Research and the State

GRADUATE STUDENT POSTER SESSION

Program Booklet

Thursday, October 27, 2022
Student Union Courtyard

KANSAS STATE UNIVERSITY
Graduate School

KANSAS STATE UNIVERSITY
Graduate Student Council

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Program Schedule

POSTER PRESENTATIONS AND JUDGING

1:30 pm to 3:30 pm
Student Union Courtyard

Research posters will be presented by over 50 K-State graduate students representing five academic colleges. The top 10 presenters will be selected by K-State faculty and post-doc judges to participate in the Capitol Graduate Research Summit (CGRS) being held in Topeka in February.

AWARDS CEREMONY

4:30 pm
Big 12 Room, Union

The top 10 graduate student poster presenters selected to represent K-State by presenting their posters at the 20th annual Capitol Graduate Research Summit (CGRS) in March 2023 will be announced at the awards ceremony. These 10 students will be presented with a monetary award to recognize their achievement.

About the CGRS
The CGRS is an annual showcase of research conducted by graduate students from Emporia State University, Fort Hays State University, Kansas State University, Pittsburg State University, the University of Kansas, the University of Kansas Medical Center, and Wichita State University. Participants have the opportunity to present their research posters and discuss the important implications their research has for issues in the state of Kansas with state legislators, the governor, and the Board of Regents. Academic and industry representatives serve as judges to select the top presenters from each institution to receive scholarship awards.

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Poster Abstracts

GROUP 1

1

CHARACTERIZATION OF THE NUMBER OF VISITS REQUIRED FOR QUANTIFICATION OF GAS FLUXES AND METABOLIC HEAT PRODUCTION USING A GREENFEED

Elizabeth Dressler, Jennifer Bormann, Robert Weaber, and Megan Rolf
Department of Animal Sciences and Industry, College of Agriculture

BACKGROUND AND PURPOSE: Enteric fermentation in cattle produces greenhouse gases that are an environmental concern and an energetic loss. A GreenFeed system (C-Lock, Inc) allows for quantification of methane (CH_4), carbon dioxide (CO_2), and oxygen (O_2) from grazing cattle. Little work has been done to establish the minimum number of visits required to quantify an individual grazing animal's gas fluxes and metabolic heat production METHOD: 100 visits from seventeen grazing mature Angus cows were collected using a GreenFeed. The mean gas fluxes and metabolic heat production were computed for the first 10 visits increasing to the full 100 visits in increments of 10 (forward) and were also computed starting from visit 100 (reverse) using the same approach. Next, mean forward and reverse gas fluxes and metabolic heat production were computed between visits 30 and 40 in intervals of 2. Pearson and Spearman correlations were computed between means from 100 visits and each shortened interval. A correlation with 100 visits greater than 0.95 determined the minimum number of visits. **RESULTS/FINDINGS**: The minimum number of visits needed for CH_4, CO_2, O_2 and metabolic heat production are 36-38, 40, 38-40, and 36, respectively. Animals met the recommended number of visits for CH_4, CO_2, O_2 and metabolic heat production in 29.5±8.7, 31.8±9.2, 30.5±9.1, and 29.5±8.7 days, respectively. **CONCLUSION**: Literature recommends a similar number of total visits; however, there is a wide range of test durations published because the daily number of visits differs greatly by animal. Therefore, GreenFeed protocols should include the total number of visits, rather than test duration.

Relevance of Research to State-Related Topic(s)

This research is relevant to Kansas legislature because this research relates to important topic areas such as sustainability, greenhouse gas emissions, and animal care/use. Methane is the second most abundant source of greenhouse gas emissions in the United States (U.S. EPA, 2022). 27% of U.S. methane emissions are produced from enteric fermentation of livestock species. Additionally, methane production is an energetically wasteful process that costs cattle producers' money in feed. Enteric fermentation is a natural and necessary digestive process for ruminant animals such as cattle, so it is important that an optimum balance between methane production and animal productivity is achieved to sustain the beef industry. This research uses a GreenFeed system to measure greenhouse gas fluxes from grazing beef cows to establish the number of visits needed to use the system. Moving forward, this protocol can be implemented in additional research to quantify greenhouse gas emissions from beef cattle.

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SEASONAL VARIABILITY OF SOIL HEALTH INDICATORS UNDER DIFFERENT CROPPING SYSTEMS IN THE SOUTHERN GREAT PLAINS

César Augusto Guareschi, Charles W. Rice, Dorivar Ruiz Diaz, and Andres Patrignani
Department of Agronomy, College of Agriculture

BACKGROUND AND PURPOSE: Crop productivity in the Southern Great Plains is lagging compared to other regions in the U.S. mostly because of soil health deterioration caused by mono-cropped systems. This study focuses on understanding the temporal dynamics of common soil health indicators in cropping systems of varied crop diversity and intensity to evaluate the best moment to conduct soil health-related biological measurements. METHOD: Six different cropping systems, ranging from winter wheat monoculture to multi-species crop rotatins, were assessed in the Rainfed Agriculture Innovation Network plots in Ashland Bottoms-KS, during the winter wheat season. Soil samples were collected at three depths (0-5, 5-15, and 15-30 cm) during emergence, flowering, and harvest stages. Soil health was determined through extracellular enzyme activity on the carbon, nitrogen, phosphorus, and sulfur cycles. The enzymes evaluated as soil health indicators were β-glucosidase, N-acetyl- β -dglucosaminidase, Acid-Phosphatase, and Arylsulfatase. RESULTS: Enzyme activity analysis through the growing season revealed that β-glucosidase had decreased around 36% in activity during flowering when compared with the emergence and harvest stages, while the other enzymes showed more consistent pattern along the growth season, reaching lower activity levels at harvest. Enzyme's activities were also affected by environmental factors, primarily by low soil moisture conditions due to drought. Three of the studied enzymes also showed a high correlation with soil organic matter, which is relevant and widely used soil health indicator. CONCLUSION: The optimal timing for soil sampling was during the crop emergence stage. The cropping system with the highest crop diversity and intensity exhibited the highest enzyme activity rates.

Relevance of Research to State-Related Topic(s)

Kansas is an agricultural state which contributes to the global food chain supply. However, current agriculture practices rely less intense and diverse regarding cropping systems. Although the state of Kansas is already leading the nation in adopting no-tillage practices, there is still a large opportunity to improve agricultural management and practices. By adding intensity and diversity to Kansas' cropping systems, farmers would be enhancing soil health and building soil organic matter thus improving nutrient cycling and soil resilience. Moreover, this project aims to improve carbon sequestration, water and nitrogen use efficiency, and develop information to in-season decisions in Southern Great Plains cropping systems.

THE COMPLEX RELATIONSHIP BETWEEN NATIVE MYCORRHIZAL COMMUNITY AND PHOSPHORUS ADDITION IN COMMERCIAL MYCORRHIZAL INOCULANT EFFECTIVENESS

Endy Lopes Kailer and Charles W. Rice.
Department of Agronomy, College of Agriculture

BACKGROUND AND PURPOSE: Arbuscular Mycorrhizal Fungi (AMF) are a group of microorganisms that provide nutritional benefits to around 80% of all plants. Our research aimed to assess the colonization potential of a commercial AMF inoculant with different soil types and phosphorus (P) fertilization. **METHOD**: Corn was grown in the greenhouse with three low P non-sterilized soils. Two soils were in current agricultural production, and the other soil was in the native prairie. Treatments included two levels of P (0 and 135 kg/ha of P_2O_5) and mycorrhizal inoculation with spores of *Rhizophagus irregularis* (no inoculation and inoculated) with four replicates in a completely randomized block design. Corn aboveground and root biomass were collected after 50 and 70 days. Nutrient uptake in roots and shoots was determined, and mycorrhizal colonization of the roots was assessed. **RESULTS**: Corn that received phosphorus fertilization had a statistically significant increase from two to four times in growth and nutrient levels (shoots and roots) in all soils. The inoculant did not significantly affect plant growth. Phosphorus fertilization partially inhibited colonization. Plants grown in the agricultural soils were colonized by the inoculant. Corn grown in the native prairie soil was not colonized by the inoculant because of the high populations of native AMF. **CONCLUSION**: Commercial inoculants can successfully colonize corn roots in soils from the agricultural sites. Future research will evaluate AMF colonization, corn growth, and yield in field conditions.

Relevance of Research to State-Related Topic

Agricultural systems rely on P fertilization for yield. Mycorrhizae could improve the P efficiency of crop production, thus reducing inputs and increasing sustainability. Mycorrhizae are also known to improve soil health by improving soil structure and soil carbon. Most agricultural soils have a lower abundance of AMF, which could benefit from inoculation.

DEVELOPING AN OPERATIONAL STATEWIDE MAP OF ROOT ZONE SOIL MOISTURE USING THE KANSAS MESONET NETWORK

Joaquin Peraza and Andres Patrignani
Department of Agronomy, College of Agriculture

BACKGROUND AND PURPOSE: The Kansas Mesonet is an environmental monitoring network that consists of 75 stations across the state of Kansas. Soil moisture sensors at each station provide accurate and temporally continuous information, but the small sensing footprint of the sensors and the sparse nature of the network hinder the development of high spatial resolution maps of soil moisture. This study aims at developing a gridded soil moisture product at a 250-meter resolution for the state of Kansas by integrating observations from the Kansas Mesonet using a model-data fusion approach. **METHOD**: Soil water storage was obtained from stations of the Kansas Mesonet for the period 2017-2021. For the same period, a parsimonious model was used to estimate soil moisture at high spatial resolution across the entire state using gridded products of daily precipitation and soil properties. Then, in situ observations and model predictions were integrated using a conditional merging technique. **RESULTS/FINDINGS**: The model alone resulted in a Median Absolute Error (MAE) of 14.2 mm, using only the station observations presented an MAE of 16.2 mm, while the merged product resulted in an MAE of 11. 2 mm. Vapor pressure deficit exhibited a negative linear ($r = -0.64$) relationship with model parameters associated to soil moisture drydown periods. Vegetation indexes marginally improved the accuracy of the calculated soil moisture. **CONCLUSION**: The integration of simple models with the existing observations from the Kansas Mesonet can accurately represent soil moisture conditions across Kansas to increase wildfire preparedness, estimate potential groundwater recharge rates and develop drought early warning systems.

Relevance of Research to State-Related Topic(s)

Generating a new high resolution (sub-county level, farm-level) operational map of daily soil moisture conditions is critical for an accurate and timely assessment of drought conditions in Kansas. Daily maps of soil moisture conditions can be used to develop drought early warning systems for better in-season agronomic decisions and forecast potential impacts on agricultural production and food safety. These early warning systems could be used by legislators and state officials to take timely, accurate and actionable decisions to help Kansas stakeholders and citizens. This project will also leverage the Kansas Mesonet, which is world-class environmental monitoring network spanning the entire state of Kansas.

A PRECIPTATION GRADIENT'S EFFECT ON BIOLOGICAL AND CHEMICAL SOIL HEALTH FACTORS

Tiffany Poydras, Charles Rice, Marcos Mansano Sarto
Department of Agronomy, College of Agriculture

BACKGROUND AND PURPOSE: Precipitation is an essential soil forming factor, as well as one of the most limiting factors effecting rainfed agriculture. While vegetation and microbial communities have long adapted to the amount of precipitation they receive, the ever-changing and shifting climate creates worry as to what effect precipitation change will have. Due to Kansas' genesis as a grassland as well as the precipitation gradient that expands from west to east, the climate creates an opportunity to examine how precipitation change can affect soil health, the ability of the soil to function as an ecosystem and support life. To examine precipitation change's effect on different land uses, native prairie, restored prairie, and conventionally tilled soil have been used as levels of disturbances for the soil, in order to find recognizable patterns. By examining the soil to a depth of 150 cm, a prediction can be made as to the way that land use, soil depth, and precipitation effects soil health and the microbial community. **METHOD**: Soil cores to the depth of 150 cm were taken in 11 sites across Kansas. In order to assess the microbial community, PLFA, Fluorometric Enzyme, Carbon, Nitrogen and Phosphorous analysis were done. Statistical analysis using multilinear models, MANOVA, and PCA. **CONCLUSION**: To predict the effect that precipitation change will have on soil health in the future will allow for more understanding of the way that microbial communities interact with their environment and resources, as well as how this might affect soil structure.

Relevance of Research to State-Related Topic(s)

Most land in Kansas is utilized in one way or another for agriculture, be it for crops or grazing. As the Kansas' climate appears to shift, it is important for us to be able to predict how this will affect agriculture and soil health. This is done by examining the effects that Kansas' precipitation gradient has on soil health and different agricultural systems, such as native prairie, restored prairie, and conventional tillage.

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EFFECT OF ROOT ASSOCIATED BACTERIA ON CORN NITROGEN USE EFFICIENCY

Wagner Squizani de Arruda, Irosha Wanithunga, and Charles W. Rice
Department of Agronomy, College of Agriculture

BACKGROUND AND PURPOSE: Nitrogen (N) is one of the most required fertilizers in the USA and the rest of the world. As a source of plant growth, it plays a key role in the agricultural sector, enabling farmers to achieve greater yield and helping feed the human population. Although agriculture still relies on synthetic N fertilizers, half is lost to the environment, bringing negative impacts. A bio-inoculant called Pivot Bio Proven colonizes corn roots by fixing nitrogen bacteria, forming plant-microbe relationships that could improve nitrogen use efficiency, increasing sustainability and productivity. The objective of this study is to determine grain yield, dry biomass, and N uptake with and without proven. **METHOD**: This study was initiated in 2021 located at the Agronomy North Farm, Manhattan, KS. The experiment design is a RCBD with 4 Nitrogen rates (0, 50, 100, 150) kg N/ha) with and without Proven with six replicates. Plant biomass was sampled at three growth stages (V7, VT, and Harvest). RESULTS: In 2021, plant biomass, plant N uptakes, and yield were significantly affected by N rate. Yield increased from 3.05 Mg/ha (52.11 bushels/acre) with no N fertilizer to 7.49 Mg/ha (111.46 bushels/acre) with 150 kg N/ha of applied urea-N. Proven did not affect plant biomass, N uptake, or yield. **CONCLUSION**: For the first year of a 3 yr study optimum N fertilizer ranged between 50 and 150 kg N/ha. Proven did not appear to supply N to corn.

Relevance of Research to State-Related Topic(s)

Nitrogen (N) is an essential element that plays a crucial role in agriculture. However, Nitrogen use efficiency is often only 50% which translates N loss to the environment. One way to increase efficiency is to manage N fertilizer inputs and develop alternative sources of N through biological N fixation. Thus, my research is to determine nitrogen use efficiency in corn with an N-fixing root-associated bacteria. The outcome will be to reduce the environmental impact of N on the environment while maintaining food production and profitability for the farmer.

7

QUANTIFYING N_2O EMISSION IN CORN PRODUCTION WITH A NOVEL N-FIXING BIOINOCULANT

Irosha Wanithunga, Wagner Squizani, and Charles W. Rice
Department of Agronomy, College of Agriculture

BACKGROUND AND PURPOSE: Nitrous Oxide (N_2O) emission is one of the inadvertent Nitrogen (N) loss pathways in agriculture, which is a potent greenhouse gas with a ~300 times greater warming potential than atmospheric carbon dioxide (CO_2). Mitigation and quantification of N_2O emissions from cropping systems are critical to limit future climate warming effects and measure the carbon footprint of cropping systems for future carbon markets. It is important to practice innovative crop production strategies to reduce N_2O emissions and increase N efficiency and profitability in agriculture. The increased cost of N fertilizers has stimulated interest in biologically fixed N. A commercially available newly developed bioinoculant (Proven) associates with corn roots and fixes N which could reduce N_2O losses. **METHOD**: The research was conducted at the Agronomy North Farm in Manhattan KS on a keenebc silt loam soil. The experiment was a Randomized Complete Block design with 4 N fertilizer rates (0, 56, 112, and 168 kg N/ha) with and without Proven. The experiment had 6 replicates. The static chamber technique was used to quantify the N_2O flux with measurements taken twice a week. RESULTS: Higher N_2O emissions were detected during the precipitation events early in the growing season in both years 2021/ 2022. Emissions of N_2O increase with increasing N fertilizer application rates. **CONCLUSION**: Proven did not reduce N_2O emissions. Drought reduced N_2O flux in 2021. The preliminary results of the 2022 season suggested lower N_2O emissions with bio-inoculants.

Relevance of Research to State-Related Topic(s)

The state of Kansas produced 766.5 million bushels of corn grain on 5.7 million acres and 4.9 million tons of corn silage on 250,000 acres in 2020. Nitrogen (N) fertilizer usage is important for crop production but losses impact the environment. N_2O emissions are primarily driven by N fertilizer rates and climate conditions. Mineral N fertilizer use and unintended N losses are direct and indirect cost for Kansans. The agriculture sector accounts for about 60% of anthropogenic N_2O emissions. N-fixing bacteria over a growing season can reduce the requirement for N fertilizer and reduce N_2O emissions. Quantifying the effect of bio-inoculant on N_2O emission is important for decision-making of N management in cropping systems and reducing the carbon footprint of Kansas agriculture.

GROUP 2

8

INSECT ABUNDANCE AND COMMUNITY COMPOSITION DIFFERS AMONG HABITATS AND ALONG EDGES

Magdeline Anderson and Tania Kim
Department of Entomology, College of Agriculture

BACKGROUND AND PURPOSE: The border cropping practice (grassland habitat strategically positioned adjacent to working land) can reduce the need for harmful insecticides because it provides refuge, additional food, and reproductive resources to beneficial insects that are instrumental in natural pest suppression. But there are concerns about the practice. It is possible that border crops generate little natural biocontrol services because insect movement between the habitats is limited, and the ecological processes are highly variable and not well documented. Growers are also concerned that border crops attract more pests and increase crop damage. Therefore, our objective is to expand the understanding of insect biodiversity patterns with border crops and their implications on agricultural practices, pest suppression, and ecosystem functioning. **METHOD**: We monitored and compared aerial and ground dwelling insect communities along the edge of soybean fields that bordered either corn or grassland habitats using pitfall and yellow sticky traps. **RESULTS/FINDINGS**: There were similar aerial and ground dwelling insect abundances between soybean field edges that bordered either corn or grassland. Furthermore, aerial insect community composition was similar between soybean edges regardless of adjacent habitat type, but ground dwelling insect community composition was different for soybean that bordered grassland. **CONCLUSION**: The impact of border crops will vary between insect groups. Increasing landscape complexity with border crops does not greatly alter aerial insect biodiversity, but it does for ground dwelling. This is important information because many terrestrial insects are crucial agricultural pest predators. However, more research is needed to understand the influence of border crops on natural biocontrol services.

Relevance of Research to State-Related Topic(s)

Kansas is in urgent need of more reliable cropping systems because climate change and the growing world population have dramatically increased agricultural pressures. A secure, prosperous, and productive farming future can be achieved with help from the simple and sustainable practice of border cropping. Border crops are native grasses and forbs planted in non-harvestable areas surrounding the working land. They provide tremendous benefits for soil retention, reduced water runoff, and increased biodiversity of crucial pollinators and beneficial insects that eat pests. Thus, border crops can ultimately contribute to essential cost savings in management practices (fewer fertilizer and insecticide applications) and support water conservation. However, there are still ecological and social concerns about this multifaceted climate smart activity from both growers and scientists. This master's research project on cross-habitat movement of insects in human modified agricultural landscapes will provide needed insight on border crops effectiveness.

9

MOLECULAR AND MORPHOLOGICAL CHARACTERIZATION OF *FUSARIUM* SPECIES IN KERNZA®

Anusha Dahal[1], Myron Bruce[1], Kathryn Turner[2], and Jessica Rupp[1]
[1]Department of Plant Pathology, College of Agriculture; [2]Crop protection Genetics, The Land Institute, Salina, KS

BACKGROUND AND PURPOSE: The perennial grain crop Kernza®, also known as intermediate wheatgrass (*Thinopyrum intermedium*) is a wild relative of wheat grown primarily in the western United States. Wheat is the third most important field crop in the U.S., after corn and soybean. One of the most important diseases affecting wheat throughout all wheat growing regions is Fusarium head blight (FHB). As Kernza® is a relative of wheat, it could also be a host or reservoir of FHB and proximity or planting into the stubble of susceptible wheat varieties could increase disease in the more resistant Kernza® crop. The objective of this project is to identify fungal pathogens associated with Kernza® and to confirm the presence of *Fusarium graminearum*. **METHOD**: To identify these pathogens, head samples were contributed from on-farm and research trial locations. Spikelets were used to isolate the fungi using morphological methods. Later, single-spored fungi were obtained and DNA was extracted. We performed PCR and DNA sequencing of the amplified products using ITS primers. **RESULTS/FINDINGS**: Of 40 samples, 32 (80%) were shown to harbor Fusarium species consisting of *graminearum, asiaticum, culmorum, oxysporum, acuminatum, armeniacum and fujikuroi.* This finding supports the hypothesis that Kernza® could act as a host of FHB. This will be confirmed by sequencing with fusarium specific primers. CONCLUSION: Identifying the species and strains of Fusarium that colonize Kernza® will be very useful for developing disease resistant cultivars, as well as better FHB disease management.

Relevance of Research to State-Related Topic(s)

Fusarium head blight is the number one disease affecting wheat across all wheat growing regions of the United States. Eastern Kansas (KS) has the greatest risk of disease due to rotation with another host, corn and increased rainfall. There has been an increase of FHB in the central regions of KS, which is a major concern as KS wheat is predominantly grown in the western 2/3 of the state. FHB produces a toxin that is harmful to humans and livestock and is therefore highly regulated. Current management practices involve good rotation away from disease hosts, using genetic resistance, and use of fungicides. Kernza® needs to be carefully examined as it will be present in the field for more than one growing season. If Kernza® harbors the disease it may cause disease on neighboring wheat fields the following season in addition to potentially being unfit for consumption by humans or animals.

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ARE BIG BLUESTEM PLANTS LOCALLY MATCHED TO THEIR SOIL MICROBES ACROSS A PRECIPITATION GRADIENT?

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BACKGROUND AND PURPOSE: Big bluestem (*Andropogon gerardii)* is a dominant forage grass of prairies and is distributed across a steep rainfall gradient in the Midwest. This gradient has given rise to locally adapted wet and dry ecotypes. A gap in our understanding of plant ecotypes is the extent to which local soil microbes interact with ecotypes. We investigated how soil microbes affect big bluestem growth and whether plant ecotypes are locally matched to their microbes. We predicted that ecotypes would grow better when grown with native microbes than when grown with microbes adapted to other big bluestem ecotypes. **METHOD**: We collected seed and soils from six native big bluestem populations from western KS (580mm) and Illinois (1,167mm). We isolated microbes from field soils and reciprocally injected wet and dry microbes into common garden soils planted with either dry or wet big bluestem ecotypes. Plants were grown in greenhouse with 6 replicates per treatment and were measured and injected weekly. After 12 weeks, plants were harvested and weighed. **RESULTS**: We found that ecotypes differed in leaf width, height, and total biomass. Wet ecotypes were larger, taller, and produced more biomass than dry ecotypes. Physiological traits, such as chlorophyll absorbance, a proxy for photosynthesis, were enhanced in ecotypes growing with local microbes. Additionally, dry ecotypes produced ~30% more biomass when matched with their local microbes. **CONCLUSION**: These results provide insight into how plants interact with native microbes, and how researchers might harness that interaction to increase plant productivity and enhance prairie sustainability.

Relevance of Research to State-Related Topic(s)

Big bluestem is the dominant grass species of the Great Plains and accounts for roughly 70% of the biomass of prairie plant communities. In recent years, millions of acres of agricultural land have been restored to prairie throughout the Great Plains and cattle ranching is a multi-billion-dollar industry in Kansas. Because of the large role it plays in prairie restoration and importance as forage for cattle, understanding how Big bluestem ecotypes interact with their local soil microbes is crucial for productivity and sustainability of this ecosystem and the industry that depends on it. Understanding the relationship between Big bluestem and its soil microbes directly impacts the effectiveness of restoration efforts as well as the forage productivity for cattle and will ultimately lead to the optimization of these endeavors.

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IMPACTS OF WOODY ENCROACHMENT ON GRASSLAND WATER YIELD

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BACKGROUND AND PURPOSE: Grasslands and rangelands globally are experiencing woody encroachment – the spread of trees and woody shrubs in historically grass-dominated ecosystems. This process reduces plant biodiversity and forage availability and is increasingly recognized as a threat to water yield because woody species use substantially more water than grasses. **METHOD**: In this study at Konza Prairie Biological Station, we used measurements of water-use by shrubs and grasses as well as a historical spatial dataset of vegetation cover to estimate daily watershed-scale water loss through time as woody cover has increased. **RESULTS**: Previous work has shown that shrubs use water at roughly twice the rate of grasses. We found that woody cover increased by ~20% from 1978-2020, resulting in a ~25% increase in daily water-use in a 53.9 ha watershed. This drastic increase in water-use has likely contributed to observed declines in streamflow at Konza Prairie since the 1980's. We also found that the relationship between streamflow and incoming precipitation has broken down in recent decades – i.e., stream discharge is declining despite an increase in precipitation – and this breakdown is highly correlated with a rapid increase in the rate of woody encroachment in the early 2000's. **CONCLUSION**: Greater growing season water-use by shrubs/trees compared to grasses has led to increased watershed-scale water loss as woody encroachment has progressed. This shift has negative implications for water yield on watersheds that support livestock grazing, but also has the potential to impact larger-scale water yield (groundwater, rivers, and reservoirs) across Kansas if woody encroachment continues at a broad spatial scale.

Relevance of Research to State-Related Topic(s)

Over 10 million acres of land in Kansas are devoted to grazing livestock. Forage availability and sustainability of rangeland water resources are of high concern to land managers and the people who rely on their food production. Alterations to key water fluxes in grasslands and rangelands – recharge of soil water, vegetation water use, soil water transport – are impacted by drastic changes in vegetation cover. The ecohydrological consequences of widespread woody encroachment include decreased streamflow and groundwater/alluvial aquifer recharge. In many cases, removing woody vegetation once it is established has limited success in restoring water yield. Legacies of woody encroachment are expected to remain for years or decades, even if aboveground vegetation is removed. We hope this research adds to the urgency to prevent or mitigate woody encroachment on private rangelands and government-owned land in Kansas in order to maintain ecosystem function and sustain water-yield in grassland headwater streams.

12

IMPACT OF GRASSY EDGES ON JAPANESE BEETLE INVASION IN SOYBEAN

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BACKGROUND AND PURPOSE: Invasive species pose a significant threat to agriculture, and Japanese beetles, *Popillia japonica,* are one of the most economically damaging pests in the United States. Their significance in the Midwest is increasing, along with their threat to soybean and corn crops. Japanese Beetles prefer to deposit their eggs in grassy areas, such as turf and lawns. This research examines the effect of grassy borders next to soybean fields compared to corn fields. **METHOD**: Sweeps for Japanese beetles were performed at transects in ten fields over three separate times during one growing season. Additionally, evaluation of Japanese beetle damage on plants was performed toward the end of the growing season. **RESULTS/FINDINGS**: Contrary to our expectations, preliminary results show the soybean with grass borders have less damage and lower presence of Japanese beetles than soybean with cornfield borders. **CONCLUSION**: Since Japanese beetles prefer grass, such as turf and lawns, as an oviposition site, we expected to see more Japanese beetles in fields with grassland borders. However, the unique height and moisture characteristics of grasslands may deter oviposition. We need to expand our research to include more sites and rule out other possible contributing factors. If it holds true that grasslands do not increase Japanese beetle levels, or encourage lower levels than other crops, then this is valuable information for local farmers who use border crops or place hay fields next to their soybean fields.

Relevance of Research to State-Related Topic(s)

Invasive species are difficult to eradicate once they are established. Predicting where they may arrive is key to prevention of infestations. As Japanese beetles move west, it is important to predict where they will have the greatest impact in Kansas. Knowing the effect of landscape will help us to predict where they will occur, and which farmers could be investing more heavily in prevention. If grasslands do reduce the number of Japanese beetles, as our preliminary data shows, this has implications for health and economy in Kansas. Local farmers could be able to reduce economic losses from pest damage through landscape modifications, by adding some grassland borders or growing hay alongside their soybeans.

13

DOMINANT PRAIRIE GRASS CROSS-TRANSPLANTED ACROSS THE MIDWEST: ECOTYPE RESPONSE TO EXPERIMENTAL DROUGHT AND IMPACT ON THE SURROUNDING COMMUNITY

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BACKGROUND AND PURPOSE: Big bluestem (*Andropogon gerardii*) is a dominant, native grass that is for critical cattle forage, conservation, and restoration. This grass grows across a sharp rainfall gradient, resulting in wet to dry adapted populations. The objectives were to observe growth of big bluestem ecotypes cross-transplanted across the gradient, quantify the impact of drought using rainout shelters, and assess effects of local adaptation on the surrounding plant community. We predicted that each ecotype would perform best in their home site, performance would decrease under rainouts and strong adaptation would result in dominance over the surrounding plant community. **METHODS**: Reciprocal gardens of restored plant communities were established in 2009 and growth was monitored over time until 2021 in four garden sites. To specifically examine the effects of drought, rainfall was reduced using rainout shelters in three sites. Cover and biomass were measured of both big bluestem and the surrounding plant community to estimate growth over time. **RESULTS**: By 2021, wet and dry ecotypes demonstrated local adaptation, based on both cover and biomass. Experimental rainfall reduction decreased growth of the wet ecotype in all sites and increased cover of the dry ecotype in the wet site, further demonstrating adaptation of this ecotype to low rainfall. Finally, strong adaptation resulted in dominance of the local ecotype over the neighboring plant community, indicating that ecotypes shape community structure. **CONCLUSION**: These results indicate the prominent role of plant ecotypes across the natural and experimental rainfall conditions. Thus, restoration should consider the use of climate-adapted ecotypes to mitigate future droughts.

Relevance of Research to State-Related Topic(s)

Big bluestem plays a critical role in agriculture since it comprises a major component of forage for cattle. The cattle industry in KS is worth $10 billion /yr. As the dominant grass in tallgrass prairie, it controls the ecological structure, function and sustainability of this vital ecosystem. Yet, this ecosystem is predicted to be threatened by severe drought. Thus, it is crucial to understand big bluestem response to drought for cattle production, conservation, and restoration. Results will provide recommendations on climate-adapted populations in the face of future drought.

GROUP 3

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EFFECTS OF PELLET QUALITY ON GROWTH PERFORMANCE OF GROW-FINISH PIGS DURING VARYING WEIGHT RANGES

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BACKGROUND: Positive influences of pelleting swine diets are commonly attributed to gain to feed (G:F) improvements. However, quality of pellets must meet a certain standard to maximize improvements. The objective of these experiments was to determine the effects of feeding pellets with increasing amounts of fines during varying weight ranges on growth performance in pigs. **METHOD**: A total of 350 pigs (600 × 241, DNA), initially 36 kg, were randomly placed in 35 pens with 10 pigs per pen (balanced by gender). Pigs were weighed prior to the onset of each experiment and placed in 1 of 7 blocks based on average pen weight. Pigs were fed 1 of 5 treatments consisting of a mash diet or pellet diet with increasing fines levels. Data were analyzed using SAS (SAS Institute, INC., Cary, NC). Results: Diets were fed for 20, 21, and 20 days for experiments 1, 2, and 3, respectively. For Exp. 1 and 2, pigs fed pellets with 12.5 and 15.5% fines had improved ($P < 0.05$) G:F compared to pigs fed mash diets; however, average daily feed intake (ADFI) increased and G:F decreased (linear, $P < 0.05$) as percent fines increased, respectively. In Exp. 3, pigs fed pellets with 9.6 and 41.8% fines had improved ($P < 0.05$) G:F compared to pigs fed the mash diets. **CONCLUSION**: Pigs fed pellets with minimal fines had improved G:F compared to those fed the mash diet. Pigs in Exp. 3 had the greatest overall improvement in G:F, 9%, when fed pellets with minimal fines.

Relevance of Research

These experiments are relevant to current state topics because the largest cost in animal production is feed costs, whose two most common ingredients are corn and soybean meal. These two ingredients have seen volatile markets in recent years and contribute to the increase in prices for animal products in stores. The present experiment could allow swine producers to make data driven decisions to make their production systems more optimal.

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EFFECT OF SORGHUM ACCESSIONS AND SMALL GRAINS ON PET FOOD EXTRUSION

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INTRODUCTION: Pet owners are more concerned today about the ingredients used in pet food. Ingredients like sorghum, may provide health benefits in extruded pet food. Extrusion relies on high temperature and pressure to produce expanded kibbles. The objectives of this study were to determine the effect of three sorghum accessions varying in pericarp color and four small grains on processing conditions and product characteristics for extruded dog foods. **METHODS**: All diets were produced using a single screw extruder (model X20; Wenger Manufacturing, Inc. Sabetha, Kansas). The control diet contained rice (50%) as the primary starch, which was replaced by white sorghums A and B, burgundy sorghum, sumac sorghum, barley, millet, or oats. Kibbles were collected for analysis at three different time points during the extrusion of each treatment with dimensions and bulk density measured. Differences in each parameter were analyzed by statistical software for a completely randomized design experiment (SAS, v.9.4). **RESULTS AND CONCLUSION**: Rice-based kibbles had the largest diameters while millet, sumac, and oats were thinnest (11.46mm, vs average 9.19mm, respectively). Thickness was greatest in burgundy sorghum, millet and sumac while barley and oats were thinnest (average 6.72 mm vs average 4.86mm, respectively). Oats had the greatest bulk density (489 g/L) while rice had the least (305 g/L) and the other grains were intermediate. Barley had the greatest hardness and toughness (6.68 kg and 57.72 kg mm, respectively) while millet and sumac were the least (2.04 kg and 15.97 kg mm, respectively). In conclusion, rice expanded better than all seven of the treatment diets.

Relevance of Research to State-Related Topic(s)

Pet food manufacturing provides approximately three billion dollars and thousands of jobs for Kansas. Extruded pet foods rely on the inclusion of grains like corn and sorghum. Sorghum requires less water to grow than other grains making it an advantageous crop for decreasing water use. Additionally, sorghum contains phenolics which may provide antioxidant capacity. The use of sorghum in pet foods could provide a health benefit for the pet food industry as well as decrease water usage for crop production in Kansas.

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THE EFFECT OF NUTRIENT VARIABILITY OF FOOD WASTE ON APPARENT METABOLIZABLE ENERGY IN BROILER CHICKENS

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BACKGROUND: Approximately 40% of food produced in the U.S. isn't consumed or used. This negatively impacts environmental resources. One way to utilize this food is to redirect it into animal feed. To determine economic viability of utilizing food waste, nutrient availability and variability need to be determined. The objective of this study was to determine apparent metabolizable energy (AMEn) of food waste when fed to broilers. **METHOD**: Food waste was collected for 30 days at Kramer Dining Center (K-State). Those days were split into 4 Food Waste Products. Each product was extruded at 284° F. At hatch, 420 broilers (Ross 708, initial BW 38.4 g) were used in an 18-day study. Broilers were housed in Petersime batteries with *ad libitum* access to feed and water. Broilers were fed a starter diet days 0 to 8, treatments d 8 to 18 with fecal samples collected on d 16-18. Treatments were assigned to 70 pens, resulting in 10 pens per treatment, 6 broilers per pen. Treatments consisted of a common basal diet, 70% basal+30% product 1,70% basal+30% product 2, 70% basal+30% product 3, 70% basal+30% product 4, 70% basal+30% soybean meal, 70% basal+30% extruded soybean meal. **RESULTS**: Analyzed values for products 1-4 were 4.90%, 5.36%, 5.50%, 6.07% crude protein; 76.98%, 76.21%, 77.72%, 74.86% moisture; 5.75%, 7.25%, 6.69%, 8.18% crude fat; 0.36%, 0.38%, 0.47%, 0.66% crude fiber; and 1.10%, 1.56%, 1.39%, 2.31% ash, respectively. AMEn data is being analyzed using SAS 9.4 (Cary, NC). **CONCLUSION**: Future research could look further into using waste as a feed ingredient.

Relevance of Research to State-Related Topic(s)

When food waste is left to decompose in landfills this process contributes to greenhouse gas emissions, water pollution and other environmental impacts. In the Environmental Protection Agency's Food Recovery Hierarchy using food to feed animals and livestock is the next most preferred method of use after feeding people. Implementing the process created in this research project would create jobs for the Kansas workforce as employees would be needed to pick food waste up from pick up sites to transport to a processing facility. Utilizing food waste would also help conserve our natural resources and prevent it from contributing to water pollution and greenhouse gases mentioned earlier.

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INFLUENCE OF GRADED LEVELS OF MICROBIALLY ENHANCED PROTEIN ON NUTRIENT DIGESTIBILITY OF EXTRUDED CAT FOODS

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BACKGROUND AND PURPOSE: Microbially enhanced protein (MEP) from soybeans is a fermented ingredient believed to promote nutrient utilization. The objective of this study was to determine the effect of increasing levels of MEP on nutrient digestibility of extruded cat food. METHOD: Four extruded dietary treatments differing by level of MEP in exchange for soybean meal (15%; SBM) at 5, 10 and 15% (5MEP, 10MEP and 15MEP, respectively) were randomly assigned to 12 individually housed adult domestic shorthair cats (6 castrated males and 6 spayed females) of similar age (0.9 ± 0.23 months) and body weight (4.35 ± 0.87). The study was designed as a 4 × 4 replicated Latin square with 9-day adaptation followed by 5-day total fecal collection for each period. Data were analyzed using a mixed model through SAS Treatment means were separated by Tukey's test. **RESULTS/FINDINGS**: The 15MEP increased fecal moisture content ($P < 0.05$) while 5MEP and 10MEP made no difference compared to SBM. No differences were observed for food intake, fecal dry matter output, fecal score, fecal pH or apparent total tract digestibility of dry matter, organic matter, crude protein or gross energy for MEPs compared to SBM. However, crude fat digestibility of cats fed 5MEP was lower ($P < 0.05$) than cats fed with10MEP and 15MEP but not different from cats fed with SBM.
CONCLUSION: These results suggest that MEP did not have adverse effects on nutrient digestibility when added to extruded diets at up to 15% in healthy adult cats.

Relevance of Research to State-Related Topic(s)

Kansas and this region has a very significant presence in the pet food manufacturing industry. This study aimed to explore beneficial ingredients for pet food industry. We tested microbially femented soybean meal in a search for processing solution to make pet food more sustainable as well. Tons of by-products from human food industry are wasted every year which could have been used in pet food. Proper processing methods would make them more costomer-acceptable and more nutritionally valuable. Meanwhile, there is growing demand on vegan pet food. This study is also part of the exploration in the effect of a micobially fermented plant-derived protein ingredient on cats, which may be helpful with developing complete and balanced vegan cat food in the future to promote both human and animal walfare.

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GRAIN SORGHUM AS A SUSTAINABLE INGREDIENT IN AQUATIC FEED – GRINDING AND PROCESSING ENERGY STUDIES

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BACKGROUND AND PURPOSE: In aquatic feed manufacturing, requirements for sustainable ingredients and processing methods are emerging. This research focused on grain sorghum as a sustainable carbohydrate ingredient in aquafeed and studied process sustainability through grinding efficiency and energy inputs. **METHOD**: Grain sorghum was ground through 3 hammermill screens (1.27, 1.02 and 0.61 mm) to obtain different particle sizes. Ground sorghum was incorporated into nutritionally balanced diets formulated for shrimp and tilapia and processed through a pilot-scale single-screw extrusion system to produce sinking and floating feed, respectively. **RESULTS/FINDINGS**: As particle size of diets decreased, extruded tilapia feed expansion increased and bulk density decreased (433 to 354 b/L), while energy requirement of the process increased (273 top 335 kJ/kg) leading to improvements of pellet quality aspects including water stability and durability. Higher preconditioner steam loss was observed with lower particle size of raw diets. Increase of thermal energy input into shrimp feed in the preconditioner led to decrease in expansion ratio of pellet from and very little change in bulk density and no noticeable improvement in quality. **CONCLUSION**: Higher grinding intensity for grain sorghum improved tilapia feed quality at the expense of higher energy requirements and greater steam loss. Thermal energy input during extrusion did not have a noticeable impact on shrimp feed quality. In optimization of aquafeed procesing, quality improvements should be weighed against process sustainability criteria such as energy input and losses. This data will be useful for feed processors to meet sustainability goals within their organization and future regulations in the aquatic feed industry.

Relevance of Research to State-Related Topic(s)

3 billion people consume 20% of their daily protein intake through seafood. By 2030, two-thirds of global seafood will be based on aquaculture, and production of aquatic animals such as shrimp and tilapia will double. This rapid growth is important to meet protein needs of a projected population of 8.6 billion. The role of processed feed in aquaculture, with quality attributes such as palatability, nutrition, digestibility, water stability and cost effectiveness, is also keeping pace with this trend. Another important trend in aquaculture industry is sustainability. Grain sorghum is a very important crop in Kansas. It is one of the most sustainable of all cereals, requiring less water and other inputs to grow. This study used grain sorghum as the primary carbohydrate source in production of aquafeed. Increased use of this crop in aquafeed applications, which are higher value than other animal feeds, would bring economic benefit to Kansas growers.

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FECAL MICROBIOME OF CATS WAS MAINTAINED WHEN FED DIETS CONTAINING CORN FERMENTED PROTEIN

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BACKGROUND AND PURPOSE: Co-products from the ethanol industry may provide high-quality sustainable protein sources for pet foods. Unlike traditional co-products, corn fermented protein (CFP) contains a yeast component which may provide additional benefits. The objective of this study was to determine the effects of CFP on fecal microbiome in cats. **METHOD**: The four experimental diets included a control with no yeast (CON) and diets containing either 3.5% brewer's dried yeast (BDY), 17.5% distiller's dried grains with solubles plus 2.5% brewer's dried yeast (BDY+DDGS), or 17.5% CFP (CFP). Diets were fed to adult cats (n = 11) in an incomplete 4 x 4 replicated Latin square design. Cats were adapted to diet for 9 days followed by a 5-d fecal collection. Fresh fecal samples (n=44) were analyzed by 16S rRNA gene pyrosequencing. Community diversity was evaluated in R (v4.0.3, R Core Team, 2019). Relative abundance data were analyzed within the 50 most abundant operational taxonomic units (OTU) using a mixed model (v9.4, SAS Institute, Inc., Cary, NC) with treatment as a fixed effect and cat and period as random effects. RESULTS/FINDINGS: Predominant phyla were Firmicutes (65.2%), Bacteroidota (25.2%), Actinobacteriota (8.4%), Proteobacteria (0.64%), and Desulfobacterota (0.55%). There were significant ($P<0.05$) shifts in predominant phyla among treatments with BDY+DDGS resulting in the lowest relative abundance of Firmicutes and Actinobacteriota and highest in Bacteroidota. Alpha-diversity indices (Observed, Chao1, Shannon, Simpson) and beta-diversity metric (principal coordinate analysis) were similar for all treatments. **CONCLUSION**: This data indicates that CFP did not alter the intestinal health of adult cats over a 14-d period.

Relevance of Research to State-Related Topic(s)

One-fourth of all protein raised and harvested in the US is consumed by dogs and cats. Combined, dogs and cats in the US are the 5th largest protein consuming "country" in the world because pet food is commonly formulated based on consumer demand rather than nutritional requirements, resulting in a less sustainable food system. The inclusion of corn fermented protein (CFP) into pet food could improve sustainability by eliminating direct competition with the human food supply, reducing human food waste, and decreasing the overall carbon footprint. However, it must first be evaluated regarding potential effects on animal health before it is an accepted ingredient among pet owners.

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EVALUATION OF FERMENTABILITY OF WHOLE SOYBEANS AND SOYBEAN OLIGOSACCHARIDES BY A CANINE *IN VITRO* FERMENTATION MODEL

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BACKGROUND AND PURPOSE: The level of whole soybeans (WSB) has been restricted to low in pet foods due to their significant content of total dietary fiber and oligosaccharides (OS). However, these components have recently been recognized as prebiotics which are fermented by microflora in the colon in humans. Fermentation of dietary fiber yields short-chain fatty acid (SCFA), which can be used as an energy source to intestinal cells and are beneficial for gut health. The hypothesis was that WSB may behave as beneficial fermentable substrates in dogs. The objective of this study was to determine the effect of WSB oligosaccharides on *in vitro* fermentation using dog feces as inoculum. **METHOD**: Experimental treatments included total dietary fiber residues from WSB, soy OS, and selected fiber sources used in pet foods. Fresh fecal samples were collected from three beagle dogs. Test tubes containing fiber sources and the inoculum were incubated for 1, 2, 4, 8, and 12 hours at 39 °C. Organic matter disappearance (OMD), pH, and SCFA were determined. The data were subjected to ANOVA using the general linear model procedure (SAS, v 9.4). **RESULTS/FINDINGS**: Soybean OS were highly fermentable ($P < 0.05$) and produced high ($P < 0.05$) concentration of butyrate. **CONCLUSION**: WSB may be an alternative to beet pulp, a prominent fiber ingredient in dog foods. They may be used as prebiotics for dogs producing beneficial fermentative profiles in the gut. Future animal feeding studies are needed to determine the appropriate dose of WSB in food for dogs to achieve optimal benefits.

Relevance of Research to State-Related Topic(s)

The research was funded by Kansas Soybean Commission. With a better understanding of the effects of whole soybeans (WSB) on dogs, we can feature positive attributes of WSB for the pet food market. Soy oligosaccharides had the potential as prebiotics in dogs suggesting that in addition to being a protein and fat rich ingredient it also is a valuable fermentative fiber source that aids gut health. Regarding the size of the pet food market ($42 billion, 2021), an increase in the use of WSB in pet food as prebiotics will positively impact plant and animal health, economic development, and job creation in Kansas. Further, the effect of beneficial short-chain fatty acids such as butyrate is known to prevent cancer in humans. Increasing the interest in utilizing dietary fiber, which lowers obesity and diabetes, within WSB will derive substantial economic value to Kansas.

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SAFETY OF WILD-CAUGHT *MUSCA DOMESTICA* FOR USE AS PROTEIN SUPPLEMENT IN CHICKEN FEED

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BACKGROUND: Protein feedstuffs are a necessary, yet often expensive, additive to chicken diets and most often consist of soybean meal in the United States. To alleviate the expenses for producers as well as the carbon footprint of the soybean industry, houseflies (*Musca domestica*), can be utilized as an alternative source of protein. Previous studies show that houseflies are abundant in animal agriculture operations but also act as mechanical vectors for disease-causing pathogens. We hypothesize that wild-caught flies, treated with heat, are safe for consumption without losing nutritional value. **METHODS**: Fly samples collected from both dairy and chicken operations were assigned to a treatment group as control (no treatment), pulverized and dried, or pulverized and heated. Subsets of flies from each location were also tested for microbial pathogens. Treatments were then plated to measure microbiological growth. Subsets of the treatment groups were also sent to a nutrition laboratory for analysis. **RESULTS**: The results demonstrated major reductions in bacterial growth from control to dried or heated flies, respectively. Nutritional analysis results indicated no significant reductions in available crude protein for the treated samples. **CONCLUSION**: The disinfection methods used are a simple and easy way to reduce the pathogen load of samples without damaging the overall nutritional value. Additional pathogen and toxin testing will need to be done to further explore the safety.

Relevance of Research to State-Related Topic(s)

Agriculture, especially animal agriculture, represents a large part of the Kansas economy. A pest that is found in swarms on animal agricultural operations are domestic houseflies. Not only are these flies pests, but they also act as mechanical vectors by which disease can be spread. By developing methods of harvesting and disinfecting these flies, this project will directly benefit Kansas producer by providing them with an affordable new source of protein for agricultural animals such as chickens, which will reduce their cost of feed, as well as reduce the number of flies on their operations.

GROUP 4

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EVALUATION OF WHEAT KERNEL AND FLOUR QUALITY AS INFLUENCED BY CHLORINE DIOXIDE GAS TREATMENT

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BACKGROUND AND PURPOSE: Increasing genetic-based resistance to widely used fumigant phosphine among stored-product insect species poses an inherent risk of losses in grain supply. It is critical to find potential fumigant alternatives that could effectively control stored-product insects without negatively affecting final product quality once phosphine is no longer effective. Chlorine dioxide (ClO_2) gas, known for its high oxidation and penetration capacity, is a potential alternative fumigant to control stored-product insect pest population. METHOD: In the present study, wheat kernels were exposed to varying levels of gaseous ClO_2 concentrations (200, 300, 400, and 500 ppm) and held in a gas-tight bucket assembly for 24 h after achieving desired concentration. Three vials containing 20 unsexed adults of lesser grain borer (*Rhyzopertha dominica*) were placed at top, middle, and bottom layers of wheat mass during fumigation for insect mortality assessment. ClO_2-treated and untreated wheat kernels were milled into straight-grade flour using Chopin mill for flour quality analysis. **RESULTS/FINDINGS**: ClO_2 gas treatment achieved complete insect mortality at 500 ppm across all vial locations. Significant reduction in germination rate and pH was observed at 300-500 ppm and 500 ppm treatments, respectively. ClO_2 gas treatment increased brightness of wheat flour samples. No difference was observed on dough behavior properties and pasting properties. **CONCLUSION**: Overall, ClO_2 gas treatment at 500 ppm is effective in killing adult lesser grain borers without negatively affecting wheat flour quality parameters but affects wheat kernel viability. ClO_2 gas is a potential alternative to phosphine in reducing insect pest population in stored wheat grains.

Relevance of Research to State-Related Topic(s)

In 2021, Kansas is the leading wheat producer among all U.S. states with a total wheat harvest of approximately 364 million bushels. It is an integral part of Kansas' economy and workforce as it contributes about $1.5 billion in output and about 3800 jobs according to the Kansas Department of Agriculture IMPLAN economic model. A huge threat to wheat grain supply is the occurrence of insect infestation and its increasing resistance to commonly used fumigants, which contribute to stored wheat losses and contamination. Further research in ClO_2 gas as a potential alternative to phosphine in wheat fumigation will help Kansas reduce postharvest wheat losses and meet its growing demand at the local and international markets. Our results will help in determining ClO_2 gas concentrations that can effectively kill the most damaging insect pest, lesser grain borer, usually found during wheat storage and transportation without negatively affecting its final product quality.

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SALMONELLA LOAD REDUCTION IN WHEAT BY ACIDIC WATER TEMPERING AND HEAT TREATMENT

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BACKGROUND AND PURPOSE: Over the last decade, there have been numerous outbreaks and recalls related to *Salmonella*- contaminated wheat flour and flour based products. To address this emerging hazard, effective antimicrobial pre-milling interventions are needed. This research aimed to assess the survival of four different *Salmonella enterica* serovars on wheat during different tempering (hydration) treatments. METHOD: Hard red spring (HRS) wheat kernels were inoculated with *Salmonella* and rested for 24h at ambient temperature. Wheat kernels were then temperd to 17% moisture with sodium bisulfate (SBS), lactic acid (LA), or citric acid (CA) solution (5% w/v) and were held at 25^{o}C or 55^{o}C (mild heating).Wheat kernels tempered with sterile water was maintained as control. **RESULTS**: The findings demonstrated that after 24h of treatment, tempering wheat with acidic water alone reduced the *Salmonella* load by 1.76 log CFU/g for CA and 1.9 log CFU/g for both SBS and LA. Heat treatment (55^{o}C) alone significantly reduced the *Salmonella* load below detection limit after 18h of treatment while combining acidic water tempering with mild heating resulted in greater reduction at shorter tempering times as *Salmonella* was reduced by ~4.0 log CFU/g after 6h for LA and 12h for both SBS and CA. **CONCLUSION**: Tempering wheat with acidic water solutions alone or in combination with mild heating are highly effective in reducing *Salmonella* load of wheat compared to tempering with water alone. The findings from this study can be used to develop preventive controls that address pathogen contamination in wheat milling which would help improve the food safety of wheat flours.

Relevance of Research to State-Related Topic(s)

Wheat flour could contain enteric pathogens such as *Salmonella* which can cause serious health consequences when eaten by consumers. In the past years, there have been 14 recalls initiated for wheat flour or wheat flour based products in the United States due to *Salmonella* or *E. coli* contamination with several contaminated products traced back as the root cause of foodborne illness outbreaks. These issues present a signficant economic burden to millers and a public health threat to consumers. The presented research focuses on developing interventions that could esure microbiological safety without adversely affecting the product quality; these can prevent the introduction of pathogen contaminated flours into the market which could lessen the risk of recalls, and illness outbreaks linked to wheat flours in the future.

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UTILIZING PROTEIN FUNCTIONALITY INFORMATION TO TAILOR QUALITY OF PLANT-BASED MEAT ANALOGUES

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BACKGROUND AND PURPOSE: Plant-based meat has recently grown significantly in popularity. Plant-protein is extruded to form texturized vegetable protein (TVP), which is combined with other ingredients to form patties and nuggets. Obstacles include consumer acceptance of flavor and texture differences from animal protein. Different plant protein sources (soy, pea, wheat) create distinct product textures. This research aimed to identify and successfully manipulate these differences to reach a desired texture goal. **METHOD**: Plant protein sources were analyzed to determine gel-forming ability when mixed with water. These results were used to formulate for 3 different texture objectives (soft, medium, and firm). To create a meat analogue that is softer in texture, a room temperature gelling ability is desired, while a heat induced gelling ability should lead to a firmer product. **RESULTS/FINDINGS**: TVP bulk density was higher for treatments targeting a firm product (274 g/L, 287 g/L) than those targeting a soft (160 g/L, 223 g/L). Softer textures exhibited structures that were flaky and gel-like. Firm treatments showed a more layered structure, while medium textures were airy and sponge-like. Soft treatments produced a lower hardness (1154 g) than the firm targeting treatments (2231 g) as expected, although there was a large standard deviation for each. **CONCLUSION**: It is important to consider texture when creating plant-based meat. Fish is much softer and flakier than chicken breast, and as such requires a different TVP formulation. By increasing knowledge of how protein functionality affects meat analogue texture, time and money can be saved and the quality of these products can be improved.

Relevance of Research to State-Related Topic(s)

The food industry has undergone a plant-based revolution in the past few years and plant-based meat analogues specifically have been growing rapidly in popularity. This arises from a growing consumer demand for protein as global population increases, and increased awareness of sustainability and the need for eco-friendly processing. Plant-based protein offers a more direct food source that can skip the livestock production portion of meat processing. By diverting Kansas crops such as wheat and soybeans directly into plant-based meat alternatives, the utilization of these ingredients is improved, and more nutritional protein is yielded per acre of crops while also decreasing the cost, time, land, and water needed to raise more livestock. Plant-based meat will not replace current livestock production but supplement the industry to meet the growing demand and give Kansas farmers an opportunity to turn their crops into high value protein products.

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THERE'S A PHOTON IN MY WATER! THE APPLICATION OF ULTRAVIOLET LIGHT TECHNOLOGY TO ENHANCE THE SAFETY OF AGRICULTURAL WATER ON KANSAS FRESH PRODUCE FARMS

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INTRODUCTION: Ultraviolet (UV) light-based water treatment systems are an increasingly investigated alternative to chemical sanitizers for agricultural surface water disinfection as they are highly effective, user-friendly, and do not produce toxic by-products. However, there are relatively few studies demonstrating the practical use of UV light for on-farm agricultural water treatment applications. **OBJECTIVE**: The objective of this project was to test the efficacy of two commercial UV devices to reduce the population of *E. coli* in agricultural water. **MATERIALS AND METHODS**: An on-farm study using three agricultural water sources was performed to determine the efficacy of the Minipure MIN-9 (1-9 gallons per minute (GPM), 1.34-gallon capacity) and SARIN (1-130 GPM, 4.75-gallon capacity) UV systems in natural agricultural water. Colilert with Quanti-tray/2000 (LoD 1 MPN/100mL) methodology was used to enumerate the surviving *E. coli* population after treatment at flow rates of 6, 7, and 9 GPM. RESULTS: The efficacy of the devices was dependent on the device ($p<0.0001$), source ($p<0.0001$), and the observed transmission ($p<0.0001$). The SARIN UV system was more effective in reducing the population of *E. coli* in agricultural waters with a high concentration of UV-absorbing particulate matter (<30 %UVT). The Minipure MIN-9, however, required a lower capital investment for installation, maintenance, and operation. **SIGNIFICANCE**: These results demonstrate the efficacy of UV light for reducing the microbial risk of agricultural water. Further studies are needed using different UV devices, flow rates and transmissions to develop guidance on using the UV technology for conventional or hydroponic produce growers.

Relevance of Research to State-Related Topic(s)

Although Kansas is a primarily grain-growing and cattle-rearing state, the contribution of the specialty crop industry to the local and state economy is growing, opening the door for opportunities for job creation, education, and supporting youth involvement in agriculure. However, recently published studies indicate that fresh produce growers may be struggling with ensuring the microbial quality of their agricultural water sources. With recent outbreaks linked to contaminated agricultural water in other regions of the United States, it is critical to the Kansas fresh produce industry that growers have access to information on agricultural water treatment options. This project could support the efforts of HB2321 – Standards for use of graywater (in agriculture) and HB2295 – Water pollution control permits.

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EFFECT OF INNOVATIVE LASER-LABELING TECHNOLOGY ON FRESH PRODUCE QUALITY AND SAFETY

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BACKGROUND AND PURPOSE: Improved traceability in the supply of fresh horticultural produce is crucial in managing foodborne disease outbreaks. Horticultural produce are traditionally labeled with price lookup (PLU) stickers. However, those stickers risk losing information if they get detached and are not environmentally friendly. The CO_2 laser labeling technology (LLT) is a novel method of produce labeling. However, the performance of this technology varies from produce to produce, and information on its effects on postharvest quality and microbial safety is unknown. The objectives of the study were to: investigate the impact on postharvest quality and microbial safety of laser marking on fresh horticultural produce. **METHOD**: Three horticultural produce, apple 'Red Delicious', cucumber, and green bell pepper, were procured from a local grocery store. In study 1, each produce was printed with a Quick Response (QR) code or text code using the laser engraver machine, followed by applying different edible wax. In study 2, different laser-labeled produce was accessed for microbial contamination through the artificially inoculated rifampicin resistance *E.coli*. **RESULTS**: Fresh weight loss for laser-printed produce was higher than the nontreated control, but no difference in visual quality ratings was observed compared to the control. The population of rifampicin-resistant *E.coli* was statistically higher in all three produce labeled with text code compared to nontreated control; however, QR-coded treatments were similar to control. **CONCLUSION**: Laser labeling technology could potentially be used in commercial applications to improve traceability in selected produce.

Relevance of Research to State-Related Topic(s)

Increasing food safety from farm to fork through improved traceability is the overall goal of this project. Fresh horticultural produce is commonly associated with foodborne disease outbreaks and food recalls. Improved traceability is very crucial in managing foodborne disease outbreaks. Fresh horticultural produce are traditionally labeled with price lookup (PLU) stickers. However, those stickers are environmental contaminants due to the use of plastic and glue. Also, frequent detachment of PLU stickers losses the information for traceability. The CO_2 laser labeling technology (LLT) is a novel method of producing labeling. The research result shows that the LLT has the potential as a better alternative to the PLU stickers because they are environmentally friendly and provide permanent labels. Hence, the findings of this study suggest that when used at an industrial scale, this technology could help Kansas produce industry to improve fresh horticultural produce traceability.

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IMPACT OF CRICKET PROTEIN POWDER ADDITION ON WHEAT DOUGH PROPERTIES AND BREAD QUALITY

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BACKGROUND AND PURPOSE: Use of alternative protein sources have become more popular due to a continuing rise in population, environmental concerns, and a shift in consumers' demands for eating more sustainable foods. As an emerging novel protein source, insect proteins, provide many benefits such as requiring fewer resources compared to the traditional raising of livestock and having lower greenhouse gas emissions than beef, poultry, and pork. However, not much research has been done on their incorporation into food formulations. This study aimed to see how the incorporation of cricket protein powder would affect the dough properties and the quality of wheat bread. **METHOD**: Two commercially available cricket protein powders, Entomo Farms (E) and GrioPro (G) were first characterized for their functional properties by evaluating protein solubility and water holding capacities. 10 or 20% incorporations of E and G into wheat doughs were evaluated for dough development properties, dough extensibility, and change in wheat protein composition in the doughs. Breads containing 5, 10, or 20% inclusions of E or G underwent color, texture, and staling analysis. **RESULTS/FINDINGS**: Processing differences led to different cricket protein functionalities which in turn resulted in differing effects on both the dough properties and final bread quality. The incorporation of G led to stronger, more stable doughs with higher water absorption. Dough extensibility and loaf volume decreased at high E and G inclusion levels. **CONCLUSION**: Low incorporations of cricket protein powders into bread are feasible. Higher inclusion levels cause the production of dense bread that is not on par with consumer standards.

Relevance of Research to State-Related Topic(s)

The Food and Agriculture Organization of the United Nations (FAO) estimates the world population to reach 9 billion by the year 2050. The use of insect proteins in food can help meet this continuing increase in demand for food while also providing some economic incentives. Insects can be fed on organic side- streams thus allowing for the conversion of low-value organic byproducts into high-value energy sources. The selling of these organic byproducts would offer additional revenue to Kansas businesses and farmers. Furthermore, the establishment of insect farms would also allow for the creation of jobs in KS. Farming insects are also more sustainable for the environment and require fewer resources which would help to ensure future generations have enough resources to thrive on.

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COMPREHENSIVE UNDERSTANDING OF ROLLER MILLING ON THE PHYSICOCHEMICAL PROPERTIES OF RED LENTIL AND YELLOW PEA FLOURS

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BACKGROUND AND RESEARCH: The development of convenience foods by incorporating nutrient-rich pulses such as peas and lentils will tremendously alter the future of pulse and cereal industries. However, these pulses should be size-reduced before being incorporated into food products. Therefore, an attempt was made to adapt roller mill settings to produce de-husked yellow pea and red lentil flours. **METHOD**: The milling flowsheets unique to yellow peas and red lentils were developed to produce small, medium, and large flours with maximum yield and flour quality. This study also investigated the differences in chemical composition, physical characteristics, and particle size distributions of the resultant six flour fractions. **FINDINGS**: Overall, the mill settings had a significant effect on the physical properties of different particle-sized flours. The geometric mean diameters of different particle-sized red lentil flours were 56.05 µm (small), 67.01 µm (medium), and 97.17 µm (large), while for yellow pea flours they were 41.38 µm (small), 60.81 µm (medium), and 98.31 µm (large). The particle size distribution of all the flour types showed a bimodal distribution, except for the small-sized yellow pea flour. The chemical composition of the flour types remained practically the same for different-sized flours, fulfilling the objective of this current study. **CONCLUSION**: The findings of this study assist the wheat millers to adapt yellow pea and red lentil milling technologies with minor modifications to the existing facilities. The study also helps in boosting the production of various baking products using pulse and wheat flour blends to enhance their nutritional quality.

Relevance of Research to State-Related Topic(s)

Kansas is the largest wheat producing state contributing to almost $1/5^{th}$ of the total wheat produced in the U.S. To understand the scale, in simple terms, the wheat produced in Kansas alone can provide each individual on earth with six loaves of bread. A standard and widely used method for producing wheat flour is roller milling. Hence, altering the roller mill settings to produce nutrient rich pulse flour is the best and most economic opportunity for wheat millers, as they could use the existing wheat-milling equipment to produce pulse flours as well avoiding the burden of initial capital investment. Therefore, by optimizing a standard protocol for optimal pretreatments and mill settings for these pulses will help in scaling up the pulse milling process industrially. This will open up many opportunities in terms of economic development, food security, and health.

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DEPLOYMENT OF INSECTICIDE-TREATED NETTING TO IMPROVE FUMIGATION EFFICACY IN BULK STORAGE AT KANSAS FOOD FACILITIES

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BACKGROUND: Insecticide-treated netting has successfully been used to impair mobility and prevent infestation by stored product beetles after harvest. Understanding how to integrate insecticide netting with existing integrated pest management (IPM) tactics at food facilities can improve the protection of commodities while increasing sustainability. One key tactic used is phosphine fumigation. **METHOD**: In our study, 60 perforated buckets were filled with 500 g of uninfested wheat. Buckets were protected by insecticide-treated netting (with 0.3% α-cypermethrin, BASF), control netting (untreated – without insecticide), or no netting (negative control). Half of each treatment was randomly assigned to a fumigation treatment, while the remainder were not fumigated. Monthly samples of 100 g of grain from four buckets from each control or treatment were taken and coincided with additional releases of insects to supplement natural populations. Insect life stages were sieved and recorded, while grain quality measures were evaluated. Based on the Federal Grain Inspection Service defect guidelines, if the tolerance was met in any bucket during the month, fumigation was triggered for those assigned to that treatment. We recorded and compared the length of protection by each fumigation, as well as the number of fumigations that are required by treatments with and without netting. **RESULTS**: Overall, we found that buckets with insecticide-treated netting had less insect infestation and required fewer fumigations compared to the negative control. **CONCLUSION**: Our results demonstrate that insecticide-treated netting can be used for effective IPM programs to enhance the efficacy of existing tactics such as phosphine fumigation.

Relevance of Research to State-Related Topic(s)

Agriculture accounts for over 40% of the total economy in Kansas, and post-harvest industry is a key part of this. As agriculture commodities move along post-harvest supply chain, insects can readily attack at each link from farm to fork. Insect damage causes economic losses by reducing quality and quantity of food. Therefore, it is critical to develop effective pest management strategies to mitigate losses. Phosphine is the most common fumigant for stored products, and 60–80% of insect populations in Kansas are resistant to this fumigant. So, it is important to develop diversified pest management programs for post-harvest supply chain. Our studies have found that the use of insecticide netting decreases the number of fumigations and increases their efficacy in bulk storage. It may therefore be used as a new, highly effective tool to reduce the food loss caused by these stored product insects and contribute to global food security.

GROUP 5

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SIRE DISTRIBUTION OF CALVES IN A HERD WITH USE OF FIXED TIME ARTIFICIAL INSEMINATION FOLLOWED BY IMMEDIATE BULL EXPOSURE FOR NATURAL SERVICE

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BACKGROUND AND PURPOSE: Use of fixed time AI (FTAI) followed by immediate exposure of females to bulls for natural service can be a useful management strategy for commercial cow-calf producers to limit labor and time related to bull turnout and increase pregnancy rates earlier in the breeding season. Considering bull fertility and time to and length of estrus in females, expectations for outcomes in natural service sire versus AI sire parentage is unknown. Our objective was to determine relative percentages of calves sired by either a natural service or FTAI sire within the same estrous period. **METHOD**: During two consecutive years, heifers and cows were synchronized and inseminated using the 7-day CO-Synch + CIDR FTAI protocol. All females were exposed to natural service bulls immediately following insemination. After calving, DNA was collected from a random subset of calves (Calves born from heifers in Year 1 = 59 and Year 2 = 82; calves born from cows in Year 1 = 89, Year 2 = 102) for parentage analysis. **RESULTS**: In Year 1**,** calves born from heifers in the first 21 days of the calving season, 5.1% (n=3/59) were sired by natural service. Calves born from cows was 14.6% (n=13/89) were sired by natural service. In Year 2, calves born from heifers, 9.8% (n=8/82) were sired by natural service, whereas calves born from cows, 20.6% (n=21/102) were sired by natural service. **CONCLUSION**: If commercial producers use FTAI with immediate bull exposure the proportion of calves sired by natural service bulls may be greater in cows than heifers.

Relevance of Research to State-Related Topic(s)

Beef cattle production is a significant contributor to the Kansas economy. Specifically, the cow-calf producers rely on a yearly calf crop to make their living and contribute back to Kansas jobs and economy. Our research works to help those producers ensure reproductive health and efficiency in their herds. This research investigates methods to improve reproductive efficiency and the overall profitability of Kansas cow-calf producers. Exposing cows to bulls sooner increases the likelihood of more pregnancies earlier in the calving season, helps to synchronize calving, and more efficiently utilizes farm labor. Our research helps find ways for Kansas cow-calf producers to become more efficient and profitable while maintaining herd reproductive health.

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MICROBIAL COMMUNITIES IN THE TROPICAL HORSE TICK, *Dermacentor nitens* (ACARI: IXODIDAE)

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BACKGROUND AND PURPOSE: Ticks are obligate hematophagous ectoparasites and transmit pathogens among various vertebrates, including humans. We investigated the tropical horse tick, *Dermacentor nitens*, which is a natural vector of *Babesia caballi* and *Theileria equi*, causal agents of equine piroplasmosis distributed throughout the Americas. In order to understand microbial communities associated with *D. nitens*, including symbionts and pathogens, we performed 16S rRNA sequencing on samples from three distinct geographical areas in Colombia. METHOD: Partially-fed female *D. nitens* adults were collected from the horses in Bolivar, Antioquia, and Cordoba. DNA was extracted, amplified for ~450 bp V3 and V4 regions of 16S rRNA gene, and sequenced on an Illumina-Hiseq platform. The sequence data were analyzed for microbial taxonomic assignment using the software Mothur, and further statistical analyses were made in R-Studio. **RESULTS/FINDINGS**: The endosymbiont group, Francisellaceae/*Francisella*, was predominant over other bacterial groups in the samples from all regions. Differences in the microbial community composition among the regions were found when excluding the endosymbiont taxa; Francisellaceae/*Francisella*. The most prevalent bacterial genera in different regions were *Corynebacterium* in Bolivar, *Staphylococcus* in Antioquia, and *Pseudomonas* in Cordoba. **CONCLUSION**: We found differences in the abundance of microbial groups among the ticks in different regions. This finding can potentially be used to make regional distinctions among the ticks and their microbial compositions. A deeper understanding of the microbial communities hosted by ticks may allow us to develop strategies to limit transmission of pathogens by the ticks.

Relevance of Research to State-Related Topic(s)

Healthy horses, as important companion animals in the state of Kansas, are part of the culture of the state. Equines are considered sentinels of many emerging and re-emerging diseases. We studied ticks that transmit the pathogens causing important horse diseases. Applying sequencing technology to understand the microorganisms associated with this ectoparasite allowed us to complete a comprehensive survey of the different microorganisms carried by different populations of ticks. Deciphering the interactions between different groups of microorganisms occurs within different tick populations will help in the development of pathogen monitoring tools for early detection, prevention, and control of potential disease outbreaks.

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PARASITIC NEMATODE DIVERSITY IN NORTH AMERICAN BISON (*BISON BISON BISON*) HERDS IN THE U.S.

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BACKGROUND AND PURPOSE: Parasitic nematodes are a significant cause of economic loss in bison production. Composition of parasites infecting bison herds in the U.S. has been understudied for the past few decades. We hypothesized that there is variation of parasitic species from farm to farm and region to region. Old diagnostic techniques are time-consuming, relying on visual identification of parasites. A technique using next generation sequencing of the ITS2 gene has been recently described to identify parasites of bison to the species level. **METHODS**: For this study, fecal samples from 10 bison herds starting in August 2021 through July 2022. We quantified the parasite burden using microscopy, and individual samples with high numbers of parasites were incubated to hatch the nematode eggs. Larvae were harvested after 21 days of incubation. DNA was extracted, and the ITS2 gene was sequenced using next generation sequencing on 50 samples to identify the different species of nematodes and their relative abundance in each animal. **RESULTS/FINDINGS**: We present the parasitic nematode species found in 50 individual bison and the difference of parasitic diversity found from farm to farm and animal to animal. *Cooperia oncophora* and *Ostertagia ostertagi* were found to be the most prevalent species. In large numbers these parasites can be responsible for production losses in bison. **CONCLUSION**: This study demonstrates how deep amplicon sequencing can be used to shed light on parasitic nematode communities within a single animal and within different herds of animals. This knowledge can help in the creation of more effective therapeutics for parasitic infections of ruminants.

Relevance of Research to State-Related Topic(s)

Bison, the state animal of Kansas, are a keystone species which have roamed the prairies for millennia. They are not only economically important but are also culturally significant to indigenous food systems. This study falls within the topic of animal health. Specifically, we have investigated and diagnosed which parasites are affecting bison herds in Kansas and neighboring states, negatively decreasing their production. In the future, the techniques and outcomes of this study will help empower bison producers and indigenous people by helping them make decisions about effective treatments to improve bison health, which in turn will create and improve economic opportunities and rural development.

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SURVEILLANCE OF *ECHINOCOCCUS MULTILOCULARIS* IN COYOTES IN THE MIDWEST UNITED STATES

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BACKGROUND AND PURPOSE: *Echinococcus* spp. are zoonotic tapeworms of wild canids that also infect humans and domestic animals. In the USA, the geographic expansion of sporadic human and animal cases of *Echinococcus multilocularis* infections is driving a need to address the gap in wildlife surveillance of this important parasite. **METHODS**: Coyotes are routinely trapped for fur trading and nuisance control. Carcasses were collected from Kansas (n=2) and Missouri (n=8). Intestinal tracts were removed, frozen at -80°C for at least 7 days, thawed, and then processed by sifting, filtration, and counting technique to identify adult *Echinococcus* spp. Positive samples, were morphologically and molecularly identified using PCR. Evidence of any other intestinal parasites was recorded. **RESULTS/FINDINGS**: Three of the twelve coyote carcasses (KS= 1/2; MO= 2/8) were positive for adult *Echinococcus multilocularis*. All positive samples were morphologically, and molecularly, identified as *E. multilocularis* with sequences closely matching previously published sequences. In addition to *Echinococcus* spp., other common intestinal parasites of domestic dogs were detected. **CONCLUSION**: This is the first description of *Echinococcus multilocularis* in a canid in Kansas and, outside of sporadic case reports, the first systematic description in Missouri. This study shows the expanding known range of *Echinococcus sp.* in the US, warranting our continued surveillance for additional wild canid and rodent hosts in historically non-endemic areas. Infected coyotes, and other wild canids, can serve as a source of infection for domestic dogs and humans alike, posing a growing zoonotic threat given the increasing peri-urban coyote populations.

Relevance of Research to State-Related Topic(s)

Alveolar echinococcosis (AE) is a chronic infection caused by larval stages of *Echinococcus multilocularis* when humans and dogs become accidental intermediate hosts after ingestion of infective eggs. These infections are often fatal, making this parasite a public health risk to both humans and dogs. Of the few *E. multilocularis* surveillance studies in the US, no wild canids were positive in Kansas or Missouri. The appearance of recent domestic dogs cases in Missouri coupled with our three positive wild canids, presses the need to re-evaluate the public health risk this parasite poses to the health of humans, dogs, and wildlife in Kansas. Especially as the country-wide coyote population expands encroaching into suburban and urban areas increases. We need to determine the prevalence of *E. multilocularis* in wild canid and rodent hosts in Kansas as potential sources of infection to humans and dogs.

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ASSESSMENT OF LOTILANER (CREDELIOCAT © AND CREDELIO©) FOR CONTROL OF DOMESTIC ENVIRONMENTAL *CTENOCEPHALIDES FELIS* INFESTATIONS

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BACKGROUND AND PURPOSE: *Ctenocephalides felis*, the "cat flea", is a key disruptor of the human-animal bond. The cat flea is of human and veterinary importance as it serves as a vector for zoonotic diseases such as *Bartonella henselae* and *Dipylidium caninum.* METHODS: In this study, 16 homes in West-Central Florida were enrolled after meeting the criteria of having at least 5 fleas on a cat, 5 fleas on environmental traps over a 16-24 hour period, and no more than 10 total dogs and/or cats in the home. All cats and dogs were treated with oral lotilaner (CredelioCAT © and Credelio©, respectively) on Days 0, 28(+2), and 56(+4) of the study. Environmental flea counts and animal flea counts were performed on Days -1, 7(±1), 14(±2), 28(± 2), 44(± 2), 56(± 2), and 80(± 4). Fleas collected from those homes were tested for *D. caninum* via PCR. **RESULTS/FINDINGS**: Across all 16 homes, there was a 100% reduction in animal and environmental flea counts from Day -1 through Day 80(± 4). A total of 1422 fleas were collected from homes, cats and dogs. These fleas were pooled into groups of three and 8/213 (3.8%) of those fleas tested positive for *D. caninum.* Of homes with fleas, ¼ of the homes had fleas that carried the zoonotic tapeworm *D. caninum.* **CONCLUSION**: This study shows that on-animal treatment with oral lotilaner is effective for eliminating animal and environmental cat flea infestations, serving as a way to further protect pets and pet owners from other zoonotic infections.

Relevance of Research to State-Related Topic(s)

The cat flea is an abundant ectoparasite in the state of Kansas that can cause Flea Allergy Dermatitis among dogs, cats, and humans. This study illustrates that on-animal flea control is effective at eliminating domestic flea infestations. Furthermore, Kansas is a significant state for the human and animal pharmaceutical business. This study serves to illustrate a product that can be utilized by veterinarians and pet owners to improve the human-animal interface.

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ANTIOXIDATION SYSTEM METABOLICALLY REPROGRAMS CELL SURVIVAL AND EXPANSION OF ACTIVATED CD4 T-LYMPHOCYTES

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BACKGROUND AND PURPOSE: CD4 T-lymphocytes (T-cells) are a type of adaptive immune cells that play important roles in host immunity. Recent studies show that cellular metabolism of CD4 T-cells governs their effector functions like activation and expansion. The metabolic byproducts of cellular metabolism like Reactive Oxygen Species (ROS) serve as second messengers of immune responses. The oxidative stress mediated by ROS is regulated by the antioxidation system, composed of Keap1 and Nrf2 proteins. Nrf2 is known to modulate the immune functions yet its role in maintaining CD4 T-cell repertoire and activation-driven expansion is unclear. Our goal is to determine the role of antioxidation systems in activation-driven expansion of CD4 T-cells and the underlying metabolic mechanisms. **METHODS**: We used mice with T-cell specific deletion of Keap1 (Keap1-KO). CD4-T cells from these mice were isolated using magnetic separation method, activated *in vitro* and their responses were compared with wild type (WT) cells. Nutrient dependency of the WT, Keap1-KO CD4 T-cells was tested by performing the *in vitro* activation in media lacking glucose or glutamine and then measuring their expansion by flow cytometry. **RESULTS**: We observed that high Nrf2 (Keap1-KO) relies on glutamine for activation-driven expansion in CD4 T-cells. We further show that increased mTORC1 signaling in high Nrf2 conditions supports glutamine metabolism in activated CD4 T-cells. **CONCLUSION**: Our findings identify a mechanism by which Nrf2 metabolically reprograms CD4 T-cells and modulates their metabolic dependencies to support cell expansion. A better understanding of this immunometabolic antioxidation crosstalk may pave way for new strategies or improve current Nrf2- modulating therapeutics.

Relevance of Research to State-Related Topic(s)

According to American Cancer Society 5,660 deaths were reported in Kansas in 2022 due to different types of cancer. In recent years a huge progress has been made to fight cancer using different types of immunotherapy and drugs. Our findings focus on improving Nrf2-modulating therapeutics because currently, there are 22 registered clinical trials to test the efficacy of various Nrf2 activators for different diseases. However, none of the Nrf2-activators report the mechanisms for maintaining CD4 T-cells homeostasis which play a central role in most pathological conditions like cancer, and autoimmune diseases like colitis, arthritis; therefore, it is highly important to study how Nrf2 activators can modulate these cells. A better understanding of these Nrf2 activators for maintaining our immune health and fighting against these diseases can benefit the entire community and the people of Kansas.

GROUP 5

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LIFE CYCLE CLIMATE PERFORMANCE (LCCP) FOR DROP-IN LOW GLOBAL WARMING POTENTIAL ALTERNATIVES

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BACKGROUND: R134a, a commonly used Hydrofluorocarbon, is used as the refrigerant for many industrial chiller systems. These chillers produce large amounts of carbon dioxide(CO_2) throughout their lifespans. The Life Cycle Climate Performance (LCCP) is a widely accepted metric that allows us to measure the carbon footprint of the chiller system. Looking at existing chiller performance data from AHRI, the aim of this research is to perform a **METHOD**: LCCP analysis to look at the impact of CO_2 emissions when using alternative R134a refrigerants, while maintaining similar chiller performance. Here, the goal is to discuss the feasibility of R134a alternatives in larger industrial chiller systems to fully understand the benefits of refrigerant alternatives. Alternative refrigerants considered were R450a, R513a, R1234ze(E), R516a and fuel sources from Environmental protection agency (EPA) includes Distillate Fuel Oil (DFO), Natural gas, Wind, Nuclear and coal. **RESULTS**: Modelling results showed that using a DFO produces the largest emissions associated with leakage of 53040 Kg and LCCP of 5.48E 11 Kg using R134a as the refrigerant. The lowest energy emission of 1.86E9 Kg CO_2, leakage of 277.9 Kg of CO_2 and LCCP of 3.85E9 Kg was produced using R1234ze(E) as refrigerant and Nuclear as a fuel source. **CONCLUSIONS**: These results show how direct carbon emissions (Energy and leakage terms) can be reduced as they are the two major drivers of emissions. The results from this research will help refrigerants manufacturer understand the benefits of using less CO_2-emitting refrigerants on mitigating climate change.

Relevance of research to state-related topics

Changing weather patterns, drought, wildfire amongst others are some of the aftermath of climate change. These mammoth conditions pose as a threat to the agricultural capability of any region. Kansas been a major agriculture producing state is not out of this discussion. According to earth.org, It is listed among the top 10 states with the most polluted rivers and streams. Also, states with the highest number of acres (163,982 acres) burned by wildfire in 2020 and 2021 respectively. These have adverse effects on the mainstay of the state and also on the health of its populace. The major outlook of this research is to reduce emission of CO_2, a major greenhouse gas, using alternative low Global warming potential refrigerants thereby abating climate change effects.

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INVESTIGATING THE EFFECTS OF FAST NEUTRON IRRADIATION ON ADDITIVE MANUFACTURED METALS

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BACKGROUND AND PURPOSE: Advanced materials are in demand from the US Department of Energy for making Generation IV nuclear reactors. New reactor designs aim to meet increased energy demands using sustaniable methods, safety and cost-effectiveness. Fabrication of complex structures for these reactors using traditional machining processes presents several challenges. Additive Manufacturing (AM), or 3D printing, is a new means of fabricating near-net-shaped, metallic components with reduced waste. The aim of this research is to compare the mechanical properties of AM and conventionally-built metals before and after neutron irradiation to expedite material qualification efforts. **METHOD**: In this study, samples made of two nickel superalloys namely Inconel 625 (IN625) and Inconel 718 (IN718) were fabricated using the laser powder bed fusion (L-PBF) AM process. These samples were irradiated using fast neutrons for 7 and 17 weeks. The mechanical properties of all samples were examined by measuring hardness before and after irradiation. **RESULTS/FINDINGS**: Results indicate that AM specimens are less prone to radiation hardening defects relative to their wrought counterparts. After irradiation, AM IN625 showed only a 1% increase in hardness. Whereas, conventionally-manufactured IN625 showed a ~5% increase in hardness. On the contrary, almost all IN718 specimens experienced little change in hardness indicating this alloy's ability to resist neutron-sourced damage. **CONCLUSIONS**: This research provides the much needed data indicating the structural integrity of AM and wrought components when exposed to same type and dose of nuclear radiation. Results should boost confidence levels for adopting AM for building nuclear reactor components which perform the same or better than conventionally-manufactured components.

Relevance of Research to State-Related Topic(s)

As per 2021, nuclear energy accounted for 15% of electricity generation in Kansas. There is one nuclear power plant in Kansas called Wolf Creek Generating Station, which is coowned by KCP&L, Westar and KEPCo. Many nuclear reactors in the US including the Wolf Creek reactor face issues of manufacturing of complex reactor core components with high structural integrity under harsh radiation environments. Production of complex nuclear reactor structures via conventional machining is challenging. This research can be discussed with House committee of Energy and Environment to comprehend that AM can serve as an alternate manufacturing process to build current and future reactor components that has similar or superior mechanical properties compared to conventional machined components. AM build components can improve the life cycle and safety level of the reactors resulting in more reliable generation of electricity. It can also provide advantage of replacing the in-service components with AM components.

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A SELF-ASSEMBLED RECOMBINANT PROTEIN COATING PLATFORM FOR CALCIUM ION SENSING

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BACKGROUND AND PURPOSE: Proteins are functional building blocks that are beneficial for the fabrication of biological materials. Functional protein-based coating materials have been investigated in broad technological applications. However, most coating fabrication requires laborious multi-step procedures with chemical modification and organic solvent under high pressure and temperature. In this study, we demonstrate a facile protein coating method based on layer-by-layer deposition through the self-assembly of engineered proteins with genetically programmed functionality. **METHOD**: We expressed and purified recombinant proteins from a bacterial culture, and fabricated the coatings on the glass substrates through the programmed protein self-assembly. After the inclusion of fluorescent proteins, we measured the fluorescence intensity to optimize the number of coating cycles. Then, we tested the coating formation on polymers and aluminum substrates and confirmed comparable robustness and stability. We further expanded this system for calcium ion sensing by incorporating genetically modified calcium indicators. **RESULTS/FINDINGS**: We achieved protein coating formation with a high density and stability while varying the time for protein incubation. We also confirmed the visibility of the coating method for various substrates and microstructured substrates such as microneedles. Using the calcium sensor coating, we could measure the concentration of calcium ions with a detection limit of 10nM. **CONCLUSION**: We developed a platform of engineered protein coatings with programmable functionality. This platform can be applied to various types of substrates and genetic programming of functions. We anticipate that the calcium sensor protein coating platform would enable point-of-care application for detecting calcium-related diseases such as cancer-related hypercalcemia.

Relevance of Research to State-Related Topic(s)

A goal of the Kansas Cancer Prevention and Control Plan of the Department of Health and Environment is the early detection and diagnosis of cancer. All currently available methods for cancer diagnosis require either expensive tests or an excisional biopsy by a professional staff, limiting a fast and inexpensive diagnosis of cancer. This research will contribute to the technology development for the detection of hypercalcemia associated with early-stage cancer. This platform will provide a method to develop a rapid self-diagnostic cancer test platform and enable early cancer diagnosis to be available to the public at a reasonably low cost. The development of a self-diagnostic test based on this research will offer great promise to reduce the cost of healthcare and improve the public health of Kansas.

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WINTER WHEAT YIELD PREDICTION USING SATELLITE IMAGERY BY INCORPORATING WEATHER AND MANAGEMENT AT FIELD SCALE IN KANSAS.

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BACKGROUND AND PURPOSE: Accurate prediction of winter wheat yield at the field scale is critical to addressing crop production challenges and reducing the impacts of climate variability. Remote sensing provides observations over large areas at regular intervals making it useful and low cost for large-scale crop modeling. This study aimed to investigate the potential of satellite imagery in predicting winter wheat yields at field scale in Kansas. We analyzed 656 fields from 2016 to 2018 by the performance of different sensors Landsat, MODIS and Sentinel. METHOD: Linear regression and random forest (RF) models were built to predict winter wheat yield based on NDVI variables: the NDVI area under the curve and NDVI weekly data. Zonal analysis (North Central, South Central, West) and prediction with weather and management variables were conducted using RF. **RESULTS/FINDINGS**: Landsat NDVI variables presented the best performance with R^2 0.54, RMSE 0.80 Mg ha^{-1}. The RF prediction model performed better by zones and when including weather and management variables. NC and SC presented the best performance with RMSE of 0.69 Mg ha^{-1} and 0.61 Mg ha^{-1}, respectively compared to West, RMSE 0.92 Mg ha^{-1}. NDVI AUC and early season NDVI weekly data showed as one of the top variables. When adding weather and management variables, NDVI during anthesis were the most appropriate for yield prediction. **CONCLUSION**: Results showed that prediction accuracy will depend on weather conditions, especially in SC and West. Finally, we suggest the adoption of homogeneous climate and management crop zones when predicting winter wheat yields using satellite imagery in Kansas.

Relevance of research to State Related Topic(s)

Winter wheat growth and development rely on management inputs and the environment, especially on weather conditions. This is particularly critical in Kansas, where the environmental heterogeneity poses challenges for winter wheat yield prediction. Satellite imagery can be a useful tool to access crop condition and monitoring, providing phenological information over large areas at regular intervals with lower costs. This study showed that the use of satellite imagery and the adoption of homogeneous climate and management crop zones (as proposed in Jaenisch et al., 2021 study), can be highly beneficial for winter wheat yield forecasting in Kansas. The results provide important insights to assist in increasing productivity and help farmers in decision-making in Kansas.

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ANALYSIS OF CRYOVOLCANO PLUMES ON ENCELADUS BY LIGHT SCATTERING AND POLARIMETRY

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BACKGROUND AND PURPOSE: Enceladus, the sixth largest moon of Saturn, was investigated by NASA's Cassini spacecraft in the early 2000s and was discovered to have cryovolcanoes, or geysers, making it one of the most geologically active bodies in the solar system. Enceladus quickly became a hot topic in planetary science research, as it was also found to have a subsurface ocean under a thick layer of ice. As life on Earth is thought to have originated at the geothermal vents, finding out what particles are present in the cryovolcano plumes tells us about the possibilty of life there. **METHOD**: Cassini completed several flybys of Enceladus where it collected data with the Imaging Science Spectrograph (ISS) and the Visual and Infrared Mapping Spectrometer (VIMS). This data is freely available and can be used for light scattering studies. By simulating particles of various shapes (such as hexagonal prisms for crystalline ice) and calculating how light scatters off each particle, the simulations can then be adjusted to match the Cassini data. **RESULTS/FINDINGS**: There is a certain amount of both crystalline and amorphous ice present in the plumes, and the particles seem to be under 10 microns in size. By the end of this project, plume particle composition and explanations for anomalous light scattering phenomena will be determined. **CONCLUSION**: This research provides insight about the habitability of other solar system objects and the origin of life. It has applications to Kansas, specifically, as these light scattering simulations can be adapted to any remote sensing problem, from seasonal dust or pollen identification, to biological weapons detection.

Relevance of Research to State-Related Topic(s)

This research impacts Kansans as learning about the origin of life and the possibility of extraterrestrial organisms can open people’s minds and allow them to zoom out so as not to get caught up in small issues. It is also of interest as these light scattering simulations can be adapted to any remote sensing problem, such as seasonal dust or pollen identification all the way to biological and chemical weapons detection. Lastly, as most of these particles are made up of different ices, it can give us insight into ice formation and how to better prepare for Kansas ice storms.

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PHYSICS IN THE FIELD: APPLICATION OF A FIELD-DEPLOYABLE ULTRAFAST LASER TO MEASURE AGRICULTURAL SIGNIFICANT GASES

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BACKGROUND AND PURPOSE: Worldwide interest in greenhouse gas emissions have prompted studies into new techniques for remote gas sensing, particularly in agriculture, where enteric fermentation from cattle is one of the largest sources of anthropogenic methane emissions in the US. METHOD: We focus on measurements of these cattle emissions by deploying a mobile open-path near-infrared dual-comb spectroscopy (DCS) system in the field without the need for external calibration. The previous measurement of methane emissions from a feedlot resulted in time-resolved concentration enhancements of methane, ammonia, carbon dioxide, and water, which we then used in conjunction with weather data to calculate fluxes for these gases of interest. **RESULTS/FINDINGS**: For comparison, the DCS system was run in parallel with a commercial cavity-ring down spectroscopy system, resulting in a methane flux agreement within 6%. Ammonia flux from the feedlot was also measured with part-per-billion precision. **FURTHER MEASUREMENTS**: Currently, there are no technologies capable of detecting with precision and temporal resolution the methane emissions from grazing cattle, but our previous results show the combination of the DCS system with existing atmospheric dispersion models can fill this void. To verify that, current efforts focus on honing our equipment precision to measure concentration enhancements of approximately 0.2 parts per billion through a controlled release of methane study in a pasture. This is preparatory to measuring net methane production from cattle in a pasture environment. Further development has also focused on the remote capabilities of the system and its robustness against harsh weather conditions and long-term outdoor measurements.

Relevance of Research to State-Related Topic(s)

The state of Kansas is one of the leading producers of beef, with an ever-expanding dairy sector. It has been estimated that enteric fermentation contributes 27% of the total anthropogenic greenhouse gas emissions in the US. However, current techniques to measure these emissions fall short on capturing the entire picture and instead focus on the emissions of a particular cattle to be extrapolated to larger numbers in a system. This DCS technique agrees closely with commercially accepted systems for open-path spectroscopy in the field, while also simultaneously measuring multiple gases of interest and requiring no external calibration. Improving upon measurements of emissions, such as methane, would equip farmers with the information they need to monitor their emissions and possibly opening doors for the emerging carbon-credit market.

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MECHANISTIC STUDIES OF LITHIUM PLATING/STRIPPING PROCESSES ON THREE-DIMENSIONAL CONDUCTIVE HOSTS FOR LITHIUM METAL BATTERIES

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BACKGROUND AND PURPOSE: To accelerate the shift in energy production towards renewable sources and the electrification of transportation, it is necessary to improve the performance of currently available batteries. To improve the energy density of batteries, lithium metal is a promising anode material as it possesses the lowest redox potential of -3.04 V vs standard hydrogen electrode and the highest theoretical capacity of 3860 mAh/g which is ~10 times greater than the graphite anode. Despite these advantages, challenges such as dendrite growth, poor cycling life, low coulombic efficiency exist. Dendrite formation occurs when the lithium metal anode is recharged at a faster rate. To delay the dendrite formation, it is a common strategy to use three dimensional(3D) electrodes with high surface area as a host and current collector. However, a deeper understanding of the lithium plating/stripping processes in 3D lithium metal anodes which is essential to develop practical lithium metal anodes is still lacking. **METHOD AND FINDINGS**: In our study, vertically aligned carbon nanofibers (VACNF) is used as a 3D host. The study revealed the effects of charging rate, lithiophilicity on parameters such as Li nucleation overpotential, size, density and morphology of electroplated lithium using electron microscopic techniques. In addition to this, the intercalation and deintercalation of lithium ions into the graphitic structure of VACNF and the nature of the solid electrolyte interphase are investigated using spectroscopic and electron microscopic techniques. **CONCLUSION**: The results from this study would improve the understanding of the lithium plating/stripping processes towards advancement in the development of lithium metal batteries.

Relevance of Research to State-Related Topic(s)

Lithium metal is a promising anode material for the development of next generation of energy dense batteries. Development of lithium metal anode technology has the potential to build lighter, more powerful batteries. This would significantly accelerate the electrification of automotive sector and growth of renewable energy economy. It could lower the sustainability issues and environmental impacts associated with lithium-ion batteries. The state of Kansas is driving innovation in energy technology with its recent largest private investment for manufacturing of lithium-ion batteries and by being the home to third fastest growing tech market in the country. Research on new battery technologies would have a positive impact on the economic and technological development of the state. In alignment with the energy goals of the state, this study will advance the scientific knowledge of the phenomena that occurs during the charging and discharging processes of lithium metal anodes, making contribution towards its commercialization.

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PRINTABLE CONDUCTING LAYERED MATERIALS FOR ELECTRONIC AND ENERGY APPLICATIONS

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BACKGROUND AND PURPOSE: The 21st century majorly focusing on rapid progression on making smart energy storage devices preferably supercapacitors which are linked in development of ultrafast energy harvesting appplications. Incorporating intelligence in energy storage devices in electronic device manufacturing industry are most wanted and still meet several challenges. Hence, development of ultra-performance energy storage devices that are manufactured in the process of utilizing thin functional material with low-cost have a great potential to offer biodegradable and recyclable solutions. **METHOD**: Two dimensional layered transition metal carbide (MXene) has been identified as a hot material interest in energy application. Realization of effective use of smart materials in energy applications still has lot of challenging tasks. In this present study, printed highly flexible supercapacitor using few layer MXene ($Ti_3C_2T_x$) ink has been demonstrated, which are preoared from chemical exfoliation process by selective removal of Al (Aluminum) layer from Ti_3AlC_2. The exfoliated $Ti_3C_2T_x$ was used as an ink that was patterned onto a desired flexible substrate for fabricate supercapacitor devices. Our fabricated printed devices gives high charge storage capacity with high energy densities. The tested multiple charge-discharge cycles validate that our fabricated supercapacitors has extend life-cycles. **CONCLUSION**: The development of printed flexible supercapacitors using interesting materials is more important to make new energy storage technology. This fabrication process has trailblazed in not only low-cost and safe to our ecosystem but also opened an avenue for future advancements where this energy can possibly be more accessible and available in our daily lives.

Relevance of Research to State-Related Topic(s)

Within the state of Kansas there are only eight landfill regional hubs for electronic waste (e-waste) recycling. E-wastes are only accepted in ten counties in Kansas which are Finney, Ford, Grant, Gray, Haskell, Meade, Morton, Seward, Stanton, and Stevens County. Within these ten counties in Kansas the only accepted e-waste items are laptops. Moreover, this excludes, radios, batteries, TVs, and other electronic devices that are considered general trash but are made from non-biodegradable materials, hazardous if not discarded properly, and if illegally dumped in a landfill it can later affect the environment and human health. Hence, my electronic device address this issue by its manufacturing process being eco-friendly, less material being wasted, and while being energy sustainable. Innovative idea of making super-performance battery materials will progressively minimize the electronic waste (e-waste) caused by illegal waste dumping and improper handling that can further affect the environment and human health.

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HARVESTING RENEWABLE GEOTHERMAL ENERGY BY USE OF ENERGY FOUNDATIONS

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BACKGROUND AND PURPOSE: After solar energy, geothermal energy is the most abundant renewable energy source on Earth. Energy foundations are multi-functional foundations enabling extraction of this energy on top of their structural support role. Nevertheless, the main challenge in utilizing these foundations is the lack of understanding of the thermally induced stresses. Experiments and computational models provide more perspective on this matter. Nonetheless, the lack of the exact solutions with capability to provide designers with the magnitudes of stresses and deformations is a major obstacle to the widespread use of these foundations. METHOD: A mathematical model was formulated for enabling computation of deformations and stresses in energy foundations subjected to combined mechanical and thermal loads during the complete heating-cooling cycles. Furthermore, computational modeling was conducted thus enabling additional cross validations against experimental results. **RESULTS/FINDINGS**: The proposed solutions were successfully validated against multiple experimental and computational models. These solutions are currently being used in an extensive investigation of the response to thermo-mechanical serviceability loads with the aim of enabling wider implementation of energy piles in engineering practice. **CONCLUSION**: It was found that the settlement of a four-story building caused by the dead and live mechanical loads can be compensated with heating in the amount of only 4.36 °C. Although the maximum amount of heating in practice depends on the given location in typical case it is expected to be several times larger than 4.36°C. This confirms the significance of thermally induced stresses and importance of carefully considering them in design of energy foundations.

Relevance of Research to State-Related Topic(s)

Zero-emission renewable energy is one of the main needs in the international community, and geothermal energy is the second most abundant source thus significantly helping in replacing the fossil fuels. Kansas, like the rest of the world, is taking steps to facilitate and accommodate use of renewable energy. To this end, several bills such as HB 2100 and HB 2241 have been introduced to support renewable energy usage across the state. This research is an important step towards accomplishing this goal. Several publications that resulted from the currently ongoing research in the Department of Civil Engineering have attracted national and international attention, thus making Kansas State University known as one of the leading institutions in geothermally active foundations research.

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MULTIAGENT WIRELESS DATA COMMUNICATION FOR PRECISION AG SYSTEMS

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BACKGROUND AND PURPOSE: Currently available agriculture technology stack lack features like collecting instantaneous operational information and applying innovative techniques for real-time data accessibility, processing and analysis. Growers have to store the session data on the platform itself, physically transfer it on a storage device, and upload it to an online portal or software for further analysis. Lately, autonomous farming is becoming prevalent where a single machinery is substituted by a fleet of robots performing the same operation. Hence, we need a system that would provide instantaneous access to the data and overcome limitations set by dynamic farming environment which can lead to data loss and safety concerns. **METHOD**: The goal of this research is to provide a proof-of-concept real-time wireless data communication system for autonomous multiagent platforms. 900 MHz Radios working in "license-free" spectrum bands (frequency) having a line-of-sight range of 52 km were selected for continuous transmission and reception of data from the platforms to central hub**. RESULTS/FINDINGS**: The communication system set up in a mesh topology included four agents, each acting as a slave, were sourcing the data with time stamp & identifiers. A central hub operating as a master collected all the data along with repeaters which help in extending the network. The experimental runs resulted in seamless operation, with minimum to no loss or deterioration in data packet content. **CONCLUSION**: This sets a foundation for data communication systems that require collecting data from multiple nodes in a farming environment and routing it wirelessly to a required destination.

Relevance of Research to State-Related Topic(s)

Precision Agriculture Technologies are becoming prevalent where equipment manufacturers are instantiating advanced engineering solutions to make the farming practices autonomous and foolproof. As substantial amount of land areas in Kansas are committed to agricultural practices (around 90% as per the Kansas Historical Society, 2011) and Kansas stands number one in wheat production (USDA, 2017), it is evident that farmers are working hard to keep up with the increasing food demands. As new advancements in hardware and software engineering are rooting in interdisciplinary areas, wireless data communication is one of the prime candidates. As number of sensors nodes are expediting to collect instantaneous data, they are advantageous in precision agriculture and autonomous farming applications since agricultural field is dynamic in nature. Wireless data transfer is an important component of autonomous farming that routes the data seamlessly to an on-premise destination and can be further analyzed on the cloud for informed decision making.

GROUP 7

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TRANSITIONING TO OPEN EDUCATION RESOURCES IN GENERAL EDUCATION MATHEMATICS COURSES: A MIXED METHODS STUDY OF THE PERCEPTIONS OF COLLEGE STUDENTS REGARDING THE QUALITY AND EFFICACY OF OER

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BACKGROUND AND PURPOSE: Textbooks and homework software are essential for general math courses in higher education settings. Most research concentrates on using the textbook without considering the supplemented package. Also, students' performance is usually the only quantitative research paradigm used to conclude the quality of OER. My study is mixed-methodological research built over side-by-side quantitative and qualitative designs and will explore the use of a free textbook and homework system. Data are collected concurrently to overcome weaknesses in using one method with the strengths of the other. The study aims to answer the following research questions: Could students achieve the same outcomes when using OER instead of CER? What are the perceptions of using OER instead of CER on the learners? **METHODOLOGY**: I will use the Grounded Theory research methodology to explore the learners' viewpoints on OER to create a theory regarding the quality and efficacy of OER. I will collect data using different methodological approaches, such as analyzing students' formative assessment results, organizing surveys, and conducting case study interviews. For a more comprehensive understanding, findings from the two qualitative and quantitative phases are integrated to compare and contrast the results. **RESULTS/FINDINGS**: The data collected will build a body of evidence for using OER instead of CER and highlight the benefits, challenges, and future opportunities. **CONCLUSION**: The study will benefit learners and institutions in general. The learners will have the ability to save money while accomplishing the same learning goals. While the institutes will adjust educational costs, improve the enrollment registration rate, and promote quality educational materials.

Relevance of Research to State-Related Topic(s)

Education cost in Kansas is getting more expensive, and Open Education Resources are one way of cutting the higher education cost of attendance while not sacrificing curriculum quality. Accessibility and affordability are reasons to switch to OER to comply with Kansas and federal legislations. OER will provide opportunities to customize the contents to fit specific communities and share resources with other rural areas. Teaching with OER will promote diversity and an active learning style that centers around learners instead of educators. The move to OER will provide free online learning with freedom of time and physical constraints.

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LABOR SHORTAGE IN THE HOSPITALITY INDUSTRY: HOW TO OVERCOME THE ONGOING LABOR SHORTAGE?

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BACKGROUND AND PURPOSE: Mass layoffs during COVID-19 have made service employees rethink their career goals. Moreover, the hospitality industry is one of the industries significantly influenced by the COVID-19 pandemic. Although most businesses are rebounding due to increased customer demands, labor shortages could slow the recovery. Such labor shortage makes hospitality employers reevaluate overall employee experiences for attracting and retaining talent. In addition to understanding the effect of the pandemic on employee satisfaction, we used Herzberg's two-factor theory, which describes satisfaction and dissatisfaction as mutually independent relationships. The purpose of the study, therefore, is to identify the elements of both satisfaction and dissatisfaction factors to provide better insight into employers. **METHODS**: 12,351 online reviews from the largest hotel chain in the world were obtained two years ago and two years later, based on 2020, when Covid-19 rapidly spreads. Also, the topic modeling method was used to extract topics for characteristics and changes in satisfaction and dissatisfaction factors. **RESULTS**: Results indicate that Herzberg's theory is confirmed through satisfaction and dissatisfaction are affected by different detailed factors. For example, 'hourly pay' was considered a critical job satisfaction factor, but employees now care more about 'compensation.' **CONCLUSION**: Suppose the existing job satisfaction and dissatisfaction are managed independently rather than as opposite concepts on the same line. In that case, the key to successful human resource management, as well as general management, is expected to be obtained. Furthermore, we believe that the labor shortage problem can be solved by preventing employee churn and contributing to attracting new employees.

Relevance of Research to State-Related Topic(s)

According to an economic report by the U.S. Department of Labor, the largest job loss was experienced in the leisure and hospitality industry in Kansas during 2020. The losses total 19,700 jobs or 15.2%, and roughly 80% are in the accommodation and food service sector. If finding factors to increase the job satisfaction of people working in Kansas, an increase in the retention rate will be followed. Furthermore, in accordance with Kansas governor Laura Kelly last year's announcement that put emphasis on the importance of the hospitality and tourism industry, new economic growth could be expected in Kansas. Economic growth can be expected if there is some recovery in the sector that has lost the most. For these reasons, our work contributes to the hospitality industry by shedding light on whether the pandemic catalyzed satisfaction changes for service employees and what hospitality firms need to do to enhance job satisfaction.

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AMERICANS EXPRESS BLIND OPTIMISM FOR OVERCOMING CLIMATE CHANGE

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BACKGROUND AND PURPOSE: The growing severity of climate change necessitates further examination into peoples' beliefs and behaviors related to overcoming it. Differences in Americans' views of climate change are well documented, but limited research has examined the extent to which Americans are optimistic about overcoming climate change and how that optimism relates to other climate change-related beliefs. **METHOD**: US-based Amazon Mechanical Turk workers (*n*=180; 39(12) years, 79% White, 53% Democrat) completed an online survey that measured various climate change-related attitudes and behaviors. **RESULTS**: Participants recorded being optimistic climate change can be overcome [*M*(*SD*)=4.87(1.56) of 7]. While *Support for Mitigative Action* was positively correlated with *Likelihood of Voting for Climate-Concerned Candidates* and *Perceptions of Government Effectiveness*, it was not correlated with *Optimism for Overcoming Climate Change*. However, *Climate Optimism* was positively correlated with *Government Effectiveness*, but not with either of the solution-related variables (*Mitigation Support* and *Voting Likelihood*). Additionally, while no relationship between *Climate Optimism* and *Political Party* surfaced, *Climate Optimism* was positively related to *Belief in American Exceptionalism.* **CONCLUSIONS**: Americans across the political spectrum are optimistic we can overcome climate change, but that optimism is not related to support for the most impactful, top-down solutions for overcoming climate change (i.e., civic and legislative action). Thus, a sense of blind optimism for overcoming climate change may be present, where Americans are optimistic climate change can be overcome, but how that will happen remains unclear. Subsequent research is seeking to confirm these results and to continue exploring potential sources of this blind optimism.

Relevance of Research to State-Related Topic(s)

Climate change is known to be a "wicked" problem, such that people believe its consequences are a future problem only others will face. However, as we continue to witness–even here in Kansas–serious consequences are here and now. For example, a 2016 report by Kansas Forest Service and Environmental Protection Agency showed continued depletion of the Higher Plains Aquifer in western Kansas and consistent trends of unprecedented warming across the state. With the KFS findings, this study's data demonstrate a powerful opportunity for Kansas lawmakers. The lack of relationship between climate optimism and support for the two legislative-related solutions suggests Americans could greatly benefit from enlightenment on how the Legislator can help initiate practical, impactful climate change solutions. While creating positive interactions with constituents, lawmakers can help to ameliorate the blindness of Kansans' climate change optimism, while also bolstering substantiated, legitimate optimism for overcoming climate change.

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THE EFFECT OF PARENTAL CLOSENESS ON TEEN DATING VIOLENCE

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BACKGROUND AND PURPOSE: Teen dating violence is an adverse childhood experience that has impacted millions of adolescents in the United States (CDC, 2022). According to Livingston et al., more than 30% of adolescents report that they experienced abuse in a romantic relationship, which includes physical, verbal, or emotional abuse (2021). With the increasing numbers of TDV, many are interested to learn what are some factors that can help serve as preventative measures from TDV. The purpose of this study was to examine if strong parental closeness with biological parents were associated with teen dating violence TDV victimization. This study also examined if abusive punishment tactics (i.e., shouting, swearing, hitting, or slapping) utilized by primary caregivers towards adolescents was significantly associated with TDV victimization. METHODS: Hypotheses were tested using data derived from the Fragile Families and Child Wellbeing Study (FFCWS). The sample from the current study included survey responses from 952 adolescent participants, aged 15 years or older, and their primary caregivers. The association between parental closeness and TDV was moderated by abusive disciplinary tactics used by primary caregivers. **RESULTS/FINDINGS**: Results suggested that abusive disciplinary tactics do have negative impacts on youth social development and may result in TDV victimization. There was not enough evidence to support the association between parental closeness and decreased levels of TDV. **CONCLUSION**: The findings of this paper indicate that parents who create safe spaces for their youth and encourage healthy social development can help prevent adolescents from falling victim to TDV and encourage them to seek healthy relationships.

Relevance of Research to State-Related Topic(s)

The current research study aims to promote mental health in adolescent youth in the state of Kansas and reduce violence present in homes, schools, and the community. Research has shown that teen dating violence can cause adolescents to experience anxiety and depression. Victims of teen dating violence are also more likely to engage in unhealthy behaviors, such as utilizing drug and alcohol products, and engaging in antisocial behaviors. These teens are also more likely to experience suicidal ideation. Victims of teen dating violence are also more at-risk for experiencing intimate partner violence as an adult. Findings from this study can promote the establishment of additional resources that promote psychoeducation for parenting, healthy relationships, and therapy services for adolescents and their families.

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INTERPROFESSIONAL SKILLS DEVELOPMENT IN PUBLIC HEALTH EDUCATION: EXPECTATIONS AND SUCCESSES

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BACKGROUND: The implementation and evaluation of interprofessional education are crucial in meeting the needs of today's public health workforce. Two studies were conducted to explore public health students' expectations and perceived successes throughout the course of undergraduate, graduate, and professional education. For analysis, surveys collected demographic data including the participant's academic backgrounds and current degree programs. **METHODS**: The first study, conducted over ten years, provided students with core competency and program perception-based questions upon entering and exiting the graduate public health program. In the second study, participants completed a pre-training survey, an interprofessional practice scenario in an online training module, and a post-training survey. Qualitative thematic analyses for both studies were conducted separately. **PURPOSE**: Common themes in student responses for both studies were then identified with the goals 1) to understand whether interprofessional skills are incorporated into public health, veterinary medicine, and One Health curricula at the undergraduate, graduate, and professional levels of education, 2) to evaluate the capability of dual-degree educational programs to enhance interprofessional skills development, and 3) to propose improvements in public health knowledge delivery, career field preparation, and other program student advising services. **RESULTS**: Overall, the commonalities demonstrated consistent themes in students' expected learning outcomes and their most valued interprofessional characteristics. **CONCLUSION**: Participant responses indicated that interprofessional education has the potential to promote an advanced understanding of key public health competencies and the capability to apply related workforce skills. The results of these studies contribute to a large base of research on interprofessional education and its implementation.

Relevance of Research to State-Related Topic(s)

This research relates to public health workforce development through the evaluation and implementation of interprofessional skills development in students. Interprofessional skills development promotes a communicative and efficient Kansas workforce.

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EFFECTIVENESS OF A BRIEF FILIAL THERAPY MODEL ON CHILD, PARENT, AND RELATIONSHIP OUTCOMES

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BACKGROUND AND PURPOSE: Filial Therapy is a play therapy parent-child treatment that was developed by Bernard and Louise Guerney in 1964. Filial Therapy helps parents learn and use child-centered play therapy skills to engage with their children, thus improving the parent-child relationship. There have been many studies examining the effectiveness of Landreth's group model of Filial Therapy (CPRT). However, there have been fewer studies examining the efficacy or effectiveness of the Guerney model of Filial Therapy. This study sought to identify various parent and child outcomes of a brief (10 sessions) Filial Therapy program that was adapted from VanFleet's (1994) individual Filial Family Therapy model. **METHOD**: This study included 24 parent-child dyads who completed Filial Therapy and completed a series of pre-tests and post-tests. Parents reported on the following: child behavior problems (Eyberg Child Behavior Inventory), parent distress (Brief Symptom Inventory General Severity Index), and parent acceptance of child (Porter Parental Acceptance Scale). In addition, independent observers rated parent communication of acceptance, parent involvement, and allowing child self-direction during parent-child play interactions (subscales of the Measurement of Empathy in Adult-Child Interaction, MEACI). **RESULTS/FINDINGS**: Filial Therapy was found to be effective in promoting positive change in all of the above areas assessed. Effect sizes ranged from .43 to 1.90. **CONCLUSION**: These findings indicate that Filial Therapy is effective in decreasing negative child behaviors and increasing positive parenting behaviors within the parent-child relationship. This study highlights the benefits of parents and children participating in Filial Therapy.

Relevance of Research to State-Related Topic(s)

This research has important implications for Kansas legislators interested in child welfare, family relationships, mental health, health care costs, and health and human services. Rates of child depression and anxiety continue to rise at alarming rates, with growing numbers of families seeking therapeutic services for their children. Consequently, waitlists for child therapists are growing, an issue that is particularly problematic in rural areas with a scarcity of trained providers. In addition, therapy costs can present a burden to those struggling financially. It is important that state funding be directed toward services that are the most cost-effective in order to maximize the number of children and families receiving care. This research demonstrates the effectiveness of a short-term intervention that requires relatively little specialized training for providers and can be easily disseminated.

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ACCEPT THE JOB OFFERS OR WALK AWAY?: THE ROLE OF INTERVIEW EXPERIENCE

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BACKGROUND AND PURPOSE: Labor demand for workers has recovered after the pandemic in the United States. However, unemployed people still hesitate to get a job, while employers strive to hire new employees. To secure job candidates who are reluctant to accept job offers, managing the interview experience that job candidates perceive during the selection process is critical to achieving job offer acceptance, because a job interview is the last interaction between job applicants and companies before job acceptance decision-making. Thus, this study aims to examine the effects of three aspects that construct the overall interview experience, interview difficulty level, rapport engagement, and interviewee' emotional reactions on job offer acceptance. **METHOD**: From Glassdoor.com, a professional online platform, 6,030 online review data regarding 115 hotel brands in the United States were collected. In the online reviews, four research variables were identified and measured. Logistic regression was employed to test hypotheses. **RESULTS**: The findings show that high rapport engagement and positive emotional reactions enhance job candidates' job offer acceptance rates. A U-shaped relationship between difficulty level and job offer acceptance indicates that candidates are likely to accept job offers in easy and difficult interview cases. Furthermore, the U-shaped relationship is moderated by emotional reactions. **CONCLUSION**: This research provides employers with a practical and effective way of enhancing candidates' job offer acceptance rates by strategically building job candidates' interview experiences. The proposed way would help local businesses overcome a labor shortage issue, contributing to the local economy and employment in the long term.

Relevance of Research to State-Related Topic(s)

The previous studies show a labor shortage issue has remained after the COVID in the United States. As industries and activities return to normal, labor demand in industry has returned to 99% of the pre-pandemic level. Nevertheless, people are unwilling to get a job and return from retirement, creating a 6.7% unemployment rate and $170 billion of the annual cost of unemployment in 2021. In Kansas state, the unemployment rate peaked at 12.2% in April 2020, and there are still more than 36,000 unemployed people in 2022. Considering the U.S. government invested $5.2 trillion in stimulating the economic recovery, Kansas state may have enjoyed fewer benefits of the economic recovery. This study proposes an effective and practical way to enhance unemployed job candidates' job offer acceptance rates by managing the interview experiences of candidates. The increased job offer acceptance rates could provide employment opportunities and economic benefits for local businesses.

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DEVELOPING A NEED-BASED HOUSING POLICY FOR AGING-IN-PLACE FOR THE ELDERLY

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BACKGROUND AND PURPOSE: The startling worldwide demographic change - that is becoming more prevalent in the African countries - has necessitated the investigation into the living conditions of the elderly. Organizations in the developed world are implementing frameworks to meet the need of an aging planet, though even in several fully developed countries such as America, efforts to comfortably and appropriately house its elderly population remain uneven at best. Can the strategies of the West be utilized in post-colonial Africa? Many challenges emerge. Little is known about the lives of the elderly in contemporary Africa – their housing condition in particular. Individuals, families, and larger groups understand the needs and priorities of this population (experiential wisdom). On the other side of the equation, governmental agencies, NGOs, and the for-profit economy attempt to develop policies and support systems (program design). Therefore, this study aims to conceive an experientially based design conceptual model for aging-in-place as an improvement to the current knowledge and implementation with a view towards developing a qualitative elderly housing policy adoptable by the developing world. **METHOD**: The study adopts a mixed-method approach. A discourse analysis (qualitative) was used to examine the key theme, while the quantitative analysis helps to examine the consistency of the findings among older adults age 60years and above. **RESULTS**: The result shows that the behavior patterns change as people grow and the housing facility does not conform with the living experience of the elderly. The study concludes that combining both perspectives is essential to creating a truly responsive framework.

Relevance of Research to State-Related Topic(s)

Majority of the states in American are experiencing demographic change favoring the elderly age 60 and above, and thereby increases the pressure on housing for successful aging. In response, studies in built environments have resulted in different supportive senior housing facilities. Also, Kansas Senior Care Act and property exemption from taxation are few among government efforts towards supporting successful aging. However, supportive senior housing does not resolve the ultimate need of the elderly to remain in their neighborhood. Report of Kansas Housing Resource Corporation (KHRC) in 2021 on housing needs assessment also corroborate this fact. The existing housing leans heavily towards programmatic design i.e., provision of housing based on statistics or conditions, but insensitive to lived experience. The end-view of this study is relevant to the Kansas State Plan on Aging 2022-2025 agenda whose first out of five goals is to explore the unmet housing needs of the older Kansans.

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IDENTIFYING QUESTION FEATURES THAT PROMOTE STUDENTS' SENSEMAKING IN SCIENCE

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BACKGROUND AND PURPOSE: Test or assignment questions, especially in science, present opportunities for students to reflect on their understanding of concepts and principles. Research in science education has focused on designing questions that support students in making sense of school science by building on their existing ideas. Sensemaking assists students to think in similar ways as scientists and engineers along with promoting scientific literacy. This work identifies question features in school science that promote sensemaking. **METHOD**: We identify a set of mental processes which are crucial for sensemaking to occur. We then argue that question features targeting these processes bring about sensemaking. **RESULTS AND FINDINGS**: The question features include: (i) presence of a real-world context, questions that require students (ii) to think about the causes and effects present in the given context, (iii) to use diagrams and gestures, and (iv) to extract physical meaning from the diagrams and gestures. **CONCLUSION**: Our findings assist teachers of Science, Technology, Engineering and Mathematics (STEM) in designing questions that make students appreciate the relevance of the concepts and principles in their everyday lives. For researchers, the methodology described in this work can assist in identifying question features that can promote other important processes in science such as modeling and argumentation.

Relevance of Research to State-Related Topic(s)

Kansas Science Standards adopted by the State of Kansas pushes for science courses taught in schools and colleges to promote critical thinking thereby enhancing scientific literacy. One of the major challenges to promoting scientific literacy is the prevalent perception of school being disconnected from students' everyday lives. Our research promotes the spirit of the adopted science standards by making students appreciate scientific ideas in light of their lived experiences.