely to retaliate against a significant other than a friend or acquaintance, (c) more likely to complain to a significant other than a friend, but more likely to complain to a friend than an acquaintance, and (d) more likely to act friendly toward a significant other or a friend than an acquaintance. **CONCLUSION:** The participants' relation with specific individuals was found to influence both the intensity of their anticipated emotional responses to ambiguous rejection and the pattern of their anticipated behavioral responses to the potential rejectors.

APPLICATION OF HEALTH BELIEF MODEL IN ASSESSING PREDICTORS OF CAREGIVERS'INTENT FOR UPTAKE OF MEASLES, MUMPS, AND RUBELLA (MMR) VACCINE

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BACKGROUND AND PURPOSE: Vaccine hesitance and declining global vaccination rates are a critical problem facing the human population. A recent worldwide measles outbreak, including a sizeable cluster in Kansas City, has resulted in thousands of cases and claimed hundreds of lives, many of whom are from areas of the world where this disease was all but eradicated. **METHOD:** Using the Health Belief Model (HBM), this study aimed to assess predictors of caregiver's intent to vaccinate themselves and their children against measles, mumps, and rubella utilizing the combined MMR vaccine. Data were gathered through an online survey (n=96) administered to parents and soon-to-be-parents at a Midwest college town. **RESULTS/FINDINGS:** Results indicate that all aspects of the HBM are significantly correlated with intention to vaccinate. Younger and less-educated caregivers had lower perceived severity vaccine-preventable disease as well as lower perceived susceptibility to vaccine-preventable disease. They also reported lower levels of self-efficacy and perceived more barriers to access to care than those who are older or more highly educated. Furthermore, while a large percentage of participants are exposed to vaccine-related information online, they continue to seek counsel from healthcare professionals as they make choices about vaccination. **CONCLUSION:** These findings illustrated the need for public health professionals and healthcare practitioners to foster interpersonal relationships with young caregivers and encourage them toward vaccine adoption by increasing perceptions of susceptibility to and severity of vaccine-preventable diseases while, simultaneously, increasing perceptions of self-efficacy and decreasing perceptions of barriers to vaccination.

COOPTION OF GENES FOR CELL-CELL ADHESION RESULTS IN MULTICELLULARITY

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BACKGROUND AND PURPOSE: The molecular mechanisms governing the transition from unicellularity to multicellularity are poorly understood. The volvocine green algae are a valuable set of model organisms for studying this transition because their lineage diverged recently, and their genomes are very similar. This project aims at understanding the molecular basis of the initial transition to multicellularity typified by *Gonium* via an unbiased approach and a candidate-gene based approach. **METHOD:** Unbiased approach: A forward genetic screen for unicellular *Gonium* yielded a set of mutant strains, which were subjected to characterization and multi-'omic' analyses. Candidate-gene based approach: Generation of *Chlamydomonas* gain-of-function (GOF) mutants expressing GpFsl1 accompanied by generation of *Gonium* GpFsl1 loss-of-function (LOF) mutants. **RESULTS/FINDINGS:** Unbiased approach: Mutant UC-1C7 is not only highly unicellular, but its phenotype is the product of a single-gene mutation. Phenotypic and proteomic analysis show UC-1C7 has significant extracellular matrix (ECM) defects, which may render it incapable of sustaining colonial development. Transcriptomic and genomic analyses show that a small set of genes have an expression profile unique to UC-1C7, including an under-expressed putative prolyl-4-hydroxylase (*P4H*) gene. Candidate gene approach: *Chlamydomonas* gain-of-function (GOF) mutants expressing GpFsl1 have a multicellular phenotype. Furthermore, complementary *Gonium* GpFsl1 loss-of-function (LOF) have a unicellular phenotype. **CONCLUSION:** Unbiased approach: Since hydroxyproline-rich glycoproteins are major components of the Volvocine ECM, this is a promising candidate for further research. Candidate gene approach: GpFsl1 likely plays a relevant role in the transition from unicellular to colonial life, and an ancestral GpFsl1- like protein was coopted for multicellularity.

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