RESEARCH AND THE STATE

GRADUATE STUDENT POSTER SESSION

NOVEMBER 6, 2012
K-STATE STUDENT UNION, KS BALLROOM

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FIRST ROUND OF POSTER JUDGING **9:00 AM to 11:00 AM**

Research posters will be presented by nearly 60 graduate students from K-State. The top 14 presenters will be selected to compete in the second round of judging.

SECOND ROUND OF POSTER JUDGING **12:30 PM to 3:00 PM**

The top 9 graduate student poster presenters will be selected to represent K-State by presenting their posters at the 10th annual Capitol Graduate Research Summit (CGRS) in Topeka on Thursday, February 14, 2013.

The CGRS is an annual showcase of research conducted by graduate students from Kansas State University, Wichita State University, the University of Kansas, and the University of Kansas Medical Center. Participants have the opportunity to present their research posters to state legislators, the governor, and the Board of Regents. Awards will be presented to the top two presenters from each institution.

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Poster Abstracts

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IN VITRO CHARACTERIZATION OF NOVEL REASSORTANT H1N2 SWINE INFLUENZA VIRUSES WITH GENES FROM PANDEMIC H1N1 VIRUS

Michael A. Duff, Jingjiao Ma, Huigang Shen, and Wenjun Ma
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The H1N2 swine influenza virus (SIV) is one major subtype of influenza A virus circulating in swine herds worldwide. Since introduction of the 2009 pandemic H1N1 virus (pH1N1) into pigs, reassortment between pH1N1 and endemic SIVs has been reported. One reassortant, H3N2 SIV with the pH1N1 Matrix gene, can cross species barriers to infect humans. Little is known about the novel reassortant H1N2 SIVs with pH1N1 genes. The purpose of this study is to characterize two reassortant H1N2 SIVs with six internal genes from pH1N1 in vitro, A/Swine/Kansas/11-128489 H1N2 (KS-128489) and A/Swine/Kansas/12-117893 (KS-117893). RT-PCR was performed to amplify gene segments for both KS-117893 and KS-128489 viruses, and each gene segment was sequenced. Sequencing and phylogenetic analysis revealed that both viruses contain the same internal genes PB2, PB1, PA, NP, M, and NS from pH1N1 and the same surface NA gene. However, the HA genes are of different lineages. KS-128489 possesses surface gene HA from reassortant H1 lineage while KS-117893 possesses a surface gene HA from H1γ Cluster lineage. Plaque assay and growth kinetics were performed for both viruses. Our preliminary study showed that both viruses formed similar-sized plaques in MDCK cells. KS-128489 showed significantly greater growth kinetics than KS-117893 on MDCK and A549 cells. These results indicate that novel reassortant H1N2 viruses with similar internal genes from pH1N1 but different surface HA genes does have an effect on replication characteristics in vitro. A pig study is needed to investigate the pathogenesis and transmissibility of novel reassortant H1N2 viruses.

Relevance of Research to State-Related Topic(s)

There are more than 1,500 hog farms and 3.1 million hogs in Kansas that account for 95% of the state's pork supply and 2.7% of the United States' total pork supply. This represents a large source of food for the nation as well as a large source of income for the Kansas economy. Currently, there are several strains of swine influenza viruses (SIVs) circulating in Kansas pigs, many of which are reassortant viruses that contain genes from the highly virulent 2009 pandemic H1N1 (pH1N1). However, little is known about these reassortant SIVs, particularly the H1N2 SIV subtype which has been reported to transmit to and infect humans. Should a more virulent H1N2 SIV with genes from pH1N1 arise, it could result in disaster for local hog farmers, the nation's food supply, and pose a threat to public health.

2

BOVINE VIRAL DIARRHEA VIRUS TRANSMISSION FROM PERSISTENTLY INFECTED CATTLE TO NON-PERSISTENTLY INFECTED CATTLE WHEN COMMINGLED: AN EVALUATION OF SERUM NEUTRALIZING ANTIBODY TITERS

Kelly A. Foster[1], Richard A. Hesse[2], Lalitha Peddireddi[2], Richard D. Oberst[2], Elizabeth G. Poulsen[2], Jianfa Bai[2], Daniel U. Thomson[1], and Gary A. Anderson[2]

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Worldwide, bovine viral diarrhea virus (BVDV) infects cattle of all ages causing huge economic loss due to ensuing morbidity and mortality. The objective of our study is to detect the presence of BVDV in cattle, following direct exposure to persistently infected (PI) cattle. Through funding from Kansas State Veterinary Diagnostic Laboratory, 53 cattle were introduced to 10 PI cattle and commingled for 27 days, becoming infected as early as 4 days post infection and maintaining infection for as long as 25 days. Serum and buffy coat samples were collected throughout the study and analyzed for the presence of BVDV nucleic acids via PCR. As demonstrated by positive buffy coat PCR, 50 of the 53 commingled cattle became transiently infected. Positive samples were submitted for genotype determination by 5' UTR sequencing. Serum neutralization assays (SN) were performed on serum collected prior to the commingling (Day -1) and on Days 8, 13, 20 and 27 to monitor seroconversion following infection. Analysis of SN and PCR data indicates that 100% of animals with no antibody titer on Day -1 became infected and seroconverted with high titer to at least one PI BVDV strain. Further analysis shows that animals with pre-existing SN antibody titers exhibited lower virus load and shorter viremia than their naïve counterparts. Among seropositive animals, those with the highest pre-existing SN titer exhibited lower virus load, shorter viremia, and were refractile to infection. Extrapolation of these field observations indicates the importance of proper immunization prior entry into the feedlot.

Relevance of Research to State-Related Topic(s)

As a leading agriculture state in the animal health corridor, animal health has continued to be an important topic in the State of Kansas. As the third largest producer of beef in the United States, beef cattle production is one of the driving factors in Kansas agriculture. Worldwide, bovine viral diarrhea virus (BVDV) infects cattle of all ages and is known to be a factor in development of Bovine Respiratory Disease Complex (BRDC). Ensuing morbidity and mortality from BVDV, BRDC and reproductive losses result in huge economic losses in cow-calf, stocker and feedlot operations. The ability to protect cattle through proper vaccination has long been known. Our study further illustrates that neutralizing antibody production, like that seen with vaccination, is indicated to decrease morbidity and mortality produced by BVDV.

3

ASSESSMENT OF AN OBJECTIVE, AUTOMATED LUNG AUSCULTATION ALGORITHM TO PREDICT THE PRESENCE OF HISTOPATHOLOGIC LESIONS IN CLINICAL BOVINE RESPIRATORY DISEASE CASES AS A TOOL IN IMPLEMENTING EVIDENCE BASED MEDICINE

Daniel Frese[1], James Lowe[2], Wade Taylor[3], Tom Noffsinger[3], Kurt Brattain[4], and Daniel U. Thomson[1]
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The objective of this study was to determine the performance of an electronic stethoscope, which uses computerized sound analysis to predict the presence of 10 different common histopathologic lung lesions present in Bovine respiratory disease (BRD). Fifteen cattle diagnosed by feedyard personnel with clinical signs consistent with bovine respiratory disease (BRD) were removed from their pens and brought to the hospital pen for treatment. Auscultation was then performed on left and right sides and lung sounds were electronically recorded and analyzed using a proprietary analytical algorithm and assigned a numerical electronic lung auscultation score (eLAS) based on severity of clinical disease as determined by auscultation. Following auscultation the cattle were euthanized and lung samples were analyzed for histopathologic analysis. The eLAS scores were analyzed using SAS Univariate analysis. Higher LAS were associated at a statistically significant level ($p<.05$) of polymorphonuclear cells (PMN), bronchopneumonia (BP) and chronic inflammation (CHR). The ability to predict histopathology lesions and inflammatory cells could be important in the accurate diagnosis and management of BRD and could be an indication that this system could be a tool for an earlier and more accurate diagnosis. Diagnosis of BRD based on clinical signs alone lacks a high degree of accuracy, and the use of an objective tool such as an electronic stethoscope could potentially improve diagnostic accuracy in BRD.

Relevance of Research to State-Related Topic(s)

Kansas is the nation's the third largest beef producer generating more than $7.6 billion in cash receipts in 2011; nearly half of all KS agricultural receipts. The health and welfare of cattle is of paramount importance for not only producers, but for the production of safe and wholesome food. Bovine respiratory disease is the costliest disease of beef cattle. However, positive identification of sick animals is a challenge and a tool such as this could be used to improve identification and treatment of sick animals with antimicrobials. Additionally such a tool could help reduce antimicrobial usage by identifying sick and healthy animals properly. The judicious and appropriate application of antimicrobials is a major concern of both public and veterinary health in providing for good animal husbandry, mitigation of antimicrobial resistance, and food safety.

4

COMPARISON OF HOST IMMUNE RESPONSE TO HOMOLOGOUS AND NEWLY ISOLATED HETEROLOGOUS PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS (PRRSV) CHALLENGE

Xiangdong Li[1], Nanhua Chen[2], Leratta Pappan[1], Benjamin Trible[2], Maureen Kerrigan[2], Amanda Beck[2], Yijing Li[1], Richard Hesse[2], Frank Blecha[1], Jerome. Nietfeld[2], Raymond Rowland[2], and Jishu Shi[1]

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Porcine reproductive and respiratory syndrome (PRRS) is a high-consequence animal disease worldwide. The objective of this study was to identify immune responses that are predictive of protection against PRRSV infection. Using MLV IngelVac PRRSV vaccine, its parental strain VR2332, and a recently isolated PRRSV strain from Long Island (Kansas), we compared immune responses induced by vaccination and by natural infection of two different PRRSV isolates. Four groups of pigs were utilized and groups 1 & 2 were vaccinated with MLV PRRSV. Twenty-eight days post vaccination (DPV), pigs in groups 1 & 3 were challenged with VR2332, and groups 2 & 4 were challenged with Long Island. qPCR analysis showed that PRRSV was detected in serum samples of groups 2, 3, & 4 pigs but not in group 1 pigs 7 after infection. Lung pathology score of group 1 pigs was significantly lower than that of other groups, confirming the vaccination-induced homologous (VR2332) protection. PRRSV-specific antibody and neutralizing antibody in the serum can be detected 7 & 28 DPV. Serum neutralizing antibody against Long Island was detected only in group 4 pigs 14 days after infection. ELISpot assay indicated that VR2332 is a stronger inducer of IFN-γ-secreting PBMCs than Long Island in all pigs, and group 2 pigs possessed more PRRSV-specific IFN-γ-secreting PBMCs. This study indicates that infection with Long Island strain induces a higher level of cellular immune response against PRRSV in vaccinated pigs, but only serum neutralizing antibody titer is associated with PRRSV vaccination-induced protection against both strains.

Relevance of Research to State-Related Topic(s)

Kansas is the tenth largest state in hog production. There are more than 1,500 hog farms in Kasnas, which produce more than 3 million market hogs with a gross market value of 456 million dollars annually. PRRS is one of the most important swine diseases, which is prevalent worldwide with fast mutation rates, leading to an economic loss of more than 600 million dollars within U.S. annually. Due to the fast mutation rates, PRRSV virulence varies greatly and vaccine effectiveness is compromised. Our study will help determine what economic impact Kansas-isolated PRRSV strains will have on Kansas farm and pork production.

5

PATHOGENICITY AND TRANSMISSIBILITY OF NOVEL REASSORTANT H3N2 SWINE INFLUENZA VIRUSES WITH THE 2009 PANDEMIC H1N1 GENES IN PIGS

Jingjiao Ma[1], Huigang Shen[1], Qinfang Liu[1], Bhupinder Bawa[1], Jürgen A. Richt[1], Richard A. Hesse[1], Steven C. Henry[2], and Wenjun Ma[1]

[1]Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine; [2]Abilene Animal Hospital PA, Abilene, KS

Swine influenza viruses (SIVs) H1 and H3 subtypes carrying genes from the 2009 pandemic H1N1 virus (pH1N1) have been isolated from pigs worldwide. Three genetically different H3N2 reassortant swine influenza viruses (SIVs) containing 3 or 5 genes of pH1N1 have been isolated from diseased pigs in Midwestern farms, but the pathogenicity and transmissibility of these novel viruses in swine remains unknown. Herein, we characterized these novel reassortant H3N2 viruses *in vitro* and in pigs using an endemic non-reassortant H3N2 SIV as a control. All 3 novel reassortant H3N2 viruses grew to higher titers than the control endemic H3N2 SIV in canine, swine and human cell lines. In the swine study, all 3 novel reassortant viruses were able to replicate efficiently in lungs and transmit to sentinel animals, similar to the control endemic H3N2 virus. The novel reassortant viruses with 3 genes (NP, M and NS) from pH1N1 were more transmissible when compared to the reassortant virus with 5 genes (PA, PB2, NP, M and NS) from pH1N1. Furthermore, concurrent molecular surveillance showed that the novel H3N2 virus with 3 genes from pH1N1 is continually isolated from swine herds and becomes a dominant H3N2 virus circulating in swine populations. All these results indicate that novel reassortant H3N2 virus may replace the endemic non-reassortant H3N2 SIV to be the dominant virus circulating in swine herds.

Relevance of Research to State-Related Topic(s)

Reassortant swine influenza viruses (SIVs) with genes from 2009 pandemic H1N1 (pH1N1) have recently emerged in Kansas swine herds. Some of these reassortant SIVs have been shown to have a higher morbidity rate than their endemic counterparts and pose a significant risk to the Kansas economy and food supply. One such reassortant SIV, H3N2 with three genes from pH1N1, has continually been isolated from swine herds and is gradually becoming the predominant genotype in Kansas. Should a more highly virulent H3N2 SIV emerge, it could affect more than 3.1 million hogs living on 1,500 hog farms in Kansas and cause a financial crisis for the Kansas economy and food supply. Therefore, more research into these reassortant H3N2 SIVs is needed for producing efficacious vaccines in order to protect the Kansas economy and food supply.

6

COMPARISON OF GAMITHROMYCIN, TILMICOSIN AND TULATHROMYCIN: METAPHYLACTIC TREATMENTS IN HIGH RISK CALVES FOR BRD

Tanner J. Miller[1], Daniel U. Thomson[1], Michael Hubbert[2], Clint Loest[3], and Chris D. Reinhardt[4]
[1]Department of Clinical Sciences, College of Veterinary Medicine; [2]Clayton Livestock Research Center, New Mexico State University; [3]Department of Animal and Range Science, New Mexico State University; [4]Department of Animal Sciences and Industry, College of Agriculture

The objective of this experiment was to compare the effects of three metaphylaxis antibiotics on health and performance of high risk feedlot cattle. Heifers (n=579, 403.7 ± 27.4 lbs) from Southwest Texas were identified as being at high risk for BRD and shipped to the Clayton Livestock Research Center in Clayton, NM. Cattle were randomly allocated within truck load lots into treatment pens (30 pens; 3 treatments; 10 reps) which contained 18 to 20 animals per pen. Pens within arrival replicate were randomly assigned to receive one of three metaphylactic antimicrobial treatments based on the randomly assigned treatment for their pen within each replicate: 1) Gamithromycin (6.0 mg/kg; GAM), 2) Tilmicosin (13.3 mg/kg; TIL), and 3) Tulathromycin (2.5 mg/kg; TUL). Treatments were administered during initial post-arrival processing. Cattle were fed for 56 to 60 days. Daily gain (ADG), dry matter intake, morbidity, and mortality were recorded. Cattle administered TUL had 0.29 lb higher ADG than cattle administered GAM ($P<0.01$) and had 0.18 lb ($P=0.09$) higher ADG than cattle that received TIL. TUL treated cattle had ($P = 0.12$) improved feed efficiency compared to GAM treated cattle. Cattle that received TUL (5.2%) had lower morbidity rates ($P < .02$) than TIL (14.6%) and GAM (12.79%) treated cattle. There were no treatment differences in dry matter intake or mortality. The results of this study indicate that tulathromycin was most effective at mitigating the effects of BRD in feedlot heifers.

Relevance of Research to State-Related Topic(s)

Bovine Respiratory Disease (BRD) continues to be one of the largest animal health concerns in the cattle industry. BRD is caused by a multifaceted group of pathogens, both viral and bacterial, that take advantage of an immune-compromised calf to cause disease. An estimated one billion dollars is lost nationally to BRD each year. Kansas is one of the largest beef producing states in the nation; therefore, animal health is of great importance to our state's economy. This study took aim at comparing three macrolide antibiotics to determine their effectiveness at mitigating the effects of BRD.

7

EFFECTS OF DELAYED STEROID IMPLANTING ON FEEDER CATTLE HEALTH, PERFORMANCE, AND CARCASS QUALITY

Robert D. Munson[1], Daniel U. Thomson[1], Christopher D. Reinhardt[2]
[1]Department of Clinical Sciences, College of Veterinary Medicine; [2]Department of Animal Sciences and Industry, College of Agriculture

Auction derived feeder calves (n=1,601; initial BW = 273.5 $\pm$ 4.7 kg) were used to examine the effects of delayed administration of the initial steroid implant on health, performance, and carcass characteristics of feedlot cattle. Steers were procured from auction markets and shipped to a central Kansas feedyard. Steers were randomly assigned, within arrival block, to 1 of 2 treatments: 1) implanted with Revalor-XS (40 mg estradiol and 200 mg trenbolone acetate) upon arrival (ARRIVAL); or 2) implanted with the same implant 45 d on feed (DELAYED). Cattle were pen weighed following processing. Feed deliveries were measured and recorded daily. Cattle were evaluated daily for morbidity and mortality. Individual animal health data were obtained and recorded daily. Final BW was calculated by dividing HCW by the average dressing percent. Carcass data were obtained by USDA personnel; presence of lung and liver pathology was evaluated by trained university personnel. Delaying the initial implant tended to reduce morbidity (24.7 vs. 28.5%; $P = 0.13$) and reduced railer rates (1.8 vs. 3.3%; $P = 0.02$); however, there were no effects of timing of implant administration ($P \geq 0.31$) rates of mortality, lung lesions, or pleural adhesions. Implanting upon feedlot arrival had no effect on ADG or feed conversion ($P \geq 0.56$). Cattle implanted upon arrival tended to have greater HCW and yield grade vs. cattle implanted on d 45 ($P \geq 0.16$). Delaying the initial implant 45 d had little effect on health, performance or carcass characteristics in high risk feeder calves.

Relevance of Research to State-Related Topic(s)

The state of Kansas is one of the largest cattle feeding states in the United States. In 2011, the Kansas beef industry had $7.6 billion in cash receipts and produced over 5.4 billion pounds of beef. Steroid implants have been utilized in beef cattle production since 1954 and are considered the single best management tool to improve feed efficiency and average daily gain in beef cattle. Recently, some questions from the field have arisen as to whether applying metabolic modifiers at the time of arrival could negatively impact the immune response in beef cattle. Animal health, food safety and animal welfare are often times woven together in modern beef cattle production issues and solutions.

8

COMPARISON OF THREE DIFFERENT DEHORNING TECHNIQUES ON PAIN, BEHAVIOR AND WOUND HEALING IN FEEDER CATTLE IN A WESTERN KANSAS FEEDLOT

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Cross-bred horned steers and heifers (n = 40; BW = 311.8 ± 4.7 kgs.) were used to determine the effect of dehorning methods on pain, cattle behavior, and wound healing. Cattle were blocked by weight and randomly assigned to 1 of 4 treatments: 1) control (CON); 2) banded using high tension elastic rubber (BAND); 3) mechanically removed (MECH); or 4) tipped (TIP). Vocalization and behavior were recorded during the dehorning process. Wound healing scores, attitude, gait and posture, appetite, and lying were recorded daily. Data were analyzed using the MIXED and GLIMMIX procedures of SAS (Cary, NC). Vocalization scores were highest for MECH cattle and BAND cattle vocalized more than TIP and CON ($P < 0.05$). Attitude ($P = 0.06$), gait and posture ($P = 0.06$), and lying scores ($P < 0.05$) were higher for BAND cattle in the days following procedures compared to MECH, TIP and CON cattle. BAND tended ($P < 0.13$) to have higher Appetite scores than the other methods. Wound healing scores (horn bud and bleeding) were higher for BAND cattle than MECH, TIP and CON cattle ($P < 0.05$). These data indicate that MECH is a painful procedure for cattle at the time of the procedure. Banding to remove horns from cattle is not recommended based on the data and observations from this study.

Relevance of Research to State-Related Topic(s)

In Kansas there are 6.1 million head of cattle. Kansas ranks in third in the U.S. in cattle and calves on farms and third in cattle and calves on grain feed. 19 percent of all U.S. beef originating from Kansas beef processing facilities. Dehorning is an animal husbandry procedure that is implemented in many Kansas dairy and beef cattle production systems every day. Dehorning can be done by several different techniques on cattle including chemically, amputation, cauterization, banding or cauterization or a combination of the aforementioned techniques. Dehorning is utilized in production systems for a variety of reasons including cattle handling safety for the cattle and the animal handlers, easier capture and handling in chutes, decrease carcass bruising and waste, increased market price and packer demands. To date there has been little research that has been done to compare the pain and behavior differences of the different techniques of dehorning.

9

A NOVEL SYSTEMATIC APPROACH TO IMPROVE CATTLE HEALTH AND WELL-BEING IN COMMERCIAL BEEF OPERATIONS

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Assessment and management tools exist within each beef industry segment to improve animal welfare and productivity, however no systems are currently in place to capture data over the entire production cycle. Therefore, a system to observe beef cattle life cycle health and well-being was designed and implemented to feedback real time data on the cattle health and productivity. These data were also used to determine the frequency and economic impact of gross pathology lesions present at slaughter. Investigators from Kansas State University gathered individual gross pathology data on 19,229 head of cattle at commercial packing plants in Kansas and Texas; corresponding pre-harvest and carcass data were was also obtained. Prevalence of lungs affected by severe and mild bovine respiratory disease lesions was 9.7 and 22.4%, respectively. Severe lung lesions were significantly associated with decreased average daily gain (ADG) and carcass weight compared to cattle with normal lungs, 0.16lb/day and 16 lb, respectively. Severe liver abscesses were observed in 4.6% of cattle and were also significantly associated with a decreased ADG and carcass weight compared to cattle with normal livers, 0.24lb/day and 24 lb, respectively. The interior of the reticulorumen was also inspected for abnormalities and lesions. A severe lesion or scar was observed in the reticulorumen of 7.6% of cattle and was significantly associated with a 0.06 lb/day decrease in ADG compared to a normal rumen. These data show that a collective monitoring system is feasible within the beef industry and significant opportunity exists to improve health and economic return.

Relevance of Research to State-Related Topic(s)

In 2011, cattle generated $7.64 billion in cash receipts for the state, with ¼ of all the fed cattle in the United States being held within our borders (Kansas Ag Statistics), making the success and sustainability of the beef industry paramount to the growth and security of the Kansas economy. While there is little debate that Kansas beef producers are among the best, improvements and efficiencies must always be sought after. Equally important is insuring the highest standards of animal husbandry and care as well as maintaining our leadership role in production agriculture to feed tomorrow's population. This research addresses all of these key issues and is a great example of the importance of our Land Grant University system to the success and prosperity of the state of Kansas.

10

IMPLEMENTATION OF INDUSTRY-ORIENTED ANIMAL WELFARE AND QUALITY ASSURANCE ASSESSMENT TOOLS IN COMMERCIAL CATTLE FEEDING OPERATIONS

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Consumer interest in production agriculture continues to prompt the beef industry to respond by developing tools to increase the accountability and transparency of management techniques within the industry. The purpose of this project was to demonstrate the ease of implementing an industry-oriented assessment, while recording useful data to show current practices within the cattle feeding industry. An assessment tool, developed by veterinarians, animal scientists and production specialists, was used to objectively evaluate key areas of beef cattle production such as animal handling, antibiotic residue avoidance, cattle comfort, food safety and others in commercial feedyards (n=56) that provide feed and care for 1,985,500 of the cattle on feed (one-time capacity) in the state of Kansas. Kansas State University personnel worked with cooperating feedyard personnel to complete the assessments. Nineteen of the 56 feedyards maintained current documentation of all management practices required by the assessment. During cattle handling observations, 78.5% of the feedyards performed at a level above passing according to the standards in the assessment. As an example, cattle handlers had to use an electric prod on only 3.98% of all cattle processed during observations. With respect to cattle comfort in the pen and feed bunks, 98% were considered acceptable; however, 25% of feedyards failed the water tank inspection. Implementation of this assessment will prove to be advantageous for management of employees while increasing consumer confidence in how cattle are handled and housed in cattle feeding operations using Kansas as a model for the rest of the beef industry.

Relevance of Research to State-Related Topic(s)

The state of Kansas' economy largely depends on production agriculture and the largest player in that portion of our economy is the cattle feeding industry. Kansas has a one-time total cattle feeding capacity of 2,370,000 cattle. This represents 16.8% of the total US inventory. Feedyards participating in this study account for 83.8% of the total cattle feeding capacity in Kansas. The results recorded are two-fold. First and foremost, it allows for documentation of normal practices of care which exceed an objective standard, while highlighting practices which may warrant improvement within operations that care for and feed cattle in the state. A study has never been conducted that demonstrates such a comprehensive assessment of animal welfare and food safety standards in the industry.

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PERCEPTION OF LAMENESS MANAGEMENT, EDUCATION, AND ANIMAL WELFARE IMPLICATIONS IN THE FEEDLOT FROM CONSULTING NUTRITIONISTS, VETERINARIANS, AND FEEDLOT MANAGERS

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In the feedlot the effect of lameness on cattle health, production efficiency, and welfare is not well defined in literature. The purpose of this survey was to describe perceptions of lameness within the feedlot industry. Consulting nutritionists (CN; n=37), consulting veterinarians (CV; n=47) and feedlot managers (YM; n=63) from the United States and Canada participated in the feedlot cattle lameness survey. The majority of the participants either manages or consults open air/ dirt floor feedyard facilities (98.4%). Participants were directed to an online survey to answer lameness management, incidence, perception, and economics questions. Across all participants, the median response for an estimate of lameness incidence in the feedyard was 2%, with a mode of 1%. Forty-one percent of participants believed that 50% or greater of the cattle suffering from lameness require treatment. Estimating the contribution of lameness to the total feedyard mortality, 81% of respondents believed it to be less than 10%. In comparison, 46% of participants estimate the contribution of lameness to the overall chronic/realizer loss in the feedyard to be 10% or greater. Footrot was measured as the most common cause of lameness by 42.2% of participants; compared to the 35.4% who considered injury the most common cause. Lameness was considered a welfare concern by 58% of participants, a growing concern by 20% of participants, and not a welfare concern by 22% of participants. This survey has provided insight into lameness perception and management through the perspective of multiple participants in feedlot cattle production systems.

Relevance of Research to State-Related Topic(s)

Kansas feedlot beef production, which is a multibillion dollar industry, is an important factor to the Kansas economy. Increased production costs associated with an increase in the cost of feedstuffs has made animal health and production efficiency as important as ever to the feedlot beef industry. Lameness in the feedlot has had little research emphasis which has led to a minimal understanding of its impacts on feedlot health and production efficiency when compared to other facets of cattle health. The impact of lameness on cattle comfort and overall welfare are other driving factors for the need of further research. It is essential that the beef production industry continues working toward a better understanding of the effects of lameness within the feedlot. All in all, discovering the perceptions of lameness within the feedlot industry can focus future research with finding the impact lameness has on the feedlot beef industry.

12

MORTALITY AND MORBIDITY DUE TO BOVINE RESPIRATORY DISEASE IN FEEDLOT CATTLE, ASSOCIATED WITH RECTAL TEMPERATURE, CASTRATION, DEHORNING (TIPPING), AND BODY WEIGHT AT ARRIVAL

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Bovine respiratory diseae (BRD) is the most common and costly disease in beef cattle. Body weight (BW) at arrival, castration, and dehorning have been postulated to be associated with the development of BRD; however, the information is inconsistent and most studies do not report the magnitude of this association. The objective of this study was to evaluate BW, castration, dehorning (tipping), and rectal temperature, at processing, as factors associated with mortality and morbidity due to BRD. The analysis included 3,365 individual animal records from three feedlots located in Kansas (n=1,002, BW 479 lb., SD ± 40 lb.), Nebraska (n=1,527, 519 lb., ± 91 lb.), and Texas (n=838, 572 lb., ± 41 lb.). Generalized linear mixed models were used to fit the categorical binary outcomes of mortality and morbidity rates. The estimated morbidity and mortality rates were 34.5% (SEM ± 4.8%) and 6.7% (SEM ± 1.9%), respectively. Odds ratios for morbidity and mortality were estimated comparing animals with fever and those with normal temperature, castrated animals vs steers, and reduction in BW. The estimated odds ratios indicated that calves with lighter weights and those with fever at arrival are in a greater risk of BRD mortality and morbidity. In addition, animals that were castrated were at greater risk of developing BRD. No evidence of association ($P \geq 0.22$) between tipping and BRD morbidity and mortality was observed. Monitoring rectal temperature and initial body weight can be beneficial tools to consider for early diagnosis, treatment, and care interventions of animals with BRD.

Relevance of Research to State-Related Topic(s)

The beef industry in the state of Kansas accounts for $6.5 Billion in annual receipts, and it is the most important sector in the Kansas Agriculture. A total of 5.1 million of cattle are placed in feedyards annually; bovine respiratory disease (BRD) is the most common and costly disease in these feedlot cattle. Economic losses are due to morttality, morbidity, treatment costs, and reduction of performance and beef quality. This research provides practical and usuful information for veterinarians, producers, and other animal care personnel, to monitor and identify risk factors associated with the disease. Then, best management practices, preventive measures, and treatment protocols can be implemented to prevent and control the disease, improve animal welllness, and increase feedlot profitability.

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ACUTE INTERSTITIAL PNEUMONIA IN FEEDLOT CATTLE

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Acute Interstitial Pneumonia (AIP) is a costly issue that affects feedlot cattle, especially during hot and dry summers. Research has yet to elucidate the exact etiology of AIP; therefore this study was conducted to determine possible factors that cause of AIP in feedlot cattle. During the summer of 2011 in a 55,000 head feedyard in southwest Kansas, animals exhibiting clinical signs of AIP were selected for ante-mortem examination and diagnostics. Animal population within the feedlot consisted of 75% heifers and 25% steers. Ante-mortem data consisted of rumen gas cap measurement for NH_3 and H_2S, rumen pH, serum chemistry, rectal temperature and body weight. Postmortem examination included similar data as ante-mortem examination with addition of visual and histological examination of lung tissue. There were 31 ante-mortem cases of clinical AIP with the following observations: rectal temperature 105.3 ± 0.7 (°F), weight 1098 ± 123 (lbs), H_2S 136 ± 133.3 (ppm), and rumen pH 6.4 ± 0.5. Twenty-five healthy cohorts were selected from identical pens to serve as controls. Observations from control animals are as follows: rectal temperature 103.7 ± 1.1 (°F), weight 1113 ± 133.3 (lbs), H_2S 269.8 ± 311.6 (ppm) and rumen pH 6.2 ± 0.6. A total of 61 post-mortem cases suspected with AIP were analyzed and determined the following outcome: H_2S 1279.7 ± 1569 (ppm), rumen pH 6.3 ± 0.36, and 53 animals had diffused, focal and /or patchy AIP confirmed by histology. This study further characterizes the diagnostic approach to AIP in feedyard cattle.

Relevance of Research to State-Related Topic(s)

According to the National Cattleman's Beef Association (NCBA), the state of Kansas is ranked as one of the top three beef producing states in the nation. As one of the largest beef producing states, the animal health sector has been our top priority within our production systems. Within the feedlot industry bovine respiratory disease complex (BRDC) continues to be the number one cause of morbidity and mortality followed by acute interstitial pneumonia. Currently, the etiology of acute interstitial pneumonia (AIP) in feedlot cattle still remains unknown. Cattle affected by AIP are very likely to die regardless of the types of treatment methods applied. This particular disease is most likely to affect cattle during late feeding periods close to their projected slaughter dates. During this particular study certain measurements were performed to find possible trends or factors that may lead to cause of AIP in beef cattle.

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SANITATION CAN INFLUENCE THE EFFICACY OF AEROSOL INSECTICIDES IN MILLING FACILITIES

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Literatures have shown that accumulated dust and food residues in flour mills can potentially decrease the efficacy of contact insecticides used against stored product insects. However, there is limited information on the effectiveness of aerosol insecticides, potential component of food facility IPM. A study was conducted to evaluate effects of flour residues on the efficacy of synergized pyrethrin aerosol against different life stages of the confused flour beetle, *Tribolium confusum* (Tenebrionidae). Twenty individuals of the adult, pupal, and larval stages were exposed to aerosol spray separately in Petri dishes containing 0, 0.1, 1, 5 or 10 g of wheat flour held inside empty sheds. After 2 h of exposure, the dishes were taken out of the sheds and placed in an incubator set at 27°C-60% RH. Adult mortality was assessed at 2, 5, 8, and 15 days post-exposure, while pupae and larval mortality were assessed at 21 and 28 days post-exposure respectively. Additionally, adult recovery after exposure was recorded for each of the flour depths. Mortality of adult beetles decreased with increasing depth of flour. Also, recovery of moribund insects increased with depths of 5 and 10 g flour compared to dishes with 0, 0.1, or 1 g of flour. Similarly, larvae and pupae were less affected when exposed in deeper flour dishes. Results suggest accumulated flour residues during application of an aerosol can reduce effectiveness; therefore sanitation should be emphasized prior to aerosol application.

Relevance of Research to State-Related Topic(s)

Methyl bromide (MB), the major structural fumigant of the food processing industries, is being phased out within the United States, in accordance to the Montreal Protocol. Other currently used pest control methods such as heat treatments, phosphine, and sulfuryl floride (SF) can be cost-intensive, require long periods of facility shutdown, and have potential negative effects on structures. Our study shows that aerosolized insecticides could be a promising alternative for MB. However, presences of dust and food residues in the facilities can influence the efficacy of applied aerosol. Therefore, this study emphasizes on through cleaning of facilities prior to aerosol application. Our results may help in the establishment of aerosol application as an easy, cost effective and safe method of pest control in the food facilities. Further, it may replace or reduce the use of heat treatments, phosphine, and SF.

15

SOIL FUNGAL AND BACTERIAL COMMUNITIES IN ORGANIC VS. CONVENTIONAL VEGETABLE PRODUCTION: CAPTURING THE ACTIVE PLAYERS THROUGH SOIL RNA ANALYSIS

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Soil microbes are fundamental to the productivity of agricultural systems. Organic management may foster more diverse soil microbial communities beneficial for crop production, with the potential to reduce losses to pathogens. We evaluated active microbial community responses in a six-year field experiment with two-year rotation of tomato and Chinese cabbage. We compared microbial communities in organic vs. conventional nutrient management with low and high fertility levels. Low fertility treatments for both organic and conventional managements only received added nutrients through a cover crop. The conventional high fertility treatment was supplemented with potassium nitrate, calcium nitrate, and inorganic pre-plant fertilizer. High organic fertility was supplied by fish hydrolyzate and compost pre-plant fertilizer. Using 454-pyrosequencing, we compared *total* resident fungal, bacterial, and archaeal communities using extracted DNA and the *actively metabolizing* microbial communities using extracted RNA. Specific primers were used to amplify 16S rRNA for bacteria and archaea and 28L rRNA for fungi. Using Inverse Simpson's Dominance as a measure of diversity, we found the highest bacterial diversity under organic management for the high fertility treatment. We recovered a number of bacterial genera that have important agroecological roles, such as *Nitrospira*, *Rhizobium*, and *Desulfovibrio*. Bacterial diversity was higher in DNA samples compared to RNA samples, indicating that the active microbial community is a subset of the DNA-inferred total community.

Relevance of Research to State-Related Topic(s)

This research addresses three key topics: bioscience, technology, and rural development. The project contributes to bioscience and technology through integration of cutting-edge DNA sequencing tools to support a better understanding of how soil management influences soil microbial communities. It contributes to rural development by providing new insights into soil resources that support farming in general, as well as new information about organic farming. Our study provides new insights about what active microbial communities are maintained by organic and conventional production methods, and also how fertilization level influences these communities. Scientists are only beginning to understand the full role of microbial communities in agricultural productivity. Results of the study will help in devising long-term strategies to manage microbial communities to make agriculture more productive and profitable.

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PREVALENCE AND DISTRIBUTION OF WHEAT VIRUSES IN KANSAS

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Viruses are some of the most economically-important pathogens infecting wheat in Kansas. The wheat streak mosaic, barley yellow dwarf, and soilborne and spindle streak complexes are the most important virus diseases of Kansas wheat. In order to develop effective virus disease management strategies to target these viruses, it is essential to characterize virus populations found in Kansas. To this end, a state-wide wheat virus survey was conducted in 2011 to determine the occurrence and regional distribution of six virus species in hard winter wheat fields across the state. Over 700 symptomatic and non-symptomatic plants were sampled and tested for the presence of *Wheat streak mosaic virus* (WSMV), High Plains Virus (HPV*), Wheat spindle streak mosaic virus* (WSSMV), *Wheat soilborne mosaic virus* (WSBMV), *Barley yellow dwarf virus* (BYDV-PAV), and *Cereal yellow dwarf virus* (CYDV-RPV) using double antibody sandwich enzyme-linked immunosorbant assay (DAS-ELISA). Overall, 53% of the plants were infected with virus. Virus was detected in 29% of the non-symptomatic plants and not detected in 27% of the plants displaying typical symptoms. Overall, the highest numbers of infected plants were found in the northern half of Kansas. An interesting outcome of the survey was the relatively high incidence of virus infected non-symptomatic plants. This finding may reflect low virus titers or late season infections that fail to result in visual symptoms. Also, estimates of yield loss due to viruses based solely on visual assessment of virus-like symptoms could underestimate the impact of these viruses on crop productivity.

Relevance of Research to State-Related Topic(s)

Wheat is the third most consumed food source globally and nearly one-fifth of all wheat produced in the United States is grown in Kansas. As such, wheat viruses have a tremendous impact on the economy of Kansas. Currently, there are few effective methods for preventing economic losses due to plant viruses. Our state-wide wheat virus survey highlights the importance of bioscience in Kansas for the development of new plant virus management strategies.

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EVALUATION OF POINT MUTATIONS IN THE ATTENUATION OF YELLOW FEVER VIRUS

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Whilst the 17D vaccine has been used extensively for the control of yellow fever virus (YFV), the roles of the specific mutations in its attenuation in both mammals and mosquitoes remain unknown. Previous research has demonstrated the importance of the envelope protein domain III (ED3) in governing the attenuation process and the virulence amongst various flaviviruses. With the cDNA infectious clones of the 17D strain, Asibi strain and chimeric viruses containing the structural region of Asibi strain on the 17D strain backbone, we evaluated the roles of two mutations located in ED3, M299I and T380R, for the infection and dissemination in Aedes aegypti. Detection of viruses in the bodies, heads, legs and wings of mosquitoes was based on TCID50 titration. Infection was reported based on the detection of viruses in either the whole body or any tissues above. Dissemination was confirmed by the detection of viruses in the heads, wings or legs. The effects of the specific mutations on infection and dissemination in mosquitoes will be discussed.

Relevance of Research to State-Related Topic(s)

The recent increases in the distribution and incidence of flaviviruses, for example West Nile virus (WNV) in the United States, has highlighted the threat not only to humans, but also the livestock. Horses and pigs for example are highly susceptible to West Nile virus and to the closely related Japanese encephalitis virus. Already this year there have been 364 equine cases of WNV in the US, despite the availability of a vaccine. The best and most cost-effective strategy to control the diseases in both human and livestocks is to adminsiter live-attenuated vaccines. Our studies with yellow fever virus are designed to provide better understanding of the mechanism of attenuation of the safe and efficaciousness YFV 17D vaccine virus. This knowledge can ultimately be applied to the generation of live-attenuated vaccine candidates for other zoonotic flaviviruses such as West Nile virus and Japanese encephalitis virus.

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IMPROVING THE PROPERTIES OF FUNGICIDES

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Triazoles and their derivatives represent an important class of fungicides which act as demethylase inhibitors (DMIs). Although anti-fungal triazole drugs like Itraconazole and Fluconazole are effective, they suffer from poor water solubility, which makes administration of the drug particularly challenging. One possible solution for improving the solubility is to synthesize co-crystals by combination of the fungicide with a co-former, such as a carboxylic acid. The co-former may offer improved solubility properties, which in turn would allow the drug to be tailored for the desired application. To test this, we first synthesize molecules containing a triazole group. The molecule is then ground together (solvent-assisted grinding) with different co-formers and the resulting mixture is analyzed for evidence of molecular 'communication'. Co-crystals are grown which contain both the drug and co-former, which will give a picture of how the two are interacting in the solid-state. Melting point and solubility measurements on the co-crystals are made to see if any changes in physical properties have been obtained. This poster will cover our current results to date.

Relevance of Research to State-Related Topic(s)

Kansas has been a leader in the agricultural industry for a number of years, and the business relies heavily on fungicides. It is important to understand how to engineer more effective materials for stopping the growth of unwanted fungicides. More importantly, it is crucial to understand how we can save farmers money by reducing the number of applications required or improving storage and handling properties of the drug. Our research aims to help understand the fundamental properties of the fungicides and how to tailor their properties.

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TRANSPOSON BASED MUTAGENESIS AND MAPPING OF TRANSPOSON INSERTION SITES WITHIN THE *EHRLICHIA CHAFFEENSIS* GENOME USING SEMI RANDOM TWO-STEP PCR

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Ehrlichia chaffeensis a tick transmitted Anaplasmataceae family pathogen responsible for human monocytic ehrlichiosis. Differential gene expression appears to be an important pathogen adaptation mechanism for its survival in dual hosts. One of the ways to test this hypothesis is by performing mutational analysis that aids in altering the expression of genes. Mutagenesis is a useful tool to study the effects of a gene function in an organism. We used *Himar* transposon mutagenesis to create mutations in *E. chaffeensis*. Multiple mutations were identified by Southern blot analysis. To identify the insertion sites, we employed a semi-random two step PCR (ST-PCR) assay and rescue cloning methods, followed by DNA sequence analysis. In ST-PCR, the first PCR is performed with genomic DNA template with a primer specific to the insertion segment and the second primer containing an anchored degenerate sequence. The product from the first PCR is used in the second PCR with nested transposon insertion primer and a primer complementary to the conserved portion of the degenerate sequence primer. The ST-PCR and rescue cloning methods aided in mapping eight insertion sites within the *E. chaffeensis* genome; six of them were located in the intergenic regions and two were located within the coding regions of hypothetical protein genes. This is the first mutational analysis study in the genome of an *Ehrlichia* species. (This study was supported by the NIH R01 grant #AI070908.)

Relevance of Research to State-Related Topic(s)

Ehrlichiosis is an emerging disease and it is transmitted to humans by the lone star tick (*Ambylomma americanum*), found primarily in the south central and eastern U.S including Kansas. It is one of the most commonly found tick on people and dogs in Kansas. White-tailed deer is a major host of lone star tick and is the reservoir host for *E. chaffeensis*. High white tail deer populations and lone star tick increase the risk of acquiring tick borne illnesses in people. As little is known about the HME infection, research leading to effective methods of controlling the infection is important. The focus of this research is to define the pathogenesis caused by the organism using modern molecular tools.

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DIFFERENT PHYSIOLOGY ROLES OF TWO DOPAMINE RECEPTORS IN ISOLATED SALIVARY GLANDS OF THE BLACKLEGGED TICK, *IXODES SCAPULARIS*

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Ticks are obligatory ectoparasites that transmit pathogens causing human diseases, such as Lyme disease. Salivary secretion in ticks is crucial, not only for the injection of bioactive salivary components into the host, but also for osmoregulation after the ingestion of large amounts of blood. Paracrine or autocrine dopamine in the salivary glands induces salivary secretion. Two dopamine receptors have recently been characterized in the salivary glands and named as the dopamine receptor (D1) and D1-like receptor (D1L), based upon their sequence similarities to vertebrate dopamine receptors. We were able to identify a D1-specific agonist (SKF82958) and three D1L-specific antagonists (acepromazine, fluphenazine, and clozapine) in the heterologous functional assay of these receptors. These compounds served as pharmacological discriminators of the two receptors *in vivo*. Isolated tick salivary glands were examined for the measurement of secretory activities following exposure to pharmacological discriminators. This semi- *in vivo* study using receptor specific antagonists and agonists provides evidence that the two receptors, D1 and D1L, are leading to two different physiological actions in salivary secretion. We propose that D1 triggers fluid transport in the epithelial cells of the acini, and that D1L is involved in gating/pumping actions of the salivary acini. Understanding the mechanisms of tick salivary gland control will lead us to the development of novel methods for the disruption of tick feeding.

Relevance of Research to State-Related Topic(s)

According to the Centers for Disease Control and Prevention (CDC), reported cases of Lyme disease in Kansas have increased by about 214% during the last five years (2007-2011) compared to the previous five years (2002-2006). However, our group is the only research group in Kansas to investigate tick physiology and provide fundamental information for the development of a novel acaricide. In the last three years, our group published papers on the peptidergic neuroendocrine network of the tick brain, neuropeptides in tick salivary glands, and evidence of dopamine receptors in tick salivary glands. An understanding of how ticks control fluid secretion via dopamine receptors would be the key to the development of a novel strategy for the disruption of tick physiology. Our current research is supported by an NIH research grant.

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CAPTURING VIRUS PARTICLES USING DIELECTROPHORESIS ON CARBON NANOFIBER NANOELECTRODE ARRAY

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Portable microfluidic devices are highly demanded for rapid pathogen detection. This work describes efficient and reversible manipulation of virus particles using a nanostructured dielectrophoresis (DEP) device as an on-chip sample preparation module toward this goal. The non-uniform electric field for DEP is created by utilizing a nanoelectrode array (NEA) made of vertically aligned carbon nanofibers (VACNFs) versus a macroscopic indium tin oxide electrode in a "points-and-lid" configuration integrated in a microfluidic channel. Virus particles (~ 200 nm) experienced less DEP force in previous microscale devices, making them a challenge to capture. NEAs can generate much higher electric fields to produce a larger DEP force on small particles, viruses. The DEP capture of the virus particles has been systematically investigated versus the flow velocity, sinusoidal AC frequency, peak-to-peak voltage, and virus concentration. At a low virus concentration ($8.9x10^4$ $pfu{\cdot}ml^{-1}$), the DEP capture efficiency of up to 60% can be obtained at isolated nanoelectrode tips and accumulates linearly with time. Due to the fact that the size of the nanoelectrodes (~ 100nm) is comparable to that of the virus particles, it is more effective to viruses than larger bacterial cells with such NEA based DEP devises. This technique can be potentially utilized as a fast sample preparation module in a microfluidic chip to capture, separate, and concentrate viruses and other biological particles in small volume of dilute solutions in a portable detection system for field applications.

Relevance if Research to the State related Topic

Detection of pathogens is crucial in industries ranging from monitoring of water and food contamination. Kansas is a leading in meat processing and agriculture. The recent cases of people getting affected by Ebola virus and pigs affected by Ebola-Reston virus have come into picture making it important to detect viruses at early stage to ensure that the consumer is safe from transmission of communicable disease due to pathogens and to avoid significant financial loss due to product recalls. We are putting our efforts in developing sample preparation methods using dielectrophoresis to capture viruses in microfluidic chip that helps to concentrate and sort microbes in the raw sample, which can be easily integrated with other on-chip identification methods for further analysis. This method is faster and more reliable than traditional techniques and fits the needs of meat processing industries and agricultural production in Kansas.

22

CANINE VISCERAL LEISHMANIASIS IN KANSAS: A NEW HEALTH RISK?

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Phlebotomine sand flies are the principal vectors of leishmaniasis, a neglected tropical disease caused by parasites of the genus *Leishmania*. Endemic transmission of leishmaniasis has been reported in 98 countries with an annual incidence of 2 million human cases. Since 1999, several cases of visceral leishmaniasis (VL) have been reported in dogs in North America, especially among Foxhounds. Strong evidence points to vertical and horizontal transmission of the parasite *Leishmania infantum* among these dogs, however a sand fly transmission route is also thought to occur. Our results indicate that VL-symptomatic Foxhounds (naturally infected) are highly infectious to laboratory-reared *Lutzomyia longipalpis* sand flies. Moreover, parasites fully develop within these flies and are transmitted to naïve vertebrate hosts following the bite of infected sand flies. Thus, the potential exists for this parasite to become endemic in North America considering the presence of native sand fly species. We are also investigating the effects of antibodies targeting sand fly molecules involved in the formation and degradation of the peritrophic matrix (PM) on sand fly oviposition. Our results show that feeding anti-PpChit1 antisera to sand fly females lead to a thickening of the PM, and that is associated with a delay in oviposition. These studies aim at understanding the potential role of U.S.-native sand flies in the transmission and establishment of leishmaniasis in North America, and at identifying targets in sand flies that can be used in transmission control strategies.

Relevance of Research to State-Related Topic(s)

Canine visceral leishmaniasis (CVL) has been diagnosed among Foxhounds in Kansas. Recently, our group reported for the first time the presence of potential sand fly vectors in Kansas and Missouri. The combination of potential vectors with infected vertebrate hosts creates a scenario for this disease to become endemic placing humans at risk of infection. In addition, the deployment of U.S. troops in *Leishmania*-endemic countries increase the risk of infection and the possibility that soldiers returning home may serve as a source of infection to native sand fly vectors. Our studies are aimed at identifying the vectorial capacity of sand flies in Kansas and at developing new strategies to control transmission to naïve hosts.

23

THE DISTRIBTUION OF A GAP JUNCTION ENHANCER (PQ11) AND ITS EFFECTS ON A MOUSE MAMMARY TUMOR MODEL

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Animal models are commonly used to analyze the mechanism of carcinogenesis as well as the development and screening of potent drugs. Loss of gap junctional intercellular communication (GJIC) is characteristic of neoplastic cells, and restoration of GJIC with small molecules such as a gap junction enhancer (PQ11) may provide treatment with less detrimental effects. The effects of PQ11 on normal tissue were first evaluated in healthy C57BL/6J mice in a systemic drug distribution study. Next the transgenic strain FVB/N-Tg(MMTV-PyVT)634Mul/J (also known as PyVT) was used as a spontaneous mammary tumor mouse model to determine the biological and histological effects of PQ11 on tumorigenesis and metastasis at three stages of development: Pre tumor, Early tumor, and Late tumor formation. PQ11 was assessed to have a low toxicity through intraperitoneal (IP) administration, with the majority of the compound being detected in the heart, liver, and lungs six hours post drug administration. The treatment of tumor bearing animals with PQ11 indicated a significant reduced tumor growth during the Pre stage of development. PQ11 treatment increased gap junctional protein, connexin, during Pre-tumor formation; while it prevented an increase in connexin expression during the Late stage tumor formation. This study shows that GJIC and neoplastic cellular growth are inversely related, but that PQ11 can alter tumor growth through targeting gap junctions to prove clinical efficacy in the treatment of spontaneous mammary tumors.

Relevance of Research to State-Related Topic(s)

A total of 1,638,910 new cancer cases and 577,190 deaths from cancer are projected to occur in the United States in 2012. The American Cancer Society's most recent estimate for breast cancer in the US are about 226,870 new cases of invasive breast cancer and 63,300 new cases of carcinoma in situ. In Kansas that is 124 per 100,000 women with invasive breast cancer and 23 per 100,000 women will die from breast cancer related causes. This is approximately 1,890 new invasive breast cancer cases and about 370 deaths.

24

EXPLORATION OF REACTANT-PRODUCT LIPID PAIRS IN MUTANT-WILD TYPE LIPIDOMICS EXPERIMENTS

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As "omics" high-throughput metabolite profiling is developed, developing methodology to use the data to identify the functions of genes is very important to biologists. For genes that encode enzymes, a mutation in the gene is expected to alter the level of the metabolites which serve as the enzyme's reactant(s) (also known as substrate) and product(s). Using metabolite data from a wild-type organism and a mutant which is deficient in a gene function, the goal is to identify candidate metabolites for the normal reactants and products of the enzyme that was lacking in the mutant. Comparing a mutant organism to a wild-type organism, the reactant concentration level will be higher and the product concentration level lower in the mutant. This is because the effect of the mutation is to block the reaction between reactant and product. To detect possible reactant and product pairs in a lipidomics experiment done in a plant (*Arabidopsis thaliana*) system, based on the above scheme, we propose several test statistics that quantify the "silencing effect" of the mutation on a reactant-product relationship. Distributions of the test statistics are explored using a bootstrap method to obtain distributional characteristics of the test statistics under a null hypothesis. This then forms the basis for a test for detecting reactant-product pairs in a mutant-wild type lipdomics experiment.

Relevance of Research to State-Related Topic(s)

Research at Kansas State University contributes to the quality and quantity of our food supply and our supply of industrial raw materials. In particular, plant biologists are discovering new information about plant lipids and their roles in biomass production, plant adaptation to climate extremes, and response to plant pathogen threats. Data on lipid quantity, localization, and dynamics provide insight into the molecular processes of plants on a functional level. The action of enzymes involved in lipid formation and break-down is dependent on the presence of genes encoding the enzymes. If a lipid-metabolizing gene is mutated and its enzyme is no longer made, the levels of the gene product's reactant(s) and product(s) will be altered. The proposed statistical method will aid in the discovery of plant pathways and genes involved in lipid metabolism and lipid signaling. Eventually the gene and pathway discoveries will be applied for improvement of crop plants.

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UTILIZATION OF HIGH LIGNIN RESIDUE ASH (HLRA) IN CONCRETE MATERIALS

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Cement, an essential ingredient of concrete, is the most expensive and energy-intensive product in most concrete. Considering the threat of climate change and global warming, efforts have been put forward to reduce the amount of CO_2 emission from the cement industry by considering alternative methods for producing more environmental friendly cement and concrete. One such way is using supplementary cementitious materials (SCMs) as a partial replacement of cement in concrete. It has been shown that agricultural residues can be potential resources for CSMs production. It is well established that dilute acid pretreatment techniques enhance the reactivity of agricultural residues ash (ARA) in concrete materials. However, the impact of dilute acid pretreatment followed by enzymatic hydrolysis or agricultural residue on the pozzolanic property of the ARA has not been addressed yet. In this study, pozzolanic reactivity of ash produced by burning high lignin residue (HLR) is documented. HLR, a byproduct of bioethanol production from corn stover, is actually dilute acid pretreated and enzymatic hydrolyzed corn stover. Based on heat of hydration, calcium hydroxide consumption, and compressive strength experiments, it was concluded that the ash produced by burning HLR is a very reactive pozzolanic material that can be used as a partial replacement of cement in concrete materials. Thus, HLR which are byproducts of biochemical conversion of AR can be utilized as valuable materials for CSMs production for concrete.

Relevance of Research to State-Related Topic(s)

Climate change and global warming caused by greenhouse gas, particularly carbon dioxide, emission is a major concern worldwide. Cement, an essential ingredient of concrete, is responsible for 8% global carbon dioxide emission. Therefore, my research aims to reduce the cement percentage in concrete materials and thus to lower the energy intensity and carbon footprint of concrete materials. My research investigates the utilization of agricultural residue ash (ARA) as a low cost and environmentally-friendly highly reactive supplementary cementitious material (SCM) that can be used as a partial replacement of cement in concrete. This will reduce carbon footprint as well as increase the durability of concrete materials, the most used material after water.

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USING AN ACYLTRANSFERASE WITH UNUSUAL SPECIFICITY TO GENERATE LOW VISCOSITY SEED OIL

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Euonymus alatus (Burning Bush) accumulates high concentrations of acetyl triacylglycerol (acTAGs) in its endosperm as storage lipids. These acTAGs possess 29% lower viscosity than long chain triacylglycerols (lcTAGs). The enzyme responsible for the generation of these acTAGs is an acyltransferase and was given the name EaDAcT (*Euonymus alatus* diacylglycerol acetyltransferase). Successful transformation and expression of EaDAcT in Arabidopsis provides us with a potential application of this enzyme in the production of low viscosity oils in commercial crops. These plants need to provide the specific substrates to the enzyme to produce high amount of these oils. So characterization of EaDAcT in terms of its specificity towards a variety of donor and acceptor substrates is necessary. EaDAcT expressed in wild type yeast microsomes was used for characterization studies. Km and V_{max} for this enzyme were found to be 104.50 μm and 454.55$\mu mols^{-1}$ respectively. Sequence alignment studies have shown that EaDAcT has high similarities with known wax synthases. It was indeed found to form alcohol acetates with a variety of primary long chain alcohols in the presence of 10% (w/v) dimethyl sulfoxide proving its wax synthase activity. Future research will involve substrate specificity assays of EaDAcT for various donor and acceptor substrates. Plant expression studies of EaDAcT were started by agrobacterium-mediated transformation of this enzyme into transgenic *Camelina sativa* lines producing high amounts of low and medium chain fatty acids. Transformants were selected using basta resistance and will be further analyzed for presence of long and medium chain fatty acid containing acTAGs.

Relevance of Research to State-Related Topic(s)

The current research will ultimately lead to the generation of transgenic plants with high levels of acTAG containing oils. These oils, due to their lower viscosity compared to usual long chain TAG containing oils, can provide an alternate source of renewable energy in the form of a improved straight vegetable oil (SVO) biofuel. Currently seed oils have to be converted to biodiesel for use in conventional diesel engines; our goal is to develop plants that synthesize seed oil that can be used directly as a transportation fuel. Further, the novel enzyme EaDAcT with its wax synthase activity can generate acetate waxes if coexpressed with fatty alcohol genes in suitable host species. These waxes can be of specific use in some high value commercial applications.

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REGIONAL COMPETITIVENESS IN THE ETHANOL INDUSTRY

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Location is an important factor in the economic viability of any ethanol plant. A plant must source grain (corn), and have markets for its ethanol and distiller's grain. In moving those products, transportation is critical, especially for corn and distiller's grains due to their cost to transport relative to value. Thus, today geographic location relative to the rest of the industry is critical to economic viability. With this study we evaluate that viability by optimizing the flows of corn and DDGS nationally based the current plant locations, and then evaluate the competitiveness of individual plants. Such information is useful for understanding the direction of industry development for addressing the competitiveness of individual plants. A compilation of current ethanol plant locations and capacities will be used for comparison to determine exit and expansion, and to identify supply and demand regions for both feed grains and DDGS. These regions will then be used to construct linear programming network-flow models for the transportation of feed grain and DDGS respectively. Two models will be used; the first to minimize the transportation cost of feed grains to demand regions, and the second to minimize the cost of transporting DDGS to demand regions. These regional transportation costs provide a method of comparing the strategic position of specific plant locations. Current plant locations and transportation cost results will be compared with those from previous research and, with additional consideration to changes in production factors, will be used to gain further understanding of industry growth.

Relevance of Research to State-Related Topic(s)

The birth and growth of the ethanol industry is a major event in agriculture over the past half century. In its infancy, the industry consisted mostly of many locally-owned and operated plants that came about with the coalescence of the interest of local corn producers, investors and economic development authorities. From 2006 to 2010 growth exploded, propelled, in part, by President George W. Bush's energy policy. Its growth has been hampered lately by high grain prices and adequate ethanol supplies. On the other hand, livestock producers have adapted rations to the use of distiller's grain, which has improved the demand for it. Technology in ethanol production and corn genetics are helping to improve the efficiency of ethanol production. Ethanol economics have changed as the industry matured. The viability of plants depends upon their location for sourcing corn, marketing distiller's grain and ethanol. This project focuses on that issue.

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DEVELOPMENT OF A PRECISION 3D NON-CONTACT PROFILOMETER TO PROVIDE AUTOMATED GEOMETRICAL FEATURE EXTRACTION AND ANALYSIS OF PRE-STRESSING STEEL REINFORCEMENT WIRE

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The purpose of this research project is to develop a precision 3D non-contact profilometer to provide automated geometrical feature extraction and analysis of pre-stressing steel reinforcement wire that is intended to be used for concrete railroad ties. Through the extraction and analysis of the reinforcement wire geometrical features, analyses have been performed to identify which features of the reinforcement wire provide high bond strength between the wire and its surrounding concrete medium. Mathematical models have been developed to predict the bond strength of reinforcement wire through the analysis of geometrical features extracted from the 3D profiling process. This developed equipment and analytical technique provides potential solutions for providing quality control of reinforcement wire manufacture. In addition this research provides opportunities in optimizing reinforcement wire design to maximize bond strength and minimize concrete fracture.

Relevance of Research to State-Related Topic(s)

The primary purpose of this research project is to provide quality control standards and geometrical design improvements of pre-stressing steel reinforcement wire to be used in the production of high speed railway concrete railroad ties. The benefits offered by this research have a direct impact on the United States railway infrastructure.

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DESIGN OF DETAILED MODELS FOR SIMULATIONS OF PERMANENT-MAGNET DIRECT DRIVE WIND TURBINES

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This work is concerned with the design of two models for permanent-magnet direct-drive wind turbines. The models are of a 10 kW and a 5 MW wind turbine, which are representative of residential scale and commercial scale turbines respectively. The models include aerodynamic and mechanical simulations through the FAST software, as well as concurrent electrical simulations through the SimPowerSystems toolbox for MATLAB/Simulink. The aim is to provide wind turbine designers and researchers with a comprehensive simulation tool that they can use to design and test many different aspects of a wind turbine. The particular novelty of these models is their high level of detail in electromechanical simulations. For each model, a generator speed controller was designed in a reference frame attached to the generator's rotor, and was executed with a 3-phase active rectifier using space-vector pulse-width modulation. Also for each model, active and reactive power controllers were designed in a reference frame synchronous with the grid, and were executed with a 3-phase inverter using space-vector pulse-width modulation. Additionally, a blade pitch controller was designed for the 5 MW model. Validation of the models was carried out in the MATLAB/Simulink environment with satisfactory results.

Relevance of Research to State-Related Topic(s)

Wind energy has been booming in Kansas over the last 5 years. With over 1,250 MW installed, and much more capacity available, Kansas has established itself as a prime location for wind power. While wind power is quickly becoming a major contributor to the power grid in Kansas, it is far from a perfect power source. There is much to be gained by improving the design of wind turbines, including higher efficiency, greater stability and control, lower failure rates, etc. The aim of the work is to provide wind turbine researchers and designers with a tool that they can use to design better wind turbines. What's good for wind energy is generally good for Kansas, and hopefully these tools will be used in a way that will benefit both the industry and the state.

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MAINTAINING SUBSTRATE QUALITY OF STORED SORGHUM BIOMASS FOR PROFITABLE PRODUCTION OF LIGNOCELLULOSIC ETHANOL IN KANSAS

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With federal mandates to increase biofuel production in the US, the promise of ethanol from lignocellulosic substrates underlines the need to examine the production and supply chain. This research examines how long-term storage impacts the photoperiod-sensitive sorghum biomass. Sorghum is ideal in Kansas for its drought tolerance, easy incorporation into existing rotations and its growth on marginally productive lands unsuitable for other crops thus allowing farmers to diversify production and management. We monitored biomass quality (biomass components: cellulose, hemicellulose and lignin), cellulose and hemicellulose degrading Extra-cellular Enzyme Activities (EEA) and – ultimately – efficiency of ethanol conversion. Sorghum biomass was harvested, baled into small square bales and stored either uncovered, covered with plastic tarp, wrapped in plastic, or wrapped and covered. The bales were stored outdoors for a total of six months. Dry matter (88% to 59.9%), cellulose (35.5% to 25%) and hemicellulose (23.7% to 16%) contents plus ethanol yields (0.20 g L-1 to 0.02 g L-1) all declined dramatically and EEA activities almost doubled in biomass stored uncovered for six months. In contrast, bales stored covered for six months maintained dry matter, cellulose, hemicellulose, and ethanol yields plus minimal EEA. This emphasizes the need to store sorghum biomass covered to retain substrate quality and maximize ethanol yields to maintain a profitable production chain. Utilization of sorghum biomass for biofuel production also allows for increased crop rotation diversity for Kansas farmers.

Relevance of Research to State-Related Topic(s)

Almost half of the State of Kansas relies on the Ogallala aquifer for crop production. This precious natural resource is becoming alarmingly depleted, resulting in increased irrigation costs, making high water requirement crops increasingly difficult to grow for Kansas farmers. In addition, increases in production inputs and total energy costs and changes in climate (e.g. extreme temperatures, more variable precipitation), crop production may be negatively impacted for those reliant on the Ogallala aquifer throughout the State of Kansas. To help reach national sustainable energy demands, specifically biofuels, Kansas' farmers could grow sorghum as a versatile bioenergy crop. Our studies show that proper storage can maintain substrate quality for lignocellulosic ethanol production from sorghum biomass leading to increased profits for Kansas farmers.

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A NEW MULTI-LEVEL INVERTER WITH D-STATCOM CAPABILITY FOR WIND APPLICATIONS

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Deployment of renewable energy systems such as wind and solar to produce energy have been attracting increasing interest in recent years. Among all renewable energy sources, wind energy has the biggest share to producing electricity. Recently, Distributed Generation (DG) has been introduced to the modern power systems in order to avoid generating power and transmitting for a long distance. Relatively small power generations such as small wind systems would be a novel approach to penetrate renewables to the power systems. Small renewable energy sources are connected to the low side of the distribution systems. In other words, in modern power systems, end customers do not act only as consumers, but they operate as active power suppliers. This idea becomes possible using power electronics in power systems. In this research, a new Multi-level D-STATCOM Inverter is designed to replace the traditional inverters for wind energy sources to regulate the active and reactive power transfer between the distribution grid and the wind turbine. The proposed single-phase Inverter with D-STATCOM capability utilizes Modular Multi-level Converter (MMC) topology which is an attractive topology for HVDC and FACTS systems. The proposed D-STATCOM is designed for grid-connected wind turbines in the small to mid-sized (10kW-20kW) range for home or farm owners in rural or remote locations. The proposed system provides high dynamic performance and power quality to the grid. To validate the performance of the system, simulation studies for an 11-level D-STATCOM are carried out it the MATLAB/Simulink.

Relevance of Research to State-Related Topic(s)

Penetration of the renewable energy systems to power systems has been attracting attention in recent years. The general idea of producing electricity from sustainable energy sources such as wind or solar is a global issue. Renewable energy systems are modular and are not scattered uniformly. Kansas has very good sources of wind energy that makes it a good choice for wind applications. Additionally, there are a lot of farms and remote locations in Kansas using single-phase power lines. The general idea of the proposed research is to lower the cost of the wind energy for small wind applications such as farms or remote homes as well as making the power quality higher for utilities. The proposed D-STATCOM Inverter is able to provide utilities with more information and knowledge about end points of the distribution systems.

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OPTIMAL OPERATIONS OF DISTRIBUTED WIND GENERATION IN A DISTRIBUTION SYSTEM USING PMUS

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Wind energy is becoming one of the most widely implemented forms of renewable energy worldwide. Traditionally, wind has been considered a non-dispatchable source of energy due to the uncertainty of wind speed and hence the variable availability of wind power. Advances in technology allow the consideration of the impact of distributed wind turbines and farms on distribution systems by combining the clean energy attributes of wind with the quickly dispatchable nature of a storage facility in order to provide the maximum amount of locally available power economically to the loads present in the distribution feeder. The task of monitoring can be effectively accomplished using Phasor Measurement Units (PMU) which have very high sampling rates and hence can measure very rapid and dynamic changes in power levels associated with distribution feeder load and wind generation. The data which is obtained from these PMUs can be used to optimize the amount of distributed generation that can be produced locally, thus resulting in a reduction in the peak load levels associated with the distribution feeder as seen by the substation monitoring system. Simulations will work to balance load requirements, wind output, and storage providing a stable system utilizing maximum renewable resources. Standard IEEE Distribution Test Feeders are used in the study. Various probabilistic models are implemented for distribution feeder load and PMU measurements, and the models are analyzed by simulations. The strategy being investigated can also be used to implement other important applications such as distribution system state estimation, protection and instability prediction.

Relevance of Research to State-Related Topic(s)

Kansas is potentially rich in wind energy generation capacity among states in USA and is second behind Texas. Recent estimations by the National Renewable Energy Laboratory (NREL) show that wind capacity in Kansas exceeds the total existing generation in USA recorded in 2011. But the effective utilization of this resource will require co-ordination with other forms of distributed energy resources. The research being carried out will help to maximize the amount of locally generated power combined from wind resources and stored energy from batteries in a distribution system, while also ensuring that this power is available when it is most required. The simulations being carried out will maximize the usage of economically available local power resources during heavy load conditions using the instantaneous information about load requirements and resource availability from Phasor Measurement Units (PMU) which measure data at rates of up to 30 samples per second.

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MAXIMIZING RENEWABLE DISTRIBUTED GENERATION AND STORAGE IN A THREE PHASE UNBALANCED DISTRIBUTED SYSTEM WITH NON-LINEAR OPTIMIZATION

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The final goal of our project is to optimize a real world three phase unbalanced distribution system with renewable distributed generation (DG-Wind) and distribution storage (DS-NaS batteries).In the first phase of our research was focused on maximizing the renewable DGs with the help of DS in a three phase unbalanced distribution system considering dynamic load, generation and storage strategies. The Matlab software was used to model the system (IEEE 37 distribution test feeder) with generation data (Northwind100 wind turbine data) and 50 kW NaS battery as the distribution storage. The aggregate demand for a real world system was used to generate the dynamic load data considering the given IEEE 37 distribution test feeder data as the peak load. The second phase focuses on optimizing sizing and siting of the DG and the storage. Objectives of the optimization are to maximize the renewable DG, minimize the capacity of the distributed storage to make the solution economically viable and minimize the total system losses. One of the major advantages of the optimization is that it allows us to identify multiple locations of DG and DS placement. Based on our previous research studies and according to reported literature the renewable DG around 70% of the total peak load of the system with the existing system losses should be able to minimize. We anticipate that the present research on the real world distribution system will allow us to achieve our final goal.

Relevance of Research to State-Related Topic(s)

Kansas has very good wind resources with a potential wind capacity second behind Texas. Most recent estimations by the National renewable Energy Laboratory (NREL) shows that the Kansas has 952 GW of wind capacity and can generate 3650 TWh of energy each year, which represent more than all the electricity generated in USA in 2011. Research we are carrying out will help to maximize the renewable generation and minimize the total system losses which will decrease cost of energy production as well as the cost of energy. It also helps to bring down the carbon footprint of the energy production, which leads in to a greener future. Large scale renewable penetration will create new job opportunities and stop the currency flows to foreign countries.

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INVESTIGATION OF BIFUNCTIONAL CATALYST ON ONE-SETP CONVERSION OF 2,3-BUTANEDIOL TO BUTENE

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The objective of this research is to convert 2,3-butanediol (2,3-BDO) produced via fermentation of biomass to butene in a single step over a bifunctional (acid and metal) catalyst. This process involves a bifunctional pathway, in which 2,3-butanediol is dehydrated on an acid site to Methyl Ethyl Ketone (MEK), isobutylaldehyde, and even butadiene, which are subsequently hydrogenated to butene on the metal site at temperatures of 473-523 K. The major challenge for this research is to balance dehydration and hydrogenation pathways in order to selectively produce butene. To investigate the influence of catalyst composition, zeolite-supported copper and nickel catalysts of varying metal loading were prepared by incipient wetness impregnation of commercial HZSM-5 (Zeolyst) with various Si/Al atomic ratios (23, 50, 80 and 280). Preliminary results show that butene can be produced selectively in the gas-phase on Cu/ZSM-5, but multiple side-products are produced, including isobutylaldehyde, MEK, 2-methyl-1-propanol, 2-ethyl-2,4,5-trimethyl-1,3-Dioxolane, unsaturated heptenone, and other products. Higher reaction temperatures lead to more side-products.

Relevance of Research to State-Related Topic(s)

Recently, microbial 2,3-budanediol production has attracted great attention worldwide. Currently, Klebsiella oxytoca and K. pneumonia have been unbeatable in the efficient production of 2,3-butanediol from xylose and glucose by fermentation. In this project, we developed a novel process for production of butene, which is a basic building block of fuels as well as many industrial chemicals, by catalytic conversion of 2,3-butanediol. Kansas is one of the most productive agricultural states in the USA, and could receive substantial economic benefits from technologies such as this, which convert the agricultural products into more useful materials.

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*****WITHDREW*****

TEMPERATURE TWO-STEP SOLID STATE FERMENTATION TO DEGRADE PHYTATE AND ENHANCE NUTRITIONAL VALUE IN SOY MEAL

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Soy meal is the main protein source for mono-gastric animals. But its main phosphorous storage source, phytate, could not be digested by mono-gastric animals. The excreted unabsorbed phytate can lead to environmental problems, such as europhication. *Aspergillus sojae* solid state fermentation was applied to degrade phytate in soy meal. Considering that the temperature for phytase production is different with the best temperature for phytase activity, temperature two-step fermentation was investigated to maximize the highest phytate degradation. In the first step, Response surface methodology (RSM) experiment design was used to obtain the best fermentation condition to maximize phytase production. That was temperature 39.72^{o}C, moisture 45% and inoculum size 1.7ml for 5g substrate. Considering that the best temperature for phytase activity was 45^{o}C, in the second stage, 24hr fermented samples were incubated in 37.92^{o}C, 45^{o}C and 50^{o}C. After another 12hr, phytate content was reduced from 0.93 g/100g to 0.85 g/100g, 0.71g/100g, 0.52g/100g, respectively for samples at the three different temperatures. Meanwhile, oligosaccharides, which could flatulence and diarrhea for mono-gastric animals, were reduced from 10.30 mmol/100g to 0.17 mmol/100g and protein content of soy meal was increased from 50% to 55%. Temperature two-step fermentation could better degrade phytate. After *Aspergillus sojae* solid state fermentation, anti-nutritional factors oligosaccharides were largely degraded and protein content was enhanced.

Relevance of Research to State-related Topic(s)

Soybean is the second largest plant cropped in the United States (30%, 2009), right after corn (33%, 2009) [http://www.soystats.com/2010/Default-frames.htm]. In the United States, soybean is mainly used for biodiesel production. After the oil extraction, the residue – flaked soybean meal are mainly used for feed. The portions of different animal usages are poultry (48%), swine (26%), beef (12%), dairy (9%), petfood (2%), others (3%) [http://www.soystats.com/2010/Default-frames.htm]. Poultry and swine account for 74%. Anti-nutritious factors in soybean meal prevent it from being the perfect feed sources, such as phytate and oligosaccharides. *Aspergillus sojae* solid state fermentation is applied in our research to degrade phytate, release phosphorous and make it available to mono-gastric animals. Meanwhile, after fermentation, anti-nutritional factors, oligosaccharides are almost totally degraded, and protein content is increased. Nutritional value of soy meal is largely enhanced. This research could benefit animal feeders, soy farmers and soy processors.

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UNDERSTANDING VARIABILITY IN PRODUCT QUALITY DURING EXTRUSION OF EXPANDED SNACKS USING A STOCHASTIC MODELING APPROACH

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Snacking patterns amongst adolescents have increased from 61% in 1970's to 83% today, according to the USDA ARS statistics. Extrusion is a popular technology to manufacture snacks and one of the major concerns of food processing industries is attaining uniformity in product characteristics which is affected by processing conditions and raw material formulation. In the current study, extruded corn puffs with different microstructures were produced by varying in-barrel moisture content (15% and 18% w.b.) and using sodium bicarbonate as a nucleating agent (0%, 0.5% and 1%). Physical properties and cellular architecture of expanded products were analyzed. X-ray microtomography studies showed decrease in average pore diameter from 398 to 379 µm and average cell wall thickness 152 to 143 µm upon addition of sodium bicarbonate. Piece density of extrudates increased with addition of sodium bicarbonate at high moisture but did not vary at low moisture content. A set of mechanistic equations for heat, mass and momentum transfer were utilized for simulating bubble growth, and resulting macrostructural properties of extrudates. A stochastic model was developed which used distributions of various parameters as input and provided output parameters, such as expansion ratio and piece density, as a distribution. The measured coefficient of variation for piece density and expansion ratio were compared with the simulated output coefficients of variation in order to validate the model. This stochastic mechanistic model was a great tool to understand variability in processing of extruded snacks**.**

Relevance of Research to State-Related Topic(s)

Kansas is one of the top 10 states in agricultural production in US and thereby harbors several food industries. Consistency in manufacturing is a big concern for the industry and understanding the primary cause of variability with the help of stochastic model developed in the current study would lead to better control over the process and product quality. The investigation on impact of variability in formulation can determine the requirements for uniformity in raw materials supply in terms of particle size or viscosity of the melt. Information on input variables such as moisture content or barrel temperature will guide for improvement in the design of manufacturing equipment. This would help industries like Wenger Manufacturing Inc for improving equipment performance which would trickle down to industries using their machinery such as Hill's Pet Nutrition. Better process control and consistency in product quality would translate to greater acceptance at consumer end.

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PHYSICAL AND PROCESSING DIFFERENCES BETWEEN BAKED AND EXTRUDED PET FOODS

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In 2011, U.S. pet food industry sold $19.85 billion of pet food. There is a predicted growth of sales in the pet food market. There are two major types of dry pet food processing baking and extrusion. This study focuses on the physical differences of a pet food produced by extrusion and baking processes. Three iso-nutritional diets were formulated for 0, 10, and 20% fresh meat (FM) inclusions. Each diet was extruded at 353 and 453 RPMs using a single screw extruder while a 30 foot experimental oven at 425 $^{\circ}$F was used for baking. Proximate analysis confirmed kibbles were iso-nutritional post-processing. Products were measured for expansion ratio (ER), piece density (PD), peak crushing force (PF), starch gelatinization, and amylose-lipid complex (AL). As FM inclusion increased (0 – 20%), ER decreased (4.1-3.5) for the 353 RPM and fluctuated for 453 RPM (2.7 – 3.7), while expansion for baked kibbles was not evident (0.96). With the absence of mechanical shear, PD was 56% higher in the baked product than the extruded product indicating higher compaction and lower ER. Texture analysis for baked kibbles displayed smooth texture curve-PF (3.4-2.7 kg) and extruded kibbles-PF (2.9-1.5 kg) displaying a serrated curve. Differential Scanning Calorimeter thermograms exhibited complete gelatinization for extruded kibbles while baked kibbles had lower gelatinization levels (32 - 45%). Extrusion processing's high gelatinization was attributed to the combination of thermal and mechanical energy leading to expansion and cell structures. The baking process showed reduced levels of gelatinization without any AL complexes.

Relevance of Research to State-Related Topic(s)

Kansas is the epicenter of pet food processing for a majority of the United States. In the state of Kansas, there are approximately 1.25 million cats and dogs. Pets provide campanionship, amusement for their owners, and can be effective work partners in the livestock industry. According to the CDC, pets promote positive health attributes in their owners such as lowering blood pressure and lowering triglyceride levels. The primary goals of pet foods are to provide a nutritionally adequate diet for the consumer's pet, to promote longevity, and prevent pet disease. Baking and extrusion are two major types of dry pet food processing; 60% of all dry pet foods are extruded. Each type of processing adds certain textural attributes to pet foods and these textural attributes can contribute to pet's pet food preferences. This study is to determine the textural differences between baked and extruded pet foods.

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DEVELOPMENT AND CHARACTERIZATION OF A SORGHUM BASED, PRE-COOKED BEAN LIKE PRODUCT USING EXTRUSION

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This study was conducted to demonstrate an effective and novel nutrient delivery mechanism for humans by utilizing an alternate food crop, like sorghum. A novel pre-cooked bean-like product was manufactured using extrusion to overcome disadvantages associated with consumption of dry beans like hard to cook, flatulence, etc. The new product formulation consisted of a blend of sorghum, wheat and soy flours at different levels to achieve ideal functional and nutritional characteristics and was compared to navy beans. A low intensity extrusion with specific mechanical energy (SME) input between 27.4-36.5kJ/kg, led to partial gelatinization ranging from 54.1-93.6%. Pasting curves generated using Rapid Visco Analyzer showed absence of cold swelling, indicating minimal starch damage during extrusion. Instrumental texture analysis was used to standardize final product preparation to 2 hours of soaking followed by 30 minutes of cooking in boiling water, resulting in an absence of uncooked core and hardness (2814.2 ± 341.6 g force) comparable to that of cooked natural navy bean (2840.07 ± 302.8 g force). Product hardness was reduced through longer cooking times and with the inclusion of higher soy flour levels. Natural navy beans had significantly ($P<0.05$) different textural values (adhesiveness, cohesiveness, etc.) than the extruded product. All final product formulations had a water activity (a_w) below 0.61 which would lead to longer shelf life though these values were significantly ($P<0.05$) different from that of natural navy beans, which had a_w of 0.39.

Relevance of Research to State-Related Topic(s)

Kansas is the leading producer of grain sorghum in U.S. with a production of 110 million bushels (51% of total production) in 2011 valued at $671 million. Sorghum is earmarked for feed and fuel production and the results of this study would add to the utility and versatility of the grain by value addition in food applications. The product would provide wholesome nutrition to consumers leading to higher demand for grain sorghum. This would translate directly to better and higher economic returns to sorghum crop growers in addition to contributing to food security. The manufacturing technology has been developed using extruder manufactured locally in Kansas and technology transfer of this product could lead to sales of the equipment which again is an added income to the company as well as the state.

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*****WITHDREW*****

PHYSICO-CHEMICAL PROPERTIES, AND WATER AND OIL UPTAKE DYNAMICS IN SOY-BASED SNACKS – ROLE OF TEXTURE MODIFIERS

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Snacks are widely consumed and the acceptability of these mostly depends on their textural properties. The effects of increasing levels of texture modifiers, soy protein isolate (SPI), calcium carbonate ($CaCO_3$) and pregelatinized wheat starch (PGWS) on texture and oil uptake were investigated by studying the dynamics of water and oil uptake during processing of dense extruded snacks. Defatted soy flour and wheat flour were used as base formulation. Physico-chemical properties like water holding capacity (WHC), oil uptake, crude fat, and texture of the samples were tested. Addition of texture modifiers decreased WHC. Degree of starch degradation and level of starch additions also influenced WHC. Oil uptake during frying correlates with WHC and is also influenced by the crust formation. At highest inclusions of SPI and $CaCO_3$, oil uptake decreased by 4% and 9% respectively whereas with PGWS it increased by 19.1%. Texture of the products is impacted by the matrix composition, oil uptake, and oil and starch matrix interactions. Hardness increased with SPI (14.4 N) and $CaCO_3$ (17.7 N) where as, with PGWS (13.1 N) it decreased compared to control (13.4 N). Descriptive sensory results agree with the experimental results, with PGWS samples having more oxidized and heated oil aroma and flavor and lower hardness followed by SPI and $CaCO_3$. Surface roughness and after taste were higher in samples with PGWS. A conceptual model was used to explain oil uptake during frying of these intermediate moisture pellets. It suggests that oil fills up the micro voids introduced by water vaporization.

Relevance of Research to State-Related Topic(s)

Savory snacks are widely consumed in United States and have high oil and caloric content. The obesity rate in Kansas doubled over past 15 years, and at present the combined rate of obesity and overweight is 64.9%. With this increase in health related problems and the growing consumer demands for nutritious and wholesome foods there is a need to develop healthier snacks without compromising the texture. Most research and development efforts are focused towards products that are low in refined carbohydrates, fat and high in protein. This study is a step in the same direction and explores the use of soybean in savory snacks while simultaneously reducing oil and increasing protein content. This research project is funded by Kansas Soybean Commission and also will benefit soybean farmers and producers in Kansas. International market development for these nutritious and value added products will increase the focus on utilizing Kansas soybeans.

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USING SENSORY METHODS TO EXAMINE DIFFERENCES IN COOKING METHODS FOR PORRIDGE PRODUCTS USED IN UNITED STATES INTERNATIONAL FOOD ASSISTANCE PROGRAMS

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The United States government supplies foods such as Corn-Soy-Blend(CSB) and alternative products to non-governmental organizations(NGOs) that in turn provide products to consumers needing food aid. The NGOs do not have consistent recommended cooking procedures, thus allowing for various cultural differences in methods, but results produce inconsistent sensory properties from what was initially developed and intended. Anecdotal evidence suggests even small variations in preparation can result in large differences in sensory properties (e.g., thickness). In a previous study of porridges, texture attributes were found to be key factors in consumer acceptability followed by flavor attributes. The aim of this study was to examine the effect of three different cooking methods on CSB and a novel Sorghum-Soy-Blend(SSB). Cooking methods differed in timing of oil addition: oil addition before the grain products were reconstituted in boiling water(method 1), oil added during reconstitution in boiling water(method 2), and oil added after reconstitution in boiling water(method 3). Descriptive sensory analysis was used to quantify differences in sensory attributes across the three cooking methods in both porridge products. Results indicated no differences in SSB among the three methods and only one difference(adhesiveness) in CSB. However, a number of significant differences were observed between CSB and SSB: one aroma attribute, two flavor attributes, and seven texture attributes. As novel products are developed, it is important to consider that existing cooking methods may not achieve the desired texture profile, highlighting the importance of product-specific cooking methods that will help retain the critical quality attributes of porridges.

Relevance of Research to State-Related Topic(s)

The research presented is part of an ongoing project, "Novel Sorghum-based Fortified Blended Foods for Infants and Young Children," in which fortified blended foods (FBFs) using combinations of corn and soy, sorghum and soy, and sorghum and cowpeas will be developed and tested. Sorghum grains are more resistant to heat and drought than corn, and are therefore more profitable in sections effected by drought, hot winds, and shallow soils. In addition, the crop offers wholesome nutrients, and is less susceptible to fungal infestations. Kansas is the number one sorghum producer in the nation and accounts for 51 percent of the U.S. grain sorghum production. Since this project promotes the use of sorghum grain in value-added applications, it may increase demand for the grain, potentially increasing returns to sorghum producers.

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MODELING THE UNCERTAINTY IN RESPONSIVENESS OF CLIMATIC, GENETIC, SOIL AND AGRONOMIC PARAMETERS IN CERES-SORGHUM MODEL ACROSS LOCATIONS IN KANSAS, USA

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Kansas ranks first in grain sorghum production in U.S. Crop modeling can provide useful insights about the functioning of sorghum and, its interactions with its environment. An important limitation to a more effective use of these models is our relatively limited knowledge of uncertainty in the models results. Studies have focused on uncertainty for maize, soybean, millet, cotton, rice models. To the knowledge of the authors no study has focused on uncertainty in model results for multiple input and output variables for CERES-Sorghum model embedded in Decision Support System for Agro-transfer Technology (DSSAT). We hypothesize that the results would vary due to multiple outputs and locations. The objective of this study is to determine the effects of uncertainties associated with 19 input parameters and six response variables in CERES-Sorghum for multiple locations across Kansas. One at a time (OAT) method of sensitivity analysis (SA) is carried out on genetic (five), climatic (four), soil (six) and agronomic (four) input parameters. In OAT method each input parameter is perturbed at a time. The results of SA were analyzed using mathematical (Sensitivity index; SI) and graphical approaches for combinations of input parameters and model response variables (yield, biomass, leaf area index, leaf number at maturity, days to anthesis and maturity). Cumulative distribution functions were used for uncertainty analysis. Preliminary results showed that, responsiveness of input parameters varied with input parameters, response variable, and location.

Relevance of Research to State-Related Topic(s)

Crop models can be used as powerful decision tools to evaluate alternate strategies such as diverse cropping system, pesticide use, soil, water and crop management practices etc. These alternate strategies/scenarios can help decision makers with improved information to minimize expenditure and risk management. It assists in synthesis of research understanding about the interaction of genetic, physiology and the environment. These models can also be used to forcast the yield and biomass production at field and regional scales under different scenarios of stresses(water, heat and/or nutrient). Field experiment are too costly and time consuming to address all scenarios, but computer models of crop growth and yield may fill the gaps if the models are shown to be accurate predictors. Our work will help to identify critical sensitivities of input to the model, which inturn improves the limitted knowledge of uncertainity for their effective use.

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DESCRIPTIVE ANALYSIS OF CORN-SOY BLEND AND SORGHUM-SOY BLEND PRODUCTS AT 20% SOLIDS

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Fortified Blended Foods (FBF) are cereal based products used in food aid situations, especially among weaning children around the world. Corn Soy Blend (CSB) is the most common food used in these situations. Recent evaluations of the effectiveness of food aid products have led to the development of an alternative to CSB using sorghum instead of corn. A previous study evaluated the differences between this sorghum soy blend (SSB) and CSB in various quality aspects, such as texture, aroma, and flavor when prepared following traditional methods. The goal of this study is to evaluate both CSB and SSB when prepared with an increased solids amount (from 11.75% to 20% solids), as recommended by recent studies to increase energy density of the products. A highly trained descriptive sensory evaluated the products for flavor, aroma, and texture, and a Bostwick Constistometer was used to evaluate viscosity. When prepared at 20% solids, there was an increase in starch flavor in both CSB and SSB, and reduced sorghum or corn flavor in the SSB and CSB, respectively. Increasing the solids amount caused an increase in viscosity in both CSB and SSB products that did not meet the current recommendations set by the USDA for weaning children. The SSB products were less viscous than the current CSB, making SSB a better choice for increasing solids amount and thereby increasing energy density from the current products. Further work is needed to determine the ideal solids content to meet the recommended flow rates.

Relevance of Research to State-Related Topic(s)

Sorghum is a drought tolerant crop grown extensively in Kansas that can be used as a grain, forage or sugar crop. The United States is the world's largest producer of sorghum, followed by Nigeria and India. Kansas is the leading producer of sorghum within the United States. Sorghum recently has gained more widespread use in food products, especially because it is gluten free. Sorghum potentially can be used as an alternative to corn in food aid products. It is especially ideal as a food aid product due to its current widespread use in underdeveloped areas such as Africa, meaning little adjustment will be needed for their diets. With adoption for use in food aid scenarios, sorghum can be increasingly useful to Kansas producers, and help meet food aid demands as well.

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EXTRUSION OF NOVEL SORGHUM-BASED FORTIFIED BLENDED FOOD FOR INFANTS, YOUNG CHILDREN AND ADULTS

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Weaning foods are developed by the USAID as part of its global food security program for undernourished infants in the world's poorest, food-insecure regions. The prevalent weaning food is a blend of corn and soy flours known as the Corn Soy Blend (CSB). Optimization of fortified blended foods for product uniformity, micronutrient content and cost of production led to a novel initiative of developing a sorghum-based fortified food blend. Hence the objective of this study was to develop a fortified blended food with sorghum as an alternate grain to corn and evaluate the effects of extrusion processing on various quality properties in comparison to the standard CSB. A Sorghum Soy Blend (SSB) was produced using two extrusion screw speeds giving high (450 rpm at 22% moisture) and low (350 rpm at 30% moisture) shear in a single screw extruder.Starch viscosity and flow rates were measured at 11.75% and 20% concentrations. SSB had lower final viscosity (229 cP) than traditional CSB (579 cP) indicating thinner gruel consistency. The flow rate of SSB indicates strong linear correlation between final viscosity values and Bostwick flow rates ($r = -0.826$). Descriptive sensory analysis showed that SSB high shear sample had the highest and lowest aroma attributes at 11.75% and 20%, respectively while starch flavor increased among all samples at 20% concentration. The newly developed fortified SSB is less viscous and free flowing compared to traditional CSB and adheres to new recommendations by Tuft's report to United States Agency for International Development (USAID).

Relevance of Research to State-Related Topic(s)

The Sorghum Soy Blend project is funded by the Kansas Grain Commission and the United Sorghum Checkoff program (USCP) in an effort to formulate nutritive weaning foods. This sorghum-based fortified blend food is a novel initiative of the USAID as part of its global food security program for eradicating world hunger. Grain sorghum (sorghum bi-color) forms the major portion of the formulation targeting malnutrition among infants and growing children in at-risk populations and people with celiac disease. About 51% of the nation's sorghum grain is harvested in Kansas, generating close to 110 million bushels (~70%) of the U.S. sorghum exports estimated at $671m (FAS 2012). As the nation's leading sorghum producer, the state of Kansas plays a crucial role in the world's food economy and contributes to food security in millions of households in many of the world's poorest, food-insecure regions.

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RELATIONSHIP BETWEEN WHEAT GLUTEN RHEOLOGY AND PHYSICO-CHEMICAL PROPERTIES OF TEXTURIZED VEGETABLE PROTEIN

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Texturized vegetable protein (TVP) based food products offer several advantages compared to animal protein, including lower costs for consumers and improved health benefits. Wheat gluten is often processed using extrusion to produce TVP. Not all varieties and batches of gluten texturize well. Chemical additives, like reducing agents (cysteine and sodium metabisulfite) and pH modifiers (tetra potassium phosphate) are used to aid in texturization of inferior quality gluten. A twin screw extruder was used to texturize two varieties of gluten, superior quality that texturizes well and inferior quality requiring texturizing aids. A phase transition analyzer was used to measure the operative rheological properties of the gluten in order to understand the mechanism of action of sulfite and phosphate. A phase transition map, involving the softening (Ts; 28-57°C) and flow (Tf; 67-126°C) temperatures of control gluten (without chemical additives) versus moisture (9.5-19.5%), was developed. Ts and Tf of inferior gluten was higher than superior gluten, indicating less mobility of protein chains. However, addition of 0.18% sulfite led to reduction in both Ts (from 48 to 44°C) and Tf (from 110 to 98°C). This indicated that sulfite cleaved disulfide bonds making protein polymeric chains more mobile and amenable to cross-linking. Little difference was observed in Ts and Tf with inclusion of 2.98% phosphate. Optimum pH of 7.5-8.5 is required for texturization of inferior gluten, and this pH adjustment produced a slightly texturized product during extrusion. The study led to an understanding of transformations induced by thermal and mechanical energy during extrusion of TVP.

Relevance of Research to State-Related Topic(s)

Annually, the state of Kansas experiences a wheat yield of 350,000-400,000 bushels. This yield carried a value near $20,000,000. As processing technology advances, wheat-based food product categories have grown. Wheat gluten is a primary ingredient for texturized vegetable protein (TVP). TVP offers several advantages, including lower cost of production and potential human health benefits compared to animal protein. Extrusion is an efficient way to create TVP. Transformations due to thermal and mechanical energy input during extrusion lead to disruption, realignment and cross-linking of gluten structure, creating a meat like texture. Analytical tests on wheat gluten might demonstrate various batches or lots to be similar in chemical and physical properties. However, considerable variation still exists for processing characteristics and in end-product quality. Determining variation will aid in optimal formulation and processing, which is vital to the conversion of wheat into value-added products, such as TVP.

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MEASURING GULLY EROSION IN TWO DISTURBED KANSAS LANDSCAPES

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Gully erosion creates human safety hazards, soil loss, and sediment and nutrient pollution. Gullies often form as a result of land use changes and interrelated factors such as soil compaction, vegetation removal and reduced rainwater infiltration. Kansas has deep, erodible soils, sporadic intense rainfall events, and heavy agricultural land management that usually increase the chance for gully erosion. This presentation describes a study of gully process in two types of heavily-used landscapes in Kansas – military training areas and agricultural fields. In both settings, heavy machinery alters the land surface, often leaving it exposed and unprotected from rainfall. My research goal is to understand gully erosion in order to predict where gullies form and how they grow. My first project objective is to measure gully growth with surveying equipment. My second objective is to identify and evaluate environmental factors that might explain gully growth, such as soil characteristics, antecedent moisture conditions, vegetative cover, slope, and drainage area. With direct field measurements and environmental characteristic data, I will attempt to correlate rates of gully growth to driving environmental forces. I expect the data will show that intense rain events, steep slopes, large drainage areas and shrink-swell clay soils contribute to erosion, while higher vegetation densities slow erosion. Finally, I will design innovative, sustainable gully mitigation measures for military training lands and agricultural fields of the Midwest. My preliminary measurements show that gully erosion is complex and inconsistent, which is why a greater understanding of gully process in Kansas is needed.

Relevance of Research to State-Related Topic(s)

Gullies are a world-wide problem, and driving factors in gully erosion vary greatly from region to region. Gullies create safety hazards, agricultural production losses, and sedimentation and pollution costs downstream. In Kansas, land directly controls the economic and ecological value of the state. In particular, Kansas agricultural production lands and military training lands are critical resources for the state and the country. Currently, there is a less-than-complete understanding of gully processes in Kansas, especially on Fort Riley, which is experiencing increasing soil and training space losses due to gullies. Knowing where gullies tend to form in the landscape, their rate of growth, and regional gully process in general will assist in the development of effective land-protection strategies. In turn, more effective land management would decrease sediment and nutrient problems downstream, including the sedimentation of Kansas reservoirs.

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EFFECTS OF LONG-TERM NITROGEN AMENDMENT AND ANNUAL BURNING ON SOIL CARBON AND NITROGEN DYNAMICS IN A TALLGRASS PRAIRIE

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Anthropogenic activities impact virtually all ecosystems, often affecting carbon (C) and nitrogen (N) dynamics on local, regional and global scales. In grasslands, widespread conversion to croplands, woody plant encroachment, elevated nitrogen deposition, and altered fire regimes all can influence C and N balances. Tallgrass prairie in North America is an ecosystem that has been heavily impacted, with the majority of native tallgrass prairie now converted to alternate land-uses (e.g., agriculture) or heavily impacted by other anthropogenic influences, such as fragmentation, nutrient enrichment, and altered natural disturbance regimes (i.e., fire frequency and grazing). Effective conservation and more sustainable management of these grasslands requires a detailed understanding of how anthropogenic drivers alter critical ecosystem processes, such as soil C and N dynamics. This study builds on a long-term experiment initiated in 1987 at Konza Prairie Biological Station (Manhattan, KS), featuring nutrient addition and contrasting prescribed fire treatments and focuses on quantifying key soil C and N pools and fluxes in plots that have been: 1) burned annually in the spring or left unburned and 2) amended with 10g N m^{-2} annually or left as non-amended controls. Data from the 2012 growing season indicate that annual burning reduces potential nitrification and increases in situ CO_2 efflux. Long-term N enrichment increases field net N mineralization (3.6 fold) and lab nitrification and ammonification, while decreasing potentially mineralizable C by ca. 14% and microbial biomass C and N by ca. 30%. These changes have important implications for C storage and N cycling in grasslands.

Relevance of Research to State-Related Topic(s)

The Flint Hills are home to the largest remaining tracks of tallgrass prairie in the United States with the vast majority of this land located in Kansas. Rolling hills and shallow soils saved the region from the plow of early settlers, and also led to an alternative use; grazing of cattle. Ranching in the Flint Hills is a dominant land use practice today, and management of this important natural resource for long-term sustainability requires an understanding of how land-use practices interact with critical environmental changes. This study aims to understand how land management, such as annual burning, and anthropogenic environmental changes, such as increased nitrogen deposition, affect the tallgrass prairie over long periods of time. Information garnered following 26 years of experimental manipulation will provide critical information to guide future land management decisions that will maintain diversity and ecosystem function, while supporting sustainable economic use of Kansas resources.

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UNDERSTANDING TRANSPORT AND TRANSFORMATIONS OF SELENIUM IN FLUE-GAS DESULFURIZATION WASTE WATER USING CONTINUOUS FLOW COLUMN SYSTEMS

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Selenium (Se) is an essential element for animals, plants and microorganisms. However, it is toxic to biological organisms in naturally rich or polluted environments with Se. Among major Se species in soil solution, reduced Se species such as selenite (SeO_3^{2-}) and selenide (Se^{2-}) are strongly adsorbed by soil constituents forming inner-sphere complexes. Main objectives of this laboratory based column study was to mimic flue gas desulphurization (FGD) wastewater-wetland treatment system to investigate fate and transport of Se. FGD wastewater contained concerned constituents namely, Se, S, As, Hg, B, Na, F and Cl, with Se concentration of 128 µg/L. Contaminant breakthrough curves (BTCs) were developed to determine the capacity of constructed wetland cells to retain Se and other contaminants. Columns were filled with pre-wetted top and engineered soils (three each) at a uniform bulk density. Up-flow (bottom up) column study was conducted at the flow rate of 1.42 mL/hr. Effluent water was collected continuously and analyzed for Se and other constituents. We found no detectable Se (< 0.5 µg/L) in the 10 PVs of effluent water (~100 days) collected in this study. Top soil consistently showed superior or equal retention capacity compared to the engineered soil. End of the study, soil analysis showed that Se was accumulated in the bottom 1/3 of the soil columns and there was no elevation of Se concentration in upper 2/3 of the columns. After 100 days of flushing with raw water, there was no retained Se released. Sequential extraction data for soil will also be presented.

Relevance of Research to State-Related Topic(s)

This research was based on the wetland treatment cells and FGD wastewater generated from large scale electricity generation power plant located in St. Mary's, Kansas. The FGD that we studied was from combustion of coal which is widely used for electricity power generation. Selenium and boron are elements of concern for plants, and aquatic life, while sulfate, chloride and sodium also are of regulatory concern when FGD water is discharged into waters used for other applications. This problem is not only limited to Kansas state but also in other places. Wetland treatment systems are used to remediate trace metals contain in wastewater. Based on our data we can determine how wetland system works for contaminants in FGD water. Therefore, conducting controlled laboratory studies can be used to help better understanding of constituent removal mechanisms.

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DEVELOPMENT AND EVALUATION OF SURFACE ENERGY BALANCE MODELS FOR MAPPING EVAPOTRANSPIRATION USING VERY HIGH RESOLUTION AIRBORNE REMOTE SENSING DATA

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Evapotranspiration (ET) is a major consumptive use of irrigation water and precipitation on croplands. Fast depleting ground water resources and the changing climate in Kansas has prompted to use water more efficiently. Remote sensing surface energy balance based algorithms have the potential to provide crop ET at regional scales. The primary objective of this research was to test and improve three widely used remote sensing based ET models. An intensive field campaign was conducted during summer cropping season of 2007 and 2008, termed as Bushland Evapotranspiration and Agricultural Remote Sensing Experiment (BEAREX07, BEAREX08). During the campaign high resolution imagery from the multispectral sensor onboard aircraft and ancillary ground data were acquired. Three algorithms evaluated include: SEBAL (Surface Energy Balance Algorithm for Land), SEBS (Surface Energy Balance System) and TSM (Two Source Energy Balance Model). The overall root mean square error (RMSE) in SEBS-ET estimation was 0.08 mm h^{-1} (16%). SEBS performed equally well for irrigated and dryland fields (corn, sorghum and cotton). However, evaluation of SEBAL for irrigated and dryland conditions revealed bias in the model's performance. A new hybrid algorithm developed using the linear temperature gradient approach from SEBAL and parameterization for excess resistance to heat transport from SEBS, showed substantial improvement in performance. The TSM model generated large overestimation error for the dryland ET estimates with an overall RMSE of 0.12 mmh^{-1} (22%). This research improves estimation of ET and provides opportunities for efficient and sustainable use of water from Ogallala aquifer.

Relevance of Research to State-Related Topic(s)

Nearly 3 million acres of irrigated cropland exists in Kansas, utilizing 90% of the water extracted from the Ogallala aquifer. Over exploitation of the water resources for irrigated agriculture has resulted in discharge from the aquifer far exceeding the natural recharge threatening the sustainability of agricultural and allied operations. Efficient water use for irrigation is of great importance to producers and water resource managers in Kansas where water scarcity often affects crop productivity. Therefore, scheduling irrigation precisely to match the spatially distributed crop water demand is critical, and needs accurate estimation of evapotranspiration (ET). Land surface energy balance models utilizing ground-, airborne-, or satellite - based remote sensing data at different spatial resolutions has proven to be robust, economical and efficient estimator of ET. This research is a step ahead in advancing the remote sensing-surface energy balance technology to an operational stage for developing efficient and sustainable methods of water use from Ogallala aquifer.

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DOES WASTEFUL IRRIGATION RESULT IN HIGHER LEVELS OF WATER CONSERVATION? THE CASE OF SHERIDAN COUNTY IN KANSAS

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As world population grows and living conditions in the developing world expand the demand for food, future irrigation needs to produce food coupled with limited water resources are a rationale for water conservation. Efficient irrigation technology adoption subsidies are commonly proposed and enacted to achieve water conservation, in part because they are more politically feasible than water taxes or water use restrictions. Previous work shows that, under certain circumstances, adopting more efficient irrigation technologies results in higher water use and faster resource depletion. This result is driven largely by the presumed reduction in return flows as irrigation technology becomes more efficient. In such cases, subsidizing the adoption of more efficient technology generates higher farm returns but lower net social benefits after accounting for the cost of such programs. A separate body of literature addresses the common-pool externalities in groundwater use in a dynamic context. However, the possibility of time-varying and endogenous irrigation capital and application efficiency is rarely incorporated in these models. In addition, the role of irrigation capital subsidies to correct the common pool externalities has not been explored. We examine the effects of irrigation technology subsidies using a model of inter-temporal common pool groundwater use with substitutable technology and declining well yields from groundwater stocks, where pumping cost and stock externalities arise from the common property problem. The potential efficacy of the policy instrument is illustrated via a numerical simulation based on agronomical and hydrological parameters from Sheridan County, KS, where irrigated farming depends mostly from groundwater pumping from the Ogallala aquifer.

Relevance of Research to State-Related Topic(s)

The issue of water use and conservation is of supreme importance to the agricultural economy of Kansas. Beyond technical hydrological and agronomical aspects and trends, the issue of the common pool groundwater use involves behaviors that are at the core of all policy and political consideration. Informing policy with rigorous modeling of such an important aspect of the economy would benefit the Kansas economy in the future. Ensuring irrigation water availability in the future is a central motivation of this research and a focal point of recent policy discussion in Kansas. Water conservation policies will, in part, determine whether "Kansas Farmers feed the world" remains a valid claim in the future, with all it social, political, and economic implications.

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ABRUPT RAINFALL CHANGE DETECTION IN KANSAS

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Precipitation has direct impacts on agricultural production, water resource management, and recreational activities. Thus understanding rainfall trends is important, especially for states like Kansas that experience a highly variable climate. The annual rainfall trends were analyzed using precipitation data from 1890 through 2011 from 24 long-term stations in Kansas. The overall analysis showed that on average western Kansas received 500 mm annual rainfall with a gradual increase of up to 1000 mm along the eastern border. In addition, a gradual increase was found in the state average total annual rainfall with a greater increase for recent years (1956 through 2011) and in the eastern part of the state. A change-point analysis was conducted to determine if the trend in increasing annual rainfall had an abrupt change. The Pettitt and CUSUM methods were used to detect the change points for all 24 stations. The Pettitt method detected a significant change-point in 12 stations and CUSUM detected a significant change -point in 9 stations. These stations were spread across the state with no special tendency. In addition, the change-points vary across the state, with the earliest one happened in 1939 for Lakin in southwest and the latest one happened in 1981 for Winfield in south, which emphasizes the rainfall variability across the state. The most significant change-point occurred in 1981 for Winfield. The majority of change-points were a start of an increase in the trend except for St. Francis, which had an increasing trend from 1908 to 1950 and a decreasing trend from 1951 to 2011.

Relevance of Research to State-Related Topic(s)

Precipitation has direct impacts on agricultural production, water resource management, recreational purpose, etc., hence investigating the rainfall trend is vital especially for Kansas state where experiences a very variable climate. In addition, withdrawing groundwater more than discharge amount, particularly in western Kansas, emphasizes the indisputable usage of the rainfall analysis results. The large annual ranifall variablity from west to east of the state needs to be analyzed regionally. Rainfall trend analysis helps us to understand how the rainfall pattern is shifiting across the state. Based on the shift, there might be a need for new design criteria for water management systems, both in runoff control and storage structures.

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POLLINATOR RESOURCE USE IN RANGELANDS THAT UTILIZE PATCH-BURN GRAZING AS A MANAGEMENT TOOL

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Wildlife species, including insect pollinators, of the North American Great Plains evolved with a variety of shifting vegetative patches created by different fire-grazing histories. This heterogeneous habitat provides three fundamental pollinator resources – food, breeding, and nesting sites – that often occur in dissimilar habitat patches across the landscape. The Flint Hills of KS, where rangelands cover >90% of the landscape, contain the largest remaining area of native tallgrass prairie in North America, and the conventional land-use management strategy is to conduct large-scale annual spring burns followed by cattle grazing. This management strategy creates a relatively uniform vegetative structure and plant species composition, which rarely provides all pollinator resource needs, or corridors that allow them to search for these resources in neighboring areas. Pollinators are fundamental to cattle and crop gains, as well as plant, wildlife, and ecosystem stability, and their decline in the Great Plains is partially due to this rangeland management technique. Patch-burn grazing (PBG) is a land-use management technique that has been shown to increase habitat heterogeneity in rangelands while maintaining cattle weight gains. The effects of PBG on pollinators have not been studied, but we predict it will increase the diversity and abundance of pollinators as compared to annually burned and grazed prairie, as well as create corridors for movement between resource patches. Preliminary results indicate an increase in pollinator diversity and abundance in PBG areas, which is likely due to observed increases in forb diversity and abundance and nesting habitat.

Relevance of Research to State-Related Topic(s)

The largest apparent benefit to the Kansas economy in utilizing PBG is its direct impact on crop gains. PBG serves as a larger pollinator source for insect-pollinated crops compared to annually burned prairie, and will likely negate some of the economic losses associated with plummeting pollinator numbers seen throughout the Great Plains. Moreover, as the primary producer of grass-to-market cattle in the United States, cattle operations in the Flint Hills are acutely vulnerable to extreme climatic events, particularly in regards to drought and rangeland forage. PBG has the potential to negate some of the impacts of drought on hay production because unlike annual burning, where no forage hay is left standing at the end of the grazing season, PBG minimally leaves 1/3 of a pasture as standing hay, creating a grassbank during drought years and decreasing the likelihood that a producer will have to sell cattle due to hay shortages.

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SAFETY RESTRAINT USAGE CHARACTERISTICS AND RISK FACTORS ASSOCIATED WITH CHILDREN INVOLVED IN CRASHES

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Involvement in road traffic crashes as vehicle occupants is a leading cause of death and serious injury among children. The objective of this study was to investigate crash-severity factors and child safety restraint-use characteristics in order to identify effective countermeasures to increase child safety. Crash data were obtained from the Kansas Department of Transportation. Children were divided into two groups, aged four to seven and eight to 13, considering Kansas child restraint laws. Frequencies, percentages, and odds ratios were used to investigate restraint-use characteristics, seating positions, and injury severity. Logistic regression models were developed to identify risk factors which increased injury severity. Results showed children not restrained, riding with drunk drivers, and riding in older vehicles were more vulnerable for crashes. The most frequent contributing factors related to children involved in crashes in Kansas were inattention in driving, failure to yield right of way, driving too fast, wet roads, and animals in the road. Based on the identified critical factors, countermeasures to improve child traffic safety were suggested which included age- and size-appropriate seat belt restraints, and the child being in the rear seat. It is important for parents and children to gain better education about these safety measures that are helpful to increase child safety on the road.

Relevance of Research to State-Related Topic(s)

Road transportation safety is one of major concerns in Kansas. Despite many efforts and the expenditure of substantial resources, safety restraint use among Kansas children aged five to 14 is currently about 79 percent based on observational surveys. Reasons for this shortfall are complex and vary among individuals, vehicles, and many other factors. Kansas safety restraint use among children has risen slowly over the past years and has saved more lives; however, additional measures are needed in order to further increase safety restraint use. Identifying causes of restraint nonuse will provide promising approaches to address this problem. This study provides several recommendations to increase the child passenger safety in Kansas. The most effective strategy for preventing injury and death, and reducing costs associated with children involved in crashes, is using age- and size-appropriate restraints. The study is funded by Kansas Department of Transportation.

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WORKING ON AND OFF THE FARM: FARM HOUSEHOLD EMPLOYMENT AND DECISION MAKING BY KANSAS FARMERS

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U.S. agrarian ideology tells us that most of our food comes from farms run by full-time farming families. However, this picture is not entirely accurate. In 2007, in 67 percent of farming households either the operator or the spouse worked off of the farm, and in 33 percent of these households both the operator and the spouse worked off-farm (Hoppe and Banker 2010). In 2007, small family farms, those with sales of less than $250,000/year, accounted for 88 percent of U.S. farms, only 16 percent of the value of production, but they own 63 percent of the farmland controlled by farms (Hoppe and Banker 2010). With it in mind that "[s]ome of today's most serious social issues, such as use of genetically modified organisms, environmental conservation…, and food safety, arise from farming" (Lobao and Meyer 2001:106) we use logistic regression to address the following questions focused on Kansas crop farmers: (1) Are their certain socio-economic characteristics of farmers related to engagement in off-farm employment? (2) Do farmers who work off-farm have different attitudes and make different types of decisions? The results suggest that if a farm operation has sales of less than $100,000/year and it is smaller than 100 acres, or the farmer is younger, more educated or started farming more recently, the chances that they have a household member working off-farm are greater.

Relevance of Research to State-Related Topic(s)

Agriculture has been, and continues to be, an important industry in Kansas. Not only do farmland acres account for a large share of the total land area, but many families depend on agriculture--to varying degrees--for their livelihoods. Livestock, particularly cattle and calves, and a number of crops, including corn, wheat, soybeans, and sorghum grain are valuable to the economy in Kansas and the United States more broadly. As is the case across the nation, many Kansas farming households cannot rely solely on the their farm operations for their incomes. Understanding who these families are and how they adapt to changes in the industry are important for knowing how to address issues relevant to these families, their communities, and agricultural production in Kansas in general.

ASSESSING THE ADOLESCENT EXPERIENCE OF MINDFULNESS

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Mindfulness, a way of paying attention to the present moment with kindness and curiosity, is an ancient practice that is currently experiencing an upsurge of support. Medical experts, therapists, educators and corporate executives are touting the benefits of mindfulness interventions. Published research has shown mindfulness activities correlate with gains in emotional regulation, worksite stress, math anxiety, eating disorders, generalized anxiety disorder and a host of other illnesses and disorders. Only a few minutes of daily mindfulness practice help students to better focus and pay attention. This investigation explored an understudied aspect of mindfulness: the experience of ninth graders in a public school classroom in Kansas who practice a brief, daily mindfulness activity. The study utilized both qualitative and quantitative research methods. Transcribed interviews were analyzed using thematic analysis and the effect of classroom mindfulness was explored using the Child and Adolescent Mindfulness Measure (CAMM) with a control and experimental group. Results indicated that adolescents soon overcome their initial awkwardness with mindfulness and found the experience consistently positive and appreciated the improved classroom environment. The experimental group scored significantly higher in perceived mindfulness on the CAMM instrument at post-test, while the control group scored significantly higher.

Relevance of Research to State-Related Topic(s)

The practice of mindfulness has multiple benefits in education, health care and the workplace. Even novice practitioners of mindfulness have demonstrated shifts in the processing of negative emotions under stress. Mindfulness does not depend or compete with any religion, cultureal context or belief system. Our study provides critical information that mindfulness activities in the classroom can have a positive effect on classroom environment, stress relief and students' lives outside the classroom. Results of this study can help Kansas counselors, therapists, and educators develop mindfulness strategies that will assist adolescents in developing emotional regulation, manage anxiety, improve classroom behavior, and foster health and wellness.

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DETERMINING FARMERS' WILLINGNESS TO GROW CELLULOSIC BIOFUEL FEEDSTOCKS ON AGRICULTURAL LAND

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Despite yearly cellulosic biofuel production standards established by the EPA, production continues to fall short of required levels. Technical feasibility studies have been conducted to determine if mandated production levels are obtainable and breakeven farmgate studies have shown farmers' costs of growing cellulosic feedstocks. However, few studies have looked at farmers' actual willingness to grow these feedstocks. This study examines the likelihood that farmers are willing to grow three different types of cellulosic biofuel: a value added crop, an annual bioenergy crop, and a perennial bioenergy crop under favorable contract conditions. The study is taken a step further by determining how many initial acres farmers are willing to plant of the annual and perennial bioenergy crops. The study found that 77% of farmers are willing to harvest their crop residue, 61% are willing to grow an annual crop, and 44% are willing to grow a perennial crop. The survey revealed the initial number of acres a farmer is willing to devote to growing annual and perennial bioenergy crops is 121 and 97 acres, respectively. Results from the study reveal that farmers take different things into consideration when determining if they are willing to grow each of the different types of cellulosic biofuel. These results imply that biorefineries cannot look at all biofuel agnostically; instead they must work with farmers to establish favorable contracts.

Relevance of Research to State-Related Topic(s)

Despite possible national implications of this study, the study focused on farmers in three regions of Kansas; western, central, and northeastern. The study revealed that initial acreage of dedicated annual and perennial crops varies for farmers in the different regions. In addition, the survey revealed farmers take different things into consideration when deciding if they are willing to grow each of the bioenergy crops. These facts can be helpful as new biorefineries look to be established in Kansas. Since different regions are willing to produce different quantities of bioenergy feedstock this can help biorefineries determine the size of the facilities needed in the different regions of the state. It also shows that it is important for the refineries to negotiate individual contracts with Kansas farmers. These findings will help establish a successful cellulosic biofuel industry in Kansas.

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THE (MIS)USE OF ALAN SEEGER: CULTURE VERSUS BARBARISM IN THE FIRST WORLD WAR

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The propaganda of the First World War characterized American intervention as the means to save civilization from the barbarism of the Hun. In promoting this dichotomous fantasy, propagandists employed Britain's technique of juxtaposing German and Austrian atrocities with the culture and heroism of the soldier-poet. When Rupert Brooke—an enlisted English poet—died in 1915, Britain had a face, name, and product to attach to the soldier-poet archetype. As the clamor for American intervention increased, the United States had only to wait for theirs. Alan Seeger was an American poet living in France at the outbreak of the war. He joined the French Foreign Legion and was killed in combat in July of 1916. Soon after, Seeger's *Poems* and his *Letters and Diary* were published and the United States had their soldier-poet. Seeger became the embodiment of civilization to contrast with and define the barbarous enemy. I will argue that representing Alan Seeger as the epitome of the American soldier-poet out to save civilization from the demon Hun misrepresents the values Seeger himself espoused. Seeger was indeed in favor of the war, but the barbarization of the enemy and intense nationalism characteristic of American propaganda contradicted the chivalrous philosophy of the medievalism he embraced. Nevertheless, as a fallen hero, his own desire to honor the opponent was lost in the American propaganda machine's appropriation of his name and works in the effort to stir up interventionist fervor.

Relevance of Research to State-Related Topic(s)

As Kansas citizens living near Fort Riley, we encounter members of the military and their families on a daily basis. Our respect for their service and concern for their well-being demands that we take an interest in the conflicts they enter in our name. My essay concerns the representation of American soldiers in World War I and it is still relevant today. As family members and friends of military personnel, our concerns about the image we project of our soldiers and their role should always be in our minds. History teaches us to be wary of the messages we endorse. Alan Seeger was proud of his role in World War I, but the United States' use of his legacy strayed from his core values. To respect self-sacrifice, we could learn from his misrepresentation and endeavor to honor the individual.

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EXPLORING THE VISITOR'S EXPERIENCE FACTORS AT THE FLINT HILLS DISCOVERY CENTER

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The purpose of this study is to explore the visitor's experience at the Flint Hills Discovery Center (FHDC). This study is designed to answer to the following two questions: What are visitors' experience factors at the FHDC and how do such factors affect visitors' experience evaluation and future intention? Experience in the consumption process is defined as a memorable event of a customer. Previous research in marketing, hospitality, and tourism have suggested that the proper experience management plays a significant role in enhancing positive attitudinal and behavioral outcomes, like satisfaction, loyalty, and intention to repurchase. Beyond delivering products and services to customers, tourism destinations should be evolved into the staged place that renders visitors experience well and keep the memorable and emotional stories. In spite of this indispensableness, research about the visitor's experiences at tourism destinations are still veiled. This study proposes basic four dimensions of the visitor's experience based on the reviews of former studies and the observation of visitors: education, interaction, entertainment, and authenticity. Additional hypotheses related to the relationship among experience, satisfaction, and word of mouth intention will be suggested. Data will be collected from visitors who visit the FHDC at least once within last 6 months. The sample size of 300 is targeted, exploratory and confirmation factor analysis, and structural equation modeling are then used to exam the proposed dimensions and relationships. The results will contribute both to the knowledge expansion and to the establishment of effective strategies attracting visitors.

Relevance of Research to State-Related Topic(s)

Kansas could have not stood out as a tourism destination, although it possesses the unique tourism resource, Flint Hills. The FHDC which opened in April 2012 could be the representative tourism destination of Kansas exhibiting geologic, biologic, and cultural histories of the Flint Hills. Since this center provides visitors with various experiences at the vast prairie, the tourist's experience can be maximized by visiting the center rather than by doing the hills. Although the facility and programs at the FHDC are attractive, the visitor's expectation and the evaluation would be ambiguous. Therefore, the organization needs to better understand the visitor's experience factors at the center. Especially, by analyzing the effects of the experience values on the visitors' future behaviors, the FHDC could establish strategies leading visitors' positive evaluations and voluntary advertisement effects.

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BROWN RICE PRODUCT: CULTURAL EFFECTS ON CONSUMER PERCEPTIONS AND BELIEFS

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This study examines perceptions, behaviors, and beliefs about a health focused food product based on focus group interviews with rice consumers classified as non-Asian Americans residing in Kansas (US-non Asian), Vietnamese with Kansas residence of 1-5 years (US-Vietnamese) and Vietnamese living in Vietnam (VN-Vietnamese). The concepts investigated were cultural differences in rice product awareness, cultural use and preparation of rice, and overall interest in a value-added brown rice product concepts incorporating health related language. US-non Asian participants showed higher awareness and interest in health related language for brown rice products than either of their Vietnamese counterparts. US-non Asians also were more accepting of brown rice products because health benefits associated with brown rice are important to them. Neither US-Vietnamese nor VN-Vietnamese consumers considered health benefits as key factors. Those consumers require specific language to address new product flavor and texture as compared to traditional white rice before Vietnamese consumers will try a new brown rice product. Despite numerous health benefits in a brown rice product concept, it was not readily accepted by Vietnamese consumers, either from Kansas or Vietnam, due to culturally negative associations of brown rice with poverty, aging, and illness. Therefore, it would take more effort to convince Vietnamese consumers to accept a new brown rice product than their US-non Asian counterparts. It is essential to understand differences in targeted messaging for health and sensory quality for new products among various ethnic groups.

Relevance of Research to State-Related Topic(s)

Health and wellness are currently an issue in the United States and in Kansas, especially as the number of elderly and obese people is increasing. In 2011, about 13.3% of Kansas population was 65 years and older (1) and the obesity rate was 29.6% (2). This study aimed to understand how language used to communicate the benefits of healthy products affects perceptions by consumers. Because many of the consumers used in this study were Kansas residents, the research can be directly linked to effective ways of communicating healthy benefits of products to Kansans. This study, using qualitative research methods, found cultural influences on the acceptability of a new healthy grain product. Our findings can be applied when new grain products are marketed towards a diverse segment of US consumers including Kansas. This is key concept because immigrants make up a rapidly growing segment of the population.

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