
2022



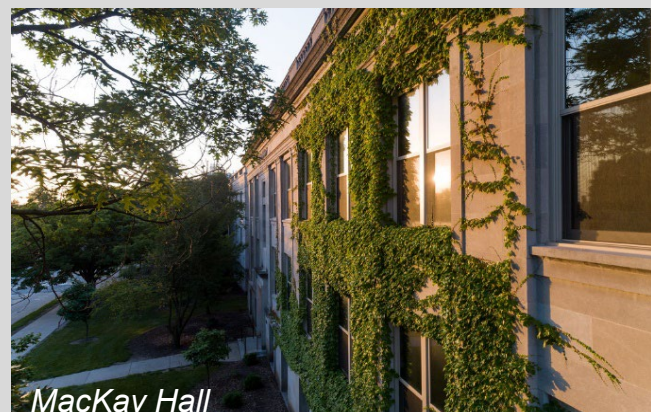
Cyclone Scholar Summer Research Experience & George Washington Carver Internship Program Research Symposium

Friday, July 29, 2022
10:00 am Curtiss Hall

Symposium is a conference for researchers to present and discuss their work. Together with academic or scientific journals, conferences provide an important channel for exchange of information between researchers.

Program

10:00 am	<i>Welcome & Opening Remarks From Deans</i>
10:15 am	Lightning Talks Begin
11:00 am	Break
11:15 am	Lightning Talks Continued
11:45 am	Lightning Talks End
11:50 am	Break
12:30 pm	Poster Session
1:30 pm	<i>End of Poster Session/Closing Remarks</i>



*Photo credit ISU College of Human Sciences & Department of Food Science and Human Nutrition
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ANALYSIS OF BUCKWHEAT AND TEFF WHOLE GRAINS IN ROOM VERSUS FREEZING CONDITIONS

Grains pose a significant role in our daily diets as a main source of carbohydrate. Grain quality is important in the production of nutrient-dense and safe grain products; however, issues with grain qualities arise with different methods of storage and environmental factors. The objective of this study was to analyze the temperature and humidity levels of buckwheat and teff whole grains hermetically stored under room vs. freezing conditions in order to determine the best methods for storage. Two digital temperature and relative humidity (RH) datalogger sensors were placed inside the middle and the edge of the center of two hermetic buckets filled with buckwheat and teff whole grains. The two buckets were stored at room temperature (23°C) for 24 hours then moved to freezer storage (-19.6°C) for 96 hours, recording data every minute. Upon analyzing the results, the buckwheat and teff whole grain sensor data demonstrated similar, non-linear changes in temperature for both sensors; as for RH, the teff whole grain sensors experienced a dramatic drop in humidity levels compared to the sensors placed in buckwheat whole grain. These evaluations are important in understanding proper grain storage, for instance, to prevent pest activity or mold and degradation brought by moist, humid environments. It is likely that teff whole grain, with its low humidity levels, would serve as a most suitable grain for storage in freezing environments around 19°C due to the physically compact nature and chemical composition of the grain.

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DOES THREE SISTERS INTERCROPPING (MAIZE, BEANS, AND SQUASH) AFFECT SOIL MICROCLIMATE & CROP HEALTH?

Traditional ecological knowledge (TEK) is that acquired by Indigenous peoples over thousands of years through interaction with their environment. One aspect of Native American TEK is their agricultural practices, including perhaps the most well-known agroecological practice of Three Sisters intercropping (3SI). 3SI includes maize (*Zea mays*), beans (*Phaseolus vulgaris*), and squash (*Cucurbita pepo*) planted in close proximity to one another. The exact origins and rationale for using 3SI are unknown, but a revival of the general practice intercropping is gaining popularity in modern regenerative and sustainable agriculture circles. Here we used a randomized, blocked experiment to test the effects of 3SI compared to monocrop (or sole planting of each sister). We found 3SI increased soil moisture by 4.32%, decreased soil temperature by 3.39 %, and decreased SPAD meter readings (a measure of leaf greenness) by 2.11% across all crops compared to monocrops. This one year of microclimate and crop health data show that 3SI had a variable influence on soil microclimate and it was reflected in the leaf chlorophyll proxy. In order to further understand this relationship, another season of data would be useful to address some of the management limitations.

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HOW NEURODEGENERATION CORRELATES WITH HIGH FAT DIET USING DROSOPHILA MELANOGASTER

Diet plays an important part in human life, it has a direct correlation with cardiovascular disease, HFD has been shown to play a large role in obesity and research has shown it can have an increased risk of neurodegeneration. We wanted to test our theory on neuroinflammation and neurodegeneration as it relates to diet on *Drosophila melanogaster* (fruit flies) we did this to understand whether the model is influenced composition (saturated vs unsaturated). We used them because of their short lifespan, well understood genomes and availability of scientific tools. Pre-liminary data shows that HFD decreases lifespan for all fat types but dietary fats high in saturated fat has a significantly greater decrease than dietary fats with more unsaturated fat. We utilized a climbing assay because it's a consistent instinctual behavior and has been shown to correlate with neurodegeneration (2). We also looked at Reactive Oxygen Levels to measure neuroinflammation which has also been correlated with neurodegeneration which also been correlated with neurodegeneration (3). We used diets, Control and HFD (Lard & Coconut), the HFD creates a unique gene expression in the brain for *Drosophila*. We looked for specific things such as how well does the *Drosophila* that is on a control diet climb compared to *Drosophila* that is on an HFD to see if we find any signs of hindered climbing ability. Preliminary results suggested that *Drosophila* that were on a controlled diet had a longer lifespan and were able to climb higher compared to *Drosophila* that were on an HFD, their lifespan was decreased significantly. Our research adds to the understanding of the genetic and cellular mechanisms that tie dietary fat to neuronal health.

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TRANSFORMATION OF CORN BYPRODUCTS INTO VALUE-ADDED CELLULOSE NANOCRYSTALS

Agricultural production can have many negative impacts on the environment, including byproducts; in the U.S., millions of tons of waste are produced yearly. If these byproducts are not properly stored and used, they can further impact the environment. Agricultural byproducts are currently used for heating, feeding, and bedding purposes. This study was designed to examine the transformation of one of those agricultural byproducts, corn stover, into value-added cellulose nanocrystals. Corn stover was first washed with DI water, then an alkaline treatment using sodium hydroxide, followed by washing. Next, sodium chlorite and acetic acid were used for bleaching treatment, followed by washing; then, cellulose nanocrystals were extracted using sulfuric acid hydrolysis. Finally, cellulose nanocrystals were characterized using Zetasizer and transmission electron microscopy (TEM). The dimensions of the produced cellulose nanocrystals as characterized by TEM were found to be average for width ranging from 7 to 9 nm, and 87-132 nm for length. The zeta potential of cellulose nanocrystals was found to average -9.5 mV. The particle size distribution of cellulose nanocrystals had an average diameter of 271 nm. Results of this study show that corn byproducts can be transformed into cellulose nanocrystals. Cellulose nanocrystals have the potential to be applied in multiple fields such as packaging, due to their remarkable mechanical properties, biodegradability, and other properties.

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CHARACTERIZING THE IMPACT OF DRIED DISTILLERS GRAIN ON POULT JEJUNAL MORPHOLOGY

Corn and soybean play a vital role in providing a cost-efficient and a precise diet for turkeys. To combat recent increases in cost use of by-product such as dried distillers grain (DDG) can provide nutrients at a lower cost. However, the potential impact of DDG on the intestinal health of poults is not well characterized. Therefore, this study was conducted to determine if there was a change in the villi and crypts of the jejunum in poults fed different DDG diets. Jejunal samples were excised then fixed in 10% formalin from 60 five-week old Nicholas poults divided into 3 dietary groups as part of a larger study. The 3 dietary treatments are Group A which were fed a control diet, Group B which were fed a diet containing 40% protein concentrate with DDG, and Group C which were fed a diet containing 50% protein concentrate with DDG. Samples were embedded on slides then stained with hematoxylin and eosin dye. Images of jejunal sections were being captured at 10x magnifications to amplify the view of the villi and crypts. An average of 5 to 10 measurements (μm) per slide were measured using cellSens software. Data which were analyzed in SAS using Proc Glimmix. Crypt depth ($P = 0.59$), villus height ($P = 0.67$), and villus height to crypt ratio (VCR) ($P = 0.96$) were not altered by dietary treatment. In conclusion, DDG does not alter jejunal morphology, and could serve as an alternative feed stuff for turkey poults.



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CAN WE INCREASE DAIRY PURCHASING AND CONSUMPTION IN INADEQUATE DAIRY CONSUMERS THROUGH EDUCATIONAL MESSAGES?

According to the Dietary Guidelines for Healthy Americans, about 90% of people are not meeting the recommendation of 3-5 servings of dairy per day or 21 servings per week. In this study, these people are referred to as inadequate dairy consumers (IDC). The goal of this research was to determine if dairy purchasing and consumption by IDC can be increased through educational messages. Volunteer IDC (n=95) were divided into 10 nominal focus groups, which focused on one of 4 messages regarding dairy nutrition topics. At the beginning of each session a Qualtrics pre-survey was conducted to determine dairy purchasing and consumption by IDC in the previous month. One month after the focus groups, another Qualtrics survey asked IDC about their dairy purchasing and consumption in the previous three weeks. To determine if purchasing and consumption of dairy products changed, analysis of variance with Tukey mean separation tests were conducted with alpha level set at 0.05. To determine if purchasing or consumption changed depending on specific educational messages, Wilcoxon signed rank tests were conducted for matched pairs of data for individual panelists (follow-up minus pre-survey). Dairy product purchasing increased significantly, by 0.19 servings per person per week, to 4.27 servings. Dairy product consumption increased significantly, by 0.57 servings per person per week, to 10.18 servings. Dairy nutrition educational messages and infographics delivered to IDC in nominal focus groups increased dairy purchasing and consumption, but not enough for them to meet the 21 servings per week recommended dairy foods intake.

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INHIBITING EFFECT OF EGGS ON HORIZONTAL TRANSFER OF ANTIBIOTIC RESISTANCE GENES IN BACTERIA

The influx of antibiotic resistant bacterial infections is a major threat to public health and food security. Bacteria are developing resistance to antibiotic drugs at a faster rate than the ability to produce new drugs. Exploration of new treatment methods to combat antibiotic resistance are of immense interest. Avian eggs have been shown to hold various antimicrobial roles for the protection of intended offspring. Current literature experiences a gap in knowledge regarding the relationship between the presence of bioactive molecules in eggs and horizontal gene transfer in bacteria. This study tested the impact of avian egg components on the frequency of horizontal transfer of antibiotic resistance plasmids between bacteria. *Escherichia coli* strains containing conjugative plasmids including APEC O2-211 (pAPEC-O2-211A-ColV) and SP915 (pKJK5-GM) were used as donors of antibiotic resistance plasmids to recipient *Escherichia coli* strain HS-4 under *in vitro* conditions. Liquid broth conjugations with treatment supplementation and serial dilution were conducted in triplicate prior to plating, and enumeration. Transconjugant colonies were detected in all treatment groups, however significantly less transconjugant pKJK5-GM colonies were detected in both the yolk ($P=0.007$) and the albumin ($P=0.005$) supplemented treatment groups compared to the control group. This study demonstrates that the presence of avian egg components can inhibit the horizontal transfer of antibiotic resistant plasmids in some bacterial populations by specifically targeting bacterial conjugation. These results encourage further exploration of the impact of egg components on horizontal gene transfer, and potential use as dietary intervention or complementary treatment to combat the emergence of antibiotic resistance.

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HEMP PROTEIN POWDER TREATMENT PREPARATION AND CHARACTERIZATION TO FIND THE BEST FORMULATION FOR A PROTEIN SHAKE

Hemp heart powder is made from ground up dry hemp seed and is a great plant-based source because it is has a major source of fatty acids like omgea-3, omega-6, protein and fiber, with several health benefits like boosting metabolism, digestion, promoting lean body mass due to its low levels of cholesterol and unsaturated fats. The objective is to test the stability of hemp heart protein through preparation and characterization to formulate a protein shake. Three hemp protein powder treatments with a pH of 7 were tested - controlled, sonication and high-pressure homogenization treatment. Each treatment underwent protein concentration characterization at absorbance of 562nm, emulsion droplet size and zeta potential characterization with fresh conditions and conditions of storage after 2 weeks at 4°C and 22°C. Solubility characterization show which hemp protein has the highest concentration, meeting the sports beverage standard of 0.4+ μm . Emulsion characterization show which conditions keep emulsion stable the longest, by staying in between zeta potential values -30mV to +30 mV and what type of instability our emulsion droplet sizes create. We found that, high-pressure homogenization treatment reaches the highest protein concentration of 589.9 $\mu\text{g/mL}$. Sonication treatment reaches the highest volume of emulsion droplet size of 30% at 5,5600 d.nm under 2 week conditions at 4°C. Sonication treatment also reaches the best zeta potential ranging between -15mV to -30mV under 2-week conditions at 4°C. Hemp protein powder formulation should start with sonication treatment, continuing the characterization and preparation process under conditions of 4 °C.

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EFFECTS OF DRY DISTILLERS GRAINS ON POULT ILEAL MORPHOLOGY

Feed cost is a major cost input in commercial turkey production. Current corn and soybean meal feed prices have drastically increased. Therefore, finding a more cost-efficient feed that does not harm the intestinal morphology of poults is important. This study was conducted to determine changes in villi and crypts of the ileum in poults after being fed dry distillers grains (DDG). This study used 60 Nicholas turkeys that were split into 3 dietary treatment groups. Group A was fed a control diet lacking DDG, Group B was fed a diet containing DDG with a 40% protein concentration, and Group C was fed a diet containing DDG with a 50% protein concentration. The poults were harvested as part of a larger study at 5 weeks of age. The ileum was excised, fixed in 10% formalin, then embedded, sectioned, and stained with hematoxylin and eosin dye. Images of ileum sections were captured at 10x magnification and 5-12 villus lengths and crypt depths (μm) were measured using cellSens software for each ileum. Data were analyzed in SAS using Proc Glimmix. Crypt depth ($P = 0.9812$), villus height ($P = 0.8970$), and villus height to crypt depth ratio ($P = 0.9981$) were similar across all three treatment groups. Therefore, the dietary treatments did not change the ileal morphology of the poults, indicating DDG can be used as an alternative feed source for turkeys without affecting their ileal morphology.

