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NORTH DAKOTA ACADEMY OF SCIENCE
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OFFICERS AND MEMBERS OF THE EXECUTIVE COMMITTEE

EDITOR

107th Annual Meeting

April 24, 2015

Fargo, North Dakota

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EDITOR'S NOTES

HISTORY

The *Proceedings of the North Dakota Academy of Science* (NDAS) was first published in 1948, with Volume I reporting the business and scientific papers presented for the 40th annual meeting, May 2-3, 1947. Through Volume XXI**,** the single yearly issue of the *Proceedings* included both abstracts and full papers. Commencing with Volume XXII, the *Proceedings* was published in two parts: A, published prior to the annual meeting, contained an abstract of each paper to be presented at the meeting, and B, published later, contained full papers by some of the presenters.

In 1979 (Vol. 33) the *Proceedings* changed to an 8½ x 11-inch format. Produced from camera-ready copy submitted by authors, it was distributed at the annual meeting. As desktop computing became more prevalent vol. 51-vol. 64 of the *Proceedings* were assembled with desktop publishing software from submitted computer disks. The current volume was assembled from electronic submission of abstracts via email and the *Proceedings* archived online as pdfs.

VOLUME 69 ORGANIZATION

In 2003 the NDAS council voted to accept all abstracts scheduled for presentation at the Annual Meeting. Thus, communications in volumes 58 to present haven't undergone a "typical" peer review. Rather, they provide an accurate reflection of the material presented before the NDAS membership at the Annual Meeting. The presentations in this year's *Proceedings* are presented in four major sections. The first contains the undergraduate communications presented as part of the A. Rodger Denison Student Research Competition. The second section comprises the graduate Denison Competition papers. The third section comprises professional communications presented by faculty and post-doctoral members of the Academy. The final section comprises abstracts of posters presented at the meeting. Readers may locate communications by looking within the major sections of these *Proceedings (see table of contents)*.

NEW FOR 2015

In order to promote better communication between academy members, an NDUS list-serv has been established. Members wishing to receive communications from the North Dakota Academy of Science, including information on future annual meetings, should send an e-mail addressed to:
NDUS-NDACADSCI@listserv.nodak.edu

IN APPRECIATION

The Academy wishes to acknowledge current and emeritus members of the Academy who continue to support the mission of the North Dakota Academy of Science Research Foundation through their special gifts. A listing of these supporters accompanies the Financial Report. The Academy also wishes to express its thanks to the presenters of papers at the Annual meeting, the session chairs, as well as all who have helped in organizing spaces and places, soliciting manuscripts, and compiling of this year's communications.

Stuart Haring, President

Bryan Schmidt, Secretary-Treasurer

SCHEDULE - Friday

8:00 AM to 8:50 AM Breakfast and Registration – Arikara Room
8:50 AM to 9:00 AM Welcome – Arikara Room

Friday, April 24

Time		Arikara Room	Meadowlark Room
9:00 AM	9:20 AM	Mayhew	Tangen
9:20 AM	9:40 AM	Kennedy	Mihaylov
9:40 AM	10:00 AM	Jerome	Nayakasinghe
10:00 AM	10:20 AM	Brock	Bass
10:20 AM	10:40 AM	**BREAK**	
10:40 AM	11:00 AM	Hone	Shah
11:00 AM	11:20 AM	Irsfeld	Krout
11:20 AM	11:40 AM	Crouse	Li
11:40 AM	12:00 PM	Best	T. Wang
12:00 PM	1:00 PM	***LUNCH – Arikara Room***	
1:00 PM	1:20 PM	Zerr	Sharma
1:20 PM	1:40 PM	Wang	Solanki
1:40 PM	2:00 PM	Wilson	Sivapragasam
2:00 PM	2:20 PM	Hartman	Crosswhite
2:20 PM	2:40 PM	**BREAK**	
2:40 PM	3:00 PM	Peterson	
3:00 PM	3:20 PM	Zhang	
3:20 PM	3:40 PM	Bairagi	

3:45 PM to 5:30 PM Poster Session – Room of Nations

5:30 PM to 6:30 PM Dinner – Arikara Room

6:30 PM to 7:30 PM Keynote Address by Dr. Scott Nelson, Iowa State University
Arikara Room

SCHEDULE – Saturday

Saturday, April 25

Time		Arikara Room
9:00 AM	9:20 AM	Dockter
9:20 AM	9:40 AM	Murphy
9:40 AM	10:00 AM	Mihaylov
10:00 AM	10:20 AM	**BREAK**
10:20 AM	10:40 AM	Heskin
10:40 AM	11:00 AM	Wu
11:00 AM	11:20 AM	Shipunov

11:30 PM to 12:00 PM – Denison Competition Judging
(All faculty members are encouraged to participate)

12:00 PM to 1:00 PM – Lunch
(Arikara Room)

1:00 PM to 2:00 PM – Business Meeting
(Arikara Room)

2:00 PM to 2:30 PM – Award Ceremony and Closing Remarks
(Arikara Room)

Arikara Room Schedule of Presentations

Friday Morning Session

9:00 AM	EXTRACTION AND CONCENTRATION OF CAFFEINE FROM ARTIFICIAL SALIVA FOR GC/MS ANALYSIS Johanna Mayhew and Naomi Winburn
9:20 AM	LATE GESTATION SUPPLEMENTATION OF DISTILLER'S GRAINS PLUS SOLUBLES TO BEEF COWS: IMPACTS ON MAMMARY BLOOD FLOW, COLOSTRUM AND MILK PRODUCTION, AND CALF WEIGHTS V.C. Kennedy, B.R. Mordhorst, J.J. Gaspers, G.L. Stokka, M.L. Bauer, K.C. Swanson, and K.A. Vonnahme
9:40 AM	THREE GENETIC VARIANTS MAY NOT BE ASSOCIATED WITH ASTHMA AMONG AMERICAN INDIAN CHILDREN Jerome D, Parisien A, Best, LG
10:00 AM	LACTOFERRIN FUNCTION IN REDUCING AND OXIDIZING ENVIRONMENTS Hannibel Brock and Bryan Schmidt
10:20 AM	**BREAK**
10:40 AM	COMBINING PHYTOREMEDIATION OF COAL FLY ASH (FA) AND BIOFUEL PRODUCTION Shannon Dawn Hone, Justin Tangen, Richard Langedoux, and Jerzy Bilski
11:00 AM	PHENYLETHYLAMINE CAN BE USED FOR PREVENTION AND TREATMENT OF BACTERIAL BIOFILMS Meredith Irsfeld, Shelley M. Horn, Shane J. Stafslien , Birgit M. Prüß
11:20 AM	MATERNAL NUTRITION AND EMBRYONIC SURVIVIAL: NUTRIENT TRANSPORTERS IN BOVINE UTERO-PLACENTAL TISSUES ON DAYS 16 TO 50 OF GESTATION Matthew S. Crouse, Kyle J. McLean, Larry P. Reynolds, Carl R. Dahlen, Brian W. Neville, Pawel P. Borowicz, and Joel S. Caton
11:40 AM	NOVEL SEQUENCES OF THE C-REACTIVE PROTEIN GENE AMONG AN AMERICAN INDIAN POPULATION Lyle G. Best, Karin Haack, Candelaria Martin, Gilbert Falcon, Kylie Keplin, Shelley A. Cole
12:00 AM	**Lunch**

Afternoon Session

1:00 PM	EFFECTS OF EXOGENOUS ABSCISIC ACID ON INDOLE-3-ACETIC ACID-INDUCED LEAF GROWTH IN *ARABIDOPSIS THALIANA* Jakob R. Zerr, Christopher P. Keller, Jo Heuschele, Jerry D. Cohen
1:20 PM	USING IMRE AND ANOVA TO SELECT MICRORNAS FOR PREDICTING PROSTATE CANCER RECURRENCE Qi Wang, Yarong Yang, Bin Guo
1:40 PM	PHOSPHORYLATION OF HUMANIZED AND OTHER EUKARYOTIC RPA IN YEAST AND ITS POTENTIAL ROLE IN CHECKPOINT REGULATION Timothy M. Wilson, Padmaja L. Ghospurkar, and Stuart J. Haring
2:00 PM	CONTINUED SLEUTHING OF PROBLEMATIC CONTINENTAL MOLLUSCAN TAXA – THE CRETACEOUS DAKOTA FORMATION Joseph H. Hartman
2:20 PM	**BREAK**
2:40 PM	BOHR REVISITED: MODEL AND SPECTRAL LINES OF HELIUM Christian Peterson
3:00 PM	ROAD UNEVENNESS MEASUREMENT: A NEW METHOD WITH IN-PAVEMENT SENSORS Zhiming Zhang, Fodan Deng, Yanmei Xie, and Ying Huang
3:20 PM	LOCALIZATION PATTERN OF PROGESTERONE RECEPTOR (PGR) AB IN SHEEP PLACENTA DURING EARLY PREGNANCY Soumi Bairagi*, Anna T. Grazul-Bilska, Pawel P. Borowicz, and Lawrence P. Reynolds

Arikara Room Schedule of Presentations

SATURDAY MORNING SESSION

9:00 AM RAPID SYNTHESIS OF N-(2-HYDROXYBENZYL)ACETAMIDE
Kaylee A. Dockter, Lioudmila I. Bobyleva and Mikhail M. Bobylev

9:20 AM ACETOACETIC ACID IMPACT ON BACTERIAL BIOFILMS AMONG A VARIETY OF STRAINS
Murphy, J.M., Horne, S., Prüß, B.M.

9:40 AM THEORETICAL MODELING OF QUANTUM EFFICIENCY OF HYDROGEN-PASSIVATED SILICON NANOSTRUCTURES
Deyan Mihaylov, Andrei Kryjevski and Dmitri Kilin

10:00 AM **BREAK**

10:20 AM INVESTIGATION OF THE OXYGEN-PRODUCING ENZYME CHLORITE DISMUTASE
Alisa Heskin, Zachary Geeraerts, Gudrun S. Lukat-Rodgers, Kenton R. Rodgers

10:40 AM FABRICATION OF HIGHLY FLUORESCENT GRAPHENE QUANTUM DOTS USING L-GLUTAMIC ACID FOR IN VITRO/IN VIVO IMAGING AND SENSING
Xu Wu, Julia Xiaojun Zhao

11:00 AM THE ECOLOGICAL IMPACT OF FLOODING: A STUDY OF TREE DAMAGE
Brandon Chrisman, Allison Rabe, Ranelle Ivens, Sarah Lopez, and Alexey Shipunov

Meadowlark Room Schedule of Presentations

FRIDAY MORNING SESSION

9:00 AM COMBINING PHYTOREMEDIATION OF COAL FLY ASH (FA) AND AGRONOMIC BIOFORTIFICATION
Justin Tangen, Shannon Dawn Hone, Richard Langedoux, and Jerzy Bilski

9:20 AM SYNTHESIS AND CHARACTERIZATION OF CHIRAL C_2-SYMMETRIC BIMETALLIC ZINC COMPLEXES OF AMIDO-OXAZOLINATES: ACTIVE INITIATORS FOR ASYMMETRIC COPOLYMERIZATION OF CO_2 AND CYCLOHEXENE OXIDE
Srinivas Abbina, Vamshi K. Chidara, Shi Bian, Angel Ugrinov and Guodong Du

9:40 AM SYNTHESIS AND CHARACTERIZATION OF SILICA THIN FILMS
Mindika Tilan Nayakasinghe, Ashish Chakradhar, Nilushni Sivapragasam, Uwe Burghaus

10:00 AM CORPUS LUTEUM (CL) VASCULARITY AND FUNCTION DURING THE ESTROUS CYCLE IN SHEEP TREATED WITH ARGININE AND FED DIFFERENT PLANE OF NUTRITION
Casie S. Bass, Samantha L. Kaminski, Dale A. Redmer, and Anna T. Grazul-Bilska

10:20 AM **BREAK**

10:40 AM DETERMINE THE EFFICACY OF VACUUM STEAM PASTEURIZATION TO INACTIVATE SALMONELLA PT30, ESCHERICHIA COLI 0157:H7, AND ENTEROCOCCUS FAECIUM ON LOW MOISTURE FOODS
Manoj Shah, Julie Sherwood, Kari Graber and Teresa Bergholz

11:00 AM COCAINE PHOTO-AFFINITY ANALOGS BIND IN THE SUBSTRATE BINDING POCKET OF THE DOPAMINE TRANSPORTER
Danielle Krout, Rejwi Acharya Dahal, Akula Bala Pramod, Babita Sharma, Michael Tomlinson, James D. Foster, Joo Hwan Cha, Jianjing Cao, Comfort Boatang, Mu-Fa Zou, Amy Hauck Newman, John R. Lever, Roxanne A. Vaughan, L. Keith Henry

11:20 AM A MULTI-TRAIT MIXED-MODEL FOR GENOME-WIDE ASSOCIATION STUDY IN BARLEY POPULATION
Qiang Li, Yarong Yang, Shaobin Zhong

11:40 AM NDSU CENTER FOR PROTEASE RESEARCH CORE BIOLOGY FACILITY SUPPORTS REGIONAL BIOMEDICAL RESEARCH
Tao Wang and Mukund Sibi

12:00 AM Lunch

Meadowlark Room Schedule of Presentations

Afternoon Session

1:00 PM — GENETIC VARIATION OF ROOT AND STALK TRAITS FOR DROUGHT RESISTANCE IN EARLY MATURING MAIZE (*ZEA MAYS* L.)
S. Sharma, and M. J. Carena

1:20 PM — PATHOGEN SENSING TRIGGERS EARLY UPREGULATION OF NLR, WHICH PRIMES LATER EFFECTOR TRIGGERED IMMUNITY RESPONSE IN BARLEY
Shyam Solanki* and Robert Brueggeman

1:40 PM — SMALL MOLECULES ADSORPTION ON GRAPHENE: A KINETIC APPROACH
Nilushni Sivapragasam, Ashish Chakradhar, Tilan Abeyratna, & Uwe Burghaus

2:00 PM — IMPACT OF PRE-BREEDING VACCINATION WITH MODIFIED-LIVE OR INACTIVATED VIRAL VACCINES ON SUBSEQUENT REPRODUCTIVE PERFORMANCE IN CROSSBRED BEEF FEMALES
Mellissa. R. Crosswhite, Bryan. W. Neville, John. C. Rodgers, Jon. T. Seeger, and Carl. R. Dahlen

2:20 PM — **BREAK**

UNDERGRADUATE COMMUNICATIONS
IN THE
A. RODGER DENISON COMPETITION

(Communications are listed alphabetically by the last name of the presenting author)

LACTOFERRIN FUNCTION IN REDUCING AND OXIDIZING ENVIRONMENTS

Hannibel Brock* and Bryan Schmidt
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Lactoferrin is a mammalian glycoprotein 80 kDa in size and 703 amino acids long. It is present in secretions such as tears, saliva, mammalian breast milk, in mucosal secretions such as pancreatic juice, small intestine secretions such as bile, and also in seminal fluid and uterine fluid. Lactoferrin is part of the innate immune system, exhibiting immunologic properties mainly in the form of antimicrobial action. As the name implies, lactoferrin's antimicrobial action is believed to be embedded in its ability to bind iron exceptionally well, making it unavailable to microbes for metabolism. The underlying hypothesis of this study is first to show that lactoferrin has antimicrobial properties, and second to debunk the belief of iron-binding being the mechanism by which lactoferrin acts. The hypothesis therefore is that the oxidation and reduction of disulfide bonds present in lactoferrin, which determine protein structure, is the mechanism through which lactoferrin exhibits its antimicrobial property. To test this, first lactoferrin was purified from store-bought skim milk using salting out with 2 M Ammonium sulphate, dialysis using tube size 8-10 kDa in sodium monobasic phosphate buffer, and ion-exchange chromatography using a DEAE-Sepharose column, techniques. The effect of lactoferrin on the growth of *Sacchromyces cerevisae* in varying conditions was tested. It was found that lactoferrin does not exhibit fungicidal properties against yeast/ fungi either in the presence or absence of iron. It was also found that disulfide mediators had fungicidal action on *Sacchromyces cerevisae*.

RAPID SYNTHESIS OF N-(2-HYDROXYBENZYL)ACETAMIDE

Kaylee A. Dockter*, Lioudmila I. Bobyleva, MS; and Mikhail M. Bobylev, PhD
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Background: Recently, we developed a rapid Leuckart reaction procedure for the synthesis of substituted benzylformamides. We also used acetamide as an alternative solvent for the Leuckart reaction. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, N-(4-chlorobenzyl)formamide was produced as a minor product with an isolated yield of only 14.4%. The use of acetamide resulted in a substantial shift towards the products of the secondary and tertiary Leuckart reactions. Specifically, N,N-di-(4-chlorobenzyl)formamide was produced as the main product with an isolated yield of 33.5%. The reaction also produced N-(4-chlorobenzyl)acetamide with an isolated yield of 16.0%. It was the first example of an amide other than formamide produced in the Leuckart reaction.
Hypothesis: The reaction conducted on benzaldehydes with electron-donating substituents may result in even larger shifts towards the products of the secondary and tertiary Leuckart reactions. In this work this hypothesis was tested on 2-hydroxybenzaldehyde.
Methods: The reaction was conducted on 10 mmol scale at 189^{o}C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: The reaction was fully completed in 7 minutes. Surprisingly, N-(2-hydroxybenzyl)acetamide appeared to be the main product of the reaction with an isolated yield of 32.9%. N,N-di-(2-hydroxybenzyl)formamide was produced as the second major product with an isolated yield of 22.9%.
Conclusions: The first Leuckart reaction producing an amide, other than formamide, as the main product, was conducted. A new approach to the rapid synthesis of N-(2-hydroxybenzyl)acetamide was developed.

Supported by NIH grant 8 P20 GM103442-12 from the National Institute of General Medical Sciences.

INVESTIGATION OF THE OXYGEN-PRODUCING ENZYME CHLORITE DISMUTASE

*Alisa Heskin**, Zachary Geeraerts, Gudrun S. Lukat-Rodgers, Kenton R. Rodgers
Department of Chemistry & Biochemistry, North Dakota State University, Fargo, ND 58105
*Department of Chemistry, Concordia College, Moorhead, MN 56562

Chlorite dismutases (Cld) are bacterial and archaeal enzymes that catalyze the decomposition of chlorite (ClO_2^-) into chloride (Cl^-) and molecular oxygen (O_2) (1). This enzymatic decomposition is rare in its capacity to produce O_2 and is significant in its potential for bioremediation of toxic oxoanions of chlorine (2). With the goal of elucidating the decomposition mechanism, the activity of the Cld from *Klebsiella pneumoniae* was measured as a function of pH using an O_2-sensing probe. Like the perchlorate-metabolizing bacterium, *Dechloromonas aromatica*, the *K. pneumoniae* enzyme exhibits maximum activity between pH 5.0 and 6.0 (2). By contrast, its activity is lower than Cld from *D. aromatica*. In order to emulate potential mechanistic intermediates, nitric oxide (NO) was coordinated to the heme cofactor in the active site (3). Both the $\{FeNO\}^6$ and $\{FeNO\}^7$ complexes were characterized for the Clds by UV-visible spectroscopy. Neither underwent reductive nitrosylation, a typical reaction for heme proteins (3). Ongoing resonance Raman experiments with wild type *D. aromatica* Cld and its distal pocket mutant, *Da*Cld(R183Q), provide insight into the ligand positioning, electrostatic landscape, and the hydrogen bonding environment of the Cld active sites, which will ultimately provide insight into the structural basis of the enzyme's function and differences in O_2-evolving activities of the Clds from different organisms.

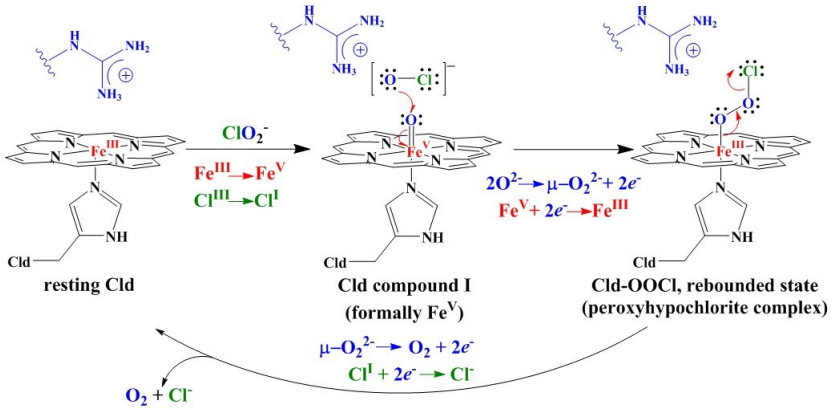

Figure: Scheme showing the current mechanistic model for Cld-catalyzed chlorite decomposition to yield O_2 and Cl^- (2).

References

1)Hofbauer S, Schaffner I, Furtmüller PG, and Oblinger C. (2014) Biotechnol J, 9, 461-473.
2)Streit B, Blanc B, Lukat-Rodgers GS, Rodgers KR, and DuBois JL. (2010) J Am Chem Soc, 16, 5711-5724.
3)Spiro TG, Soldatova AV, Balakrishnan G. (2013) Coordin Chem Rev, 257, 511-527.
4)Goblirsch BR and Wilmot CM. (2010) J Biol Inorg Chem, 15, 879-888.
5)Mlynek G, Sjöblom B, Kostan J, Füreder S, Maixner F, Gysel K, Furtmüller PG, Obinger C, Wagner M, Daims H, Djinović-Carugo K. (2011) J Bacteriol, 193, 2408-2417.

This research funded by grants from the National Science Foundation (NSF-CHE 1062701) and the National Institutes of Health (AI072719, GM094039).

COMBINING PHYTOREMEDIATION OF COAL FLY ASH (FA) AND BIOFUEL PRODUCTION.

Shannon Dawn Hone, Justin Tangen, Richard Langedoux, and Jerzy Bilski
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The INBRE funded research being conducted at Valley City State University (VCSU) since 2009 is oriented on environmental health aspects of coal fly ash utilization for plant media. It focuses on the utilization of coal fly ash (FA), a coal combustion residue, for growing and cultivating plants, the uptake of metals from FA based plant growth media, and phytoremediation of FA.

This project focuses on the potential to dispose of FA in an environmentally safe manner through the use of phytoremediation with cover crops that can be used for biofuel.

To date, there is limited information concerning the environmental health aspects of FA utilization as a component of growth media for plants. The issue of combining coal FA phytoremediation with biofuel (bioethanol) production has not yet been explored.

Many herbaceous plants, primarily grasses, exhibit rapid growth and are moderately resistant to environmental stress. Therefore grasses are often used as cover crops in environmental restoration and remediation projects. This creates a platform to include at least some bioethanol producing plants, such as corn, reed canary grass, cord grass, sorghum, switchgrass, and miscanthus into this FA phytoremediation project. In Part 1 of our study, seeds of several plant species (see below) will be planted in growth media mixtures of FA and a soil control. The FA will be mixed with the soil control in 0, 10, 20, 30, 40 50, 60, 70, 80, 90 and 100% concentrations by volume basis.

In Part 2 of our study, the same plant species will be seeded on plant growth media composed of FA, soil, and Milorganite (91.4% sewer sludge) in 33.33, 50, and 100% concentrations by volume basis. Each of the plant species in this experiment will be represented by 3-4 cultivars, common for North-Central States. The following plant species (showing a potential for biofuel production) will be examined: corn *(Zea mays*), reed canary grass, cord grasses, sorghum *(Sorghum bicolor)*, switchgrass *(Panicum virgatum)*, miscanthus *(Miscanthus gigantheus)*, perennial ryegrass *(Lolium multiflorum)*, barley *(Hordeurn vulgare)*, wildrye *(Elymus arenarius)*, needlegrass *(Stipa tenacissima)*, fescue *(Festuca rubra)*.

Plants will be grown for 21-28 days (depending on the time of seedlings germination and growth), harvested, dried, and weighed. Experiments will be replicated three times. The concentration of selected micronutrients in growth media and digested young plants will be determined using inductively coupled plasma (ICP) emission spectrophotometry. The data will be analyzed statistically using ANOVA and Statistical Analysis System.

In preliminary studies barley, hybrid pearl millet, regreen, rye, sorghum-sudangrass hybrid, and triticale were used. When planted in FA/soil mixtures that used VCSU's power plant FA (FA from lignite coal), rye, sorghum-sudangrass hybrid, and triticale grew in the 0, 10, and 20% FA mixtures. Barley grew in the 0 and 10% FA mixtures. When NDSU's power plant FA was used (FA from semi-bitominous coal), all six plant types grew in at least three of the 0-100% FA mixtures. The plants that grew in all (0-100%) NDSU FA mixtures were the sorghum-sudangrass hybrid and the triticale. When planted in a 50% NDSU FA and 50% Milorganite growth media, all six plant types grew. These are results from the first of three replications.

All of the above plants were harvested and have been sent to NDSU to be weighed and have their micronutrients determined. All of the growth media mixtures used were sampled prior to planting and after harvest to detect if and how much phytoremediation of micronutrients occurred.

Supported by North Dakota INBRE Grant Number P20 RR016741 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health.

THREE GENETIC VARIANTS MAY NOT BE ASSOCIATED WITH ASTHMA AMONG AMERICAN INDIAN CHILDREN

Authors: Jerome D, Parisien A, Best, LG
Affiliation: Turtle Mountain Community College, Belcourt, North Dakota

PURPOSE: Asthma is recognized as a complex, multifactorial condition with a genetic component that is well recognized. While certain genetic variants at the chromosome 17q21 locus have been found associated with asthma in a number of populations, it is not known if these associations are seen in American Indian children with asthma. METHODS: The electronic medical records of a northern plains Indian Health Service facility identified all children between ages 6 and 17 with a clinical diagnosis of asthma (N=108). Detailed medical records were reviewed for case defining criteria. Control children (N=216), matched for age, were identified. Real-time polymerase chain reaction, TaqMan (Life Technologies) assays were used to genotype three single nucleotide polymorphisms (SNPs) at the 17q21 locus. Mean values were compared between cases and controls using the Student t test; and genotypic distributions by case/control status were evaluated by chi-square and logistic regression methods. RESULTS: Of three possibly modifying covariates, age, gender and body-mass index (BMI), only the latter was found to be independently associated with asthma (OR=1.04, $p<0.03$). Among the <175 participants genotyped to date, neither rs7216389, rs8076131, or rs2305480 were found to be associated with asthma in either additive, dominant or recessive models. CONCLUSION: As found in other populations2, American Indian children appear to show an increased risk of asthma associated with obesity. Although only about one half of the participants have thus far been genotyped, we have been unable to replicate associations in this American Indian population between genetic variants in the 17q21 locus and asthma.

Wu H, Romieu I, Shi M, et al. (2010) J Allergy Clin Immunol. 125:321-327.
2 Permaul P, Kanchongkittiphon W, Phipatanakul W. (2014) Ann Allergy Asthma Immunol. 113:244-6.

Funding: North Dakota INBRE and the National Institute of Health, NCRR. (P20 RR016741)

EXTRACTION AND CONCENTRATION OF CAFFEINE FROM ARTIFICIAL SALIVA FOR GC/MS ANALYSIS

Johanna Mayhew* and Naomi Winburn
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The analysis of saliva for drug testing is a well-known technique. In this study, a simple liquid-liquid extraction of caffeine from artificial saliva using 0.200 mL of chloroform was optimized for convenience, efficiency, and speed. Extraction was performed on artificial saliva with controlled amounts of caffeine. Caffeine concentrations in extracted samples were determined using GC-MS. It was found that maximum extraction efficiency in minimum time was achieved using 0.200 mL ethanol as a dispersion solvent and placing samples in a cell disruptor for 60 s. Using a simple calibration curve for rough quantification, the detection limit was 0.05 mg/L and the quantification limit was 5.00 mg/L. Results will be used in future studies regarding the effects of caffeine on human behavior.

BOHR REVISITED: MODEL AND SPECTRAL LINES OF HELIUM

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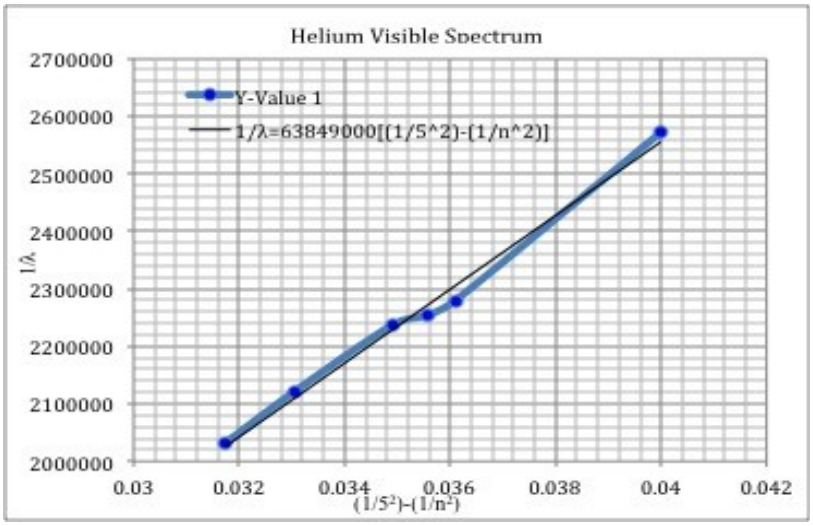
In 1913, Niels Bohr introduced a quantum mechanical model of the hydrogen atom. The Bohr model supposed that electrons orbit the nucleus in set orbitals or paths, and as energy was added to the atom the electrons made transitions between orbitals. When the atom released the energy, it would be given off in light, of which the wavelength would differ, depending on between which orbitals the electron made its quantum transition. This has thus been replaced by Schrödinger's theory. I have found, augmenting Bohr's model by assuming two electrons diametrically opposed in a circular orbit that certain spectrum properties of helium are predicted to within five percent. However, fitting the new Rydberg constant to experimental data to account for screening and correlation leads to an agreement to less than one percent.

The Graph on the right shows a fit of the experimental data based from the constant originating from the model.

$$\frac{1}{\lambda} = 6.3849 * 10^{7}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$



The Table below shows the percent error between the experimental wavelengths in the He spectrum and those predicted by the model with the adjusted constant.

Atom and Orbital	Calculated line	Experimental line	Percent Error
He $n_{11} \rightarrow n_5$	493.51 nm	492.193 nm	.27% Error
He $n_{12} \rightarrow n_5$	473.81 nm	471.338 nm	.52% Error
He $n_{14} \rightarrow n_5$	448.79 nm	447.147 nm	.37% Error
He $n_{15} \rightarrow n_5$	440.49 nm	443.79 nm	.74% Error
He $n_{16} \rightarrow n_5$	433.92 nm	438.79 nm	1.11% Error
He $n_{\infty} \rightarrow n_5$	391.55 nm	388.86 nm	.69% Error

References:

[1] F A Deeney and J P O'Leary 2012 *The effects of the Pauli exclusion principle in determining the ionization energies of the helium atom and helium like ions* Eur. J. Phys. 33 667-675

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[4] Richard Payling and Peter Larkins 2000 *Optical Emission Lines of the Elements* Wiley & Sons Ltd England

COMBINING PHYTOREMEDIATION OF COAL FLY ASH (FA) AND AGRONOMIC BIOFORTIFICATION.

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Coal fly ash (FA) is a major industrial by-product from electric power plants. Disposal of FA is becoming a major issue because of the potential to contaminate air, surface, and groundwater with arsenic, boron, heavy metals, sulphate anions, etc. A promising solution to the FA issue is phytoremediation, the use of green plants to clean up our environment. In our research project we will attempt to combine phytoremediation with the exploration of the possibility to bio fortify cereal crops grown on FA with Fe, Zn, and Se.

Combining FA phytoremediation with agronomic biofortification is a very important issue because Fe, Zn, and Se deficiencies are not only serious public health issues, but also important soil constraints to crop production. This is particularly true in the developing world.

Exploiting the genetic variability and biotechnological approach (e.g., genetic modifications) to the development of plants with high Fe, Zn, and Se content may be an efficient method to improve human nutrition, but, unfortunately, it is not cost effective and requires significant amount of time. Agronomic approaches, proposed in this study, such as application of FA based plant growth media containing high concentration of Fe, Zn, and Se, called "agronomic biofortification" seems to be a cost-effective, fast and practical method to enhance Fe, Zn, and Se concentration in cereal crops.

In a past study a soil control (Fargo clay), two coal FA (one from Montana semi-bituminous coal and another from North Dakota lignite) alone, or in combination with BA from Montana semi-bituminous coal, were used as plant growth media.

Experimental treatments consisted of following growth media:

1Soil (Fargo Clay) as a control

1)FA from North Dakota lignite coal (FA1)

2)FA from semi-bituminous coal from Montana (FA2)

3)BA from the same semi-bituminous coal from Montana

4)FA/BA (1:1 weight based) from semi-bituminous coal from Montana

Six plant species were tested including barley (*Hordeum vulgare*), Jerry oats (*Avena sativa*), rye (*Secale cereale*), wheat (*Triticum aestivum*), perennial ryegrass (*Lolium multiflorum*), and ReGreen (wheat x wheatgrass hybrid (*Triticum aestivum x Thinopyrum intermedium*).

Plants were grown for 14-21 days (depending on the time of seedlings germination and growth), harvested, dried, and weighed. Experiments were replicated three times. The concentration of Ca, Mg, Zn, Fe, Se, B in growth media and digested young plants was determined using inductively coupled plasma (ICP) emission spectrophotometry. The data were analyzed statistically using ANOVA and Statistical Analysis System.

Plants were able to germinate in media containing FA and/or BA compared to soil control. The concentration of Fe in all media consisting of coal ash was significantly greater ($P<0.05$) than in soil control. The concentration of Zn in all media consisting of coal ash was significantly greater ($P<0.05$) than in soil control, although the differences between Zn concentrations in the soil and coal ashes were much smaller than in the case of Fe. The concentration of selenium (Se) in all plants growth media composed of coal ashes was ~10-100-fold greater ($P<0.05$) than in soil control. Our study demonstrated, that it is possible to establish cereal crops growth on growth media composed exclusively of coal combustion by-products, and that these crops are able to accumulate elevated amounts of Fe, Zn and Se, as compared to plants grown on the soil used as control. Accumulated levels of these elements may justify treating the process of cultivating cereal crops on coal ash piles not only as a phytoremediation process, but also as means of agronomic biofortification of planted crops.

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EFFECTS OF EXOGENOUS ABSCISIC ACID ON INDOLE-3-ACETIC ACID-INDUCED LEAF GROWTH IN *ARABIDOPSIS THALIANA*

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The plant morphogenic hormone indole-3-acetic acid (IAA) controls multiple aspects of plant growth including vascular development and root and leaf initiation. Previous reports to NDAS annual meetings (Proc. North Dakota Acad. Sci. Vol 65, p20; Vol 67, p19; Vol 68, p34) have described studies of how IAA impacts leaf expansion in the model plant, *Arabidopsis*. Increasing the IAA content of young expanding intact attached, intact detached, and wounded attached leaves resulted in inhibition of growth, while IAA treatment of excised leaf strips or wounded detached leaves stimulated rather than inhibited growth. These results indicated that leaf tissue must be both wounded and detached from the plant for IAA to induce increased growth. A model was suggested whereby exogenous IAA applied to leaves induces (in the absence of leaf-wounding) the synthesis of a growth inhibiting substance both within the leaf and within the roots (Plant Signaling & Behavior [2011] Vol 6, p1997-2007). Several candidate plant growth controllers are known but the isoprenoid compound abscisic acid (ABA; 5-(1-Hydroxy-2,6,6-trimethyl-4-oxo-2-cyclohexen-1-yl)-3-methyl-2,4-pentanedienoic acid) seemed a particularly strong candidate for the hypothesized growth inhibiting substance as it is a known plant growth inhibitor. Here we report first on the results of the tests of the hypothesis that IAA induces increased ABA synthesis within *Arabidopsis* leaves.

As with for previous experiments in this ongoing project, seedlings of *Arabidopsis* were grown in moist potting soil in a growth chamber at 19°C, with continuous illumination. After 10-14 days, plants were selected with both the first two true leaves 2.8-3.2 mm in diameter and rapidly expanding. One of these first two leaves from each plant served as the experimental leaf and the other leaf served as a paired control. For growth experiments, detached leaves were treated 24 hours with media +/- ABA and/or IAA. For analysis of endogenous leaf ABA content using a high throughput purification and quantification with GC-MS, after 24 hours (and at time zero) leaves (detached, attached, and wounded detached) were pooled.

In initial experiments, 10 µM exogenous ABA significantly inhibit the growth of detached leaves of wild type (Columbia) *Arabidopsis*. As well, 30 and 10 µM (but not 1 µM) ABA significantly inhibited leaf growth with ABA deficient mutant plants (CS5736: Arabidopsis Biological Resource Center).

At time zero, attached expanding wild type leaves were found to contain 1907 +/- 181 ng/g fresh wt. ABA. After 24 hours, leaves still attached to the plant treated with a 5 µL drop of control media contained 1373 +/- 178 ng/g ABA while attached leaves treated with a drop of media also containing IAA contained 1631 +/- 159 ng/g ABA. Detached intact leaves floated 24 hours on control media contained 341 +/- 88 ng/g ABA while IAA treated detached intact leaves contained 260 +/- 61 ng/g ABA. Detached wounded leaves (three cuts from the margin to the midvein) floated on control media contained 194 +/- 61 ng/g ABA while IAA treated detached wounded leaves contained 385 +/- 111 ng/g ABA. Together the results indicate that IAA-induced leaf-growth inhibition is not the simple result of IAA stimulation of ABA synthesis in detached and attached leaves as hypothesized.

We also tested a second hypothesis, that, rather than inducing increased ABA synthesis, the hormone increases the sensitivity of growth to the inhibitory effects of ABA. Remarkably, however, the growth of mutant (cs5736) leaves exposed to both IAA (50 µM) and ABA (30 µM or 10 µM) was not significantly different than that of leaves grown on IAA (50 µM) alone. Further, leaves exposed to 50 µM and 1 µM ABA grew highly significantly more than those treated with 50 µM IAA alone. While these results do not suggest IAA increases leaf growth inhibition sensitivity to ABA, they do suggest a model in which high concentrations of ABA initiates a growth inhibition pathway that is, itself, blocked by IAA and that low concentrations of ABA initiates a different growth-inducing pathway which also requires IAA.

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GRADUATE COMMUNICATIONS
IN THE
A. RODGER DENISON COMPETITION

(Communications are listed alphabetically by the last name of the presenting author)

CORPUS LUTEUM (CL) VASCULARITY AND FUNCTION DURING THE ESTROUS CYCLE IN SHEEP TREATED WITH ARGININE AND FED DIFFERENT PLANE OF NUTRITION

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Proper progesterone (P4) production from the corpus luteum (CL) is necessary for pregnancy maintenance and reproductive cyclicity, and is influenced by many factors including hormones, growth and angiogenic factors, nutritional plane, selected nutritional components and/or supplements, such as arginine (Arg), a semi-essential amino acid. During the estrous cycle, the CL undergoes rapid changes including vascular development and regression, and tissue growth and regression.

The aim of this study was to determine if Arg supplementation to control (C), overfed (O), and underfed (U) ewes impacts 1) body weight (BW) and body condition score (BCS), 2) P4 serum concentration and content in the CL, 3) CD31 (an endothelial cell marker), Ki67 (a proliferating cell marker), endothelial nitric oxide synthase (eNOS), and NO receptor soluble guanylate cyclase (sGC) protein and/or mRNA expression in the CL, and 4) mRNA expression of selected angiogenic factors in CL during the estrous cycle. Ewes were categorized by weight and randomly assigned to one of three different nutritional planes: C (2.14 Mcal/kg; n=37), O (2xC Mcal/kg; n=37), and U (60% of C Mcal/kg; n=37) beginning 60 days prior to Arg treatment. Body weight and BCS were determined once weekly. Estrus was synchronized and one day after CIDR removal, ewes from each diet were randomly assigned to one of two treatments; Arg (L-Arg-HCl; 155 μmol Arg/kg BW) or saline (~10 ml). Treatments were administered three times daily (0700, 1400, 2100 h) via jugular catheter beginning on day 0 of the first estrous cycle until blood and tissue collection at the early- or mid-luteal phase of the second estrous cycle or the late-luteal phase of the first estrous cycle. CL were counted, collected, weighed, and one portion was fixed for immunohistochemistry followed by image analysis, and another portion was snap-frozen for RNA extraction followed by quantitative real time RT-PCR for 11 angiogenic factors. During the experiment, C maintained BW and BCS, O gained 4.1±1.3 kg, and U lost 15.5±0.6 kg; for the O group, BCS increased by 1.1±0.1 and U decreased by 0.5±0.1. The CL number, and thus the ovulation rate, was greater ($P<0.01$) in O than C or U (2.0±0.1 vs 1.7±0.1 vs. 1.2±0.1), and was not affected by Arg treatment. The CL weight was greater ($P<0.001$) at mid- and late than early-luteal phase (514±25 and 513±27 vs. 231±19 g) and was not affected by plane of nutrition or Arg treatment. Serum P4 concentration was greater ($P<0.0001$) at mid- than early- or late-luteal phases (2.3±0.1 vs. 1.2±0.1 ng/ml and 0.9±0.1 ng/ml), tended to be greater ($P=0.1$) in O than C or U, and was not affected by Arg treatment. Concentration of P4 in luteal tissues was greater ($P=0.001$) in mid- than early- or late-luteal phase (10.5±0.8 vs. 7.3±0.9 and 6.2±0.8 μg/g of tissue). Luteal vascularity as determined by CD31 protein expression, was greater ($P<0.01$) in early- than mid- or late-luteal phase, and less ($P=0.01$) in Arg- than Sal-treated ewes. Luteal cell proliferation determined by Ki67 expression was greater ($P<0.01$) in early- than mid- or late-luteal phase, and treatment x day interactions ($P=0.06$) demonstrated greatest cell proliferation at the early-luteal phase in Arg-treated ewes. eNOS protein was greater ($P=0.01$) at mid- than early- or late-luteal phases (27.9%±1.6 vs. 23.3%±1.2 or 21.8%±1.2, respectively), and was not affected by diet or Arg treatment. Protein expression for sGC-beta in the CL was similar in all groups. For *eNOS* mRNA expression in CL, Arg treatment x luteal phase interactions ($P<0.04$) demonstrated an increase in Arg-treated ewes at the early luteal phase. *GUCY1B3* (isoform of sGC) mRNA expression tended ($P=0.09$) to be greater in Arg-treated ewes, but was not affected by diet or estrous cycle stage. *VEGF* mRNA expression was greater ($P=0.02$) at mid- than early- or late-luteal phase and was not affected by Arg treatment or nutritional plane. For *KDR* mRNA, nutritional plane x Arg treatment x luteal phase interactions ($P=0.05$) demonstrated that in mid-luteal stage, expression was greater in 1) Arg treated than Sal treated C ewes, and 2) Arg treated C and U compared to O ewes similarly treated. *ANGPT-2* mRNA expression was less ($P=0.01$) at early- than mid- or late-luteal phases and was not affected by Arg treatment or nutritional plane. Expression of mRNA for *FLT-1*, *ANGPT-1*, *Tie2*, *FGF2*, *FGFR2*, and *PGF* was similar in all groups. In summary, we have demonstrated that 1) nutritional plane affects BW, BCS, and ovulation rates, 2) serum P4, and CL weight, P4 content, vascularity, cell proliferation and expression of selected members of the VEGF system and ANGPT-2 change during the estrous cycle, 3) Arg treatment affects luteal vascularity, cell proliferation, and eNOS and GUCY1B3 expression, and 4) diet affects KDR receptor expression depending on diet and stage of the estrous cycle. Thus, selected luteal functions are affected by Arg-treatment or diet and these effects depend on the stage of the estrous cycle, but regulatory mechanisms remain to be elucidated.

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SYNTHESIS AND CHARACTERIZATION OF CHIRAL C_2-SYMMETRIC BIMETALLIC ZINC COMPLEXES OF AMIDO-OXAZOLINATES: ACTIVE INITIATORS FOR ASYMMETRIC COPOLYMERIZATION OF CO_2 AND CYCLOHEXENE OXIDE

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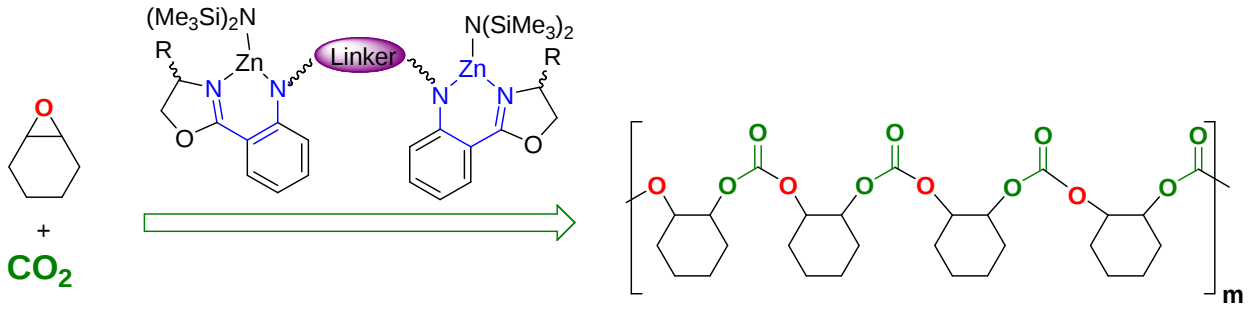

With the depletion of petroleum based feedstocks and environmental concerns, production of biodegradable polymers from renewable resources has attracted much attention. Carbon dioxide (CO_2) is one of the leading renewable carbon resources because it is abundant, inexpensive, non-toxic, and non-flammable. Significant efforts have been directed towards the catalytic alternating copolymerization of aliphatic epoxides with carbon dioxide that generates aliphatic polycarbonates with a wide array of applications.

A family of new chiral C_2 symmetric amido-oxazolinate ligands, bridged by three different linkers, have been synthesized via a modular Buchwald-Hartwig amination reaction. Treatment of ligands with two equiv. of $Zn[N(SiMe_3)_2]_2$ in dry toluene generated a series of bimetallic zinc complexes and reaction with one equiv. of $Zn[N(SiMe_3)_2]_2$ leads to formation of a homoleptic mononuclear zinc complex in decent yield. These complexes were found to be effective catalysts for asymmetric alternating copolymerization of CO_2 and cyclohexene oxide (CHO).

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IMPACT OF PRE-BREEDING VACCINATION WITH MODIFIED-LIVE OR INACTIVATED VIRAL VACCINES ON SUBSEQUENT REPRODUCTIVE PERFORMANCE IN CROSSBRED BEEF FEMALES[1]

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Five hundred and fifty-nine Angus crossbred females (410 cows and 149 heifers) were used to compare pregnancy attainment and calving distributions of females administered either a killed or modified-live pre-breeding vaccine per label recommendations. Cows were stratified by days postpartum while heifers were stratified by birth date, then all females were randomly assigned to receive one of 3 treatments; 1) Sterile saline administered i.m. on d -60 and -30 relative to breeding (**Control**, n = 185), 2) Sterile saline administered i.m. on d -60 relative to breeding and a modified-live vaccine (Bovi-Sheild Gold FP5 L5 HB, Zoetis, Inc., Florham, NJ, USA) administered i.m. on d -30 relative to breeding (**MLV**, n = 188), or 3) Killed vaccine (Vira-Sheild 6+L5 HB, Novartis Animal Health US, Inc., Larchwood, IA, USA) administered s.q. on d -60 and -30 relative to breeding (**Killed**, n = 186). All vaccines were administered according to manufacturer's label recommendations and consisted of 3 different lots and serials. All females were exposed to the 7-d CO-Synch + CIDR synchronization protocol with a single fixed-time artificial insemination (TAI) at 54 h after CIDR removal for heifers and 60-66 h after CIDR removal for cows. Clean-up bulls were placed in breeding pastures 10 d after AI and remained with females until 56 d after TAI. Presence of a viable fetus was determined at d 28, 56, and 90 relative to TAI. At parturition, date, birth weight, calf vigor, and calving ease (1 – 5 with 1 = no problem, 5 = extreme difficulty) were recorded. No differences were observed among treatments in the proportion of females pregnant (d 28: $P = 0.94$, d 56: $P = 0.36$, and d 90: $P = 0.19$) There were also no differences in calving date in the calving season ($P = 0.76$) as well as no differences in distribution of calves born in 21 day calving intervals ($P = 0.49$). More calving difficulty ($P = 0.05$) was observed in females exposed to the saline control treatment compared with females in the MLV or Killed treatments (1.09, 1.01, 1.04, control, modified-live, and killed, respectively). However, no differences observed among treatments in calf birth weight ($P = 0.27$) or calf vigor ($P = 0.51$). When modified-live or killed pre-breeding vaccines were administered per label recommendations no impacts on pregnancy attainment or calving distribution were observed.

[1] [1]*Sincere appreciation is expressed to Zoetis Animal Health for financial support of this experiment.*

MATERNAL NUTRITION AND EMBRYONIC SURVIVIAL: NUTRIENT TRANSPORTERS IN BOVINE UTERO-PLACENTAL TISSUES ON DAYS 16 TO 50 OF GESTATION

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To meet the projected food requirements of the growing population, the world needs to significantly increase its output of meats by 2050 (4). Currently, fertilization rates for first service AI are approximately 90% in beef heifers (3); however, by d 30 of gestation, only 50 to 60% are viable embryos. Moreover, Thatcher et al., (1994) indicated that up to 40% of all embryonic loss occurs before d 40 of gestation. We recently developed a standing, flank ovariohysterectomy procedure that allows for a detailed and accurate assessment of expression of utero-placental nutrient transporters during the early stages of gestation (NP to d 50 of gestation). The presence of nutrient transporters and nutrient flow to the growing embryo is crucial for proper development and growth. During this time, the placenta is developing and the fetus begins to utilize increasing quantities of glucose and amino acids (5; 6; 1). Thus, the expression of glucose and amino acid transporters in the utero-placenta becomes essential to the viability of the conceptus. The main utero-placental glucose transporters are GLUT1 and GLUT3. The GLUT1 isoform is the main glucose transporter and is present in most tissues throughout the body and is ubiquitous across species. The GLUT3 is a specific neural and placental glucose transporter. The main cationic utero-placental amino acid transporters are SLC7A1, SLC7A2, and SLC7A3. The substrates for these transporters are amino acids such as arginine and lysine, which are directly linked to angiogenesis and cell proliferation. Our hypothesis was that transporters for glucose and amino acids in utero-placental tissues would be differentially expressed across days of early pregnancy. To test this hypothesis, crossbred Angus heifers (n = 46), were synchronized, bred via AI and then ovariohysterectomized on d 16, 22, 28, 34, 40, or 50 of gestation (n = 5 to 9/d), or were not bred and ovariohysterectomized on d 16 of the synchronized estrous cycle (n = 7) to serve as non-pregnant (NP) controls. Utero-placental tissues (caruncular, CAR; intercaruncular endometrium, ICAR; and fetal membranes, FM [chorioallantois, d 22 and later]) were collected from the uterine horn of pregnancy immediately following ovariohysterectomy. For NP controls only CAR and ICAR were obtained. Relative mRNA expression of the glucose transporters GLUT1 and GLUT3 as well as cationic amino acid transporters SLC7A1, SLC7A2, and SLC7A3 was determined for each tissue from d 16 to d 50 of gestation and also for NP controls. In CAR, expression of GLUT1 was greatest ($P < 0.0001$) on d 16, and expression of GLUT3 was greatest ($P = 0.01$) on d 50 of gestation. The expression of cationic amino acid transporter SLC7A1 was greater ($P \leq 0.05$) in CAR on d 28, 34, and 40 compared to NP and d 16, 22, and 50. There was no effect of day on SLC7A2 expression in CAR. Expression of SLC7A3 was greatest ($P = 0.01$) in CAR on d 16. In ICAR, the expression of GLUT1 was greatest ($P < 0.0001$) on d 16 of gestation. Relative expression of GLUT3 tended to be greater ($P = 0.06$) in ICAR at d 34 and 40 compared to NP. Intercaruncular expression of SLC7A1 and SLC7A2 was greatest on d 34 ($P < 0.0001$ and $P = 0.02$, respectively). Relative expression of SLC7A3 was greater ($P \leq 0.05$) in ICAR on d 28, 34, and 40 compared with d 16 and 22. In FM, GLUT1 was greater ($P \leq 0.05$) on d 22 compared with d 34, 40, and 50. There was no effect of day on expression of GLUT3 in FM. The expression of SLC7A1 was greatest ($P = 0.0003$) in FM at d 22. There was no day effect for SLC7A2 or SLC7A3 in FM. These results support our hypothesis that there is an effect of day on the expression of glucose and amino acid transporter mRNAs in utero-placental tissues of heifers during early pregnancy.

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EFFECT OF DRY-ROLLED CORN PROCESSING AND DISTILLER'S GRAIN INCLUSION RATE ON RUMEN PH, VOLATILE FATTY ACIDS, AMMONIA CONCENTRATION AND *IN VITRO* METHANE PRODUCTION

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Increased dried distillers grains with solubles (DDGS) inclusion and decreased corn particle size have been shown to lower ruminal pH and reduce methanogenic bacteria and hydrogen production. Objectives were to determine the effects of dry-rolled corn processing and DDGS inclusion rate on ruminal pH, VFA and NH_3 concentration, and in vitro methane production. Eight ruminally cannulated Holstein steers (526 ± 3.6 kg) were assigned to treatments in a 2 × 2 factorial arrangement with factors including 1) particle size (coarse-rolled corn [2.5 mm] or fine-rolled corn [1.7 mm]) and 2) DDGS inclusion level (20 or 40%). Diets were formulated to meet or exceed NRC recommendations and were offered ad libitum. The experiment was designed as a 4 × 4 Latin square with 7 d of diet adaptation and 7 d of sample collection. Ruminal pH was measured using wireless pH sensors (Kahne Ltd.) with measurements taken every 5 min from d 3 to 5 of the collection period. To determine VFA and NH_3 concentration, approximately 200 mL of ruminal fluid was sampled from d 3 to 5 in a manner to represent every other hour in a 24-h cycle. Gas production was examined on d 1 and 7 of the collection period using 4 replicates per treatment. Approximately 0.375 g of each of the 4 dietary substrates was added to 250-mL flasks with 175 mL of McDougall's buffer and 37.5 mL of ruminal fluid. The flasks were flushed with CO_2, fitted with pressure monitor caps, and placed in an oscillating water bath at 39°C for 24 h. A gas pressure monitoring system (ANKOM) was used to measure the changes in pressure relative to atmospheric pressure as a consequence of gas produced during fermentation. Data were analyzed using the MIXED procedure of SAS with statistical significance declared at $P \leq 0.05$. Ruminal pH was not affected ($P \geq 0.07$) by treatment while NH_3 concentration was greater ($P = 0.02$) in steers fed 20% DDGS. Steers fed fine-rolled corn had greater ($P = 0.02$) concentrations of butryric acid. Total gas production and methane concentration were not influenced ($P \geq 0.08$) by particle size or DDGS inclusion level. Urea was supplemented in diets containing 20% DDGS to meet DIP requirements, which likely accounted for the increase in NH_3. Despite a rise in ruminal butyric acid, acetate and propionate were not affected ($P \geq 0.20$), possibly reducing the likelihood of hydrogen capture and subsequent methane mitigation.
Key Words: bovine, corn, distillers, rumen

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PHENYLETHYLAMINE CAN BE USED FOR PREVENTION AND TREATMENT OF BACTERIAL BIOFILMS

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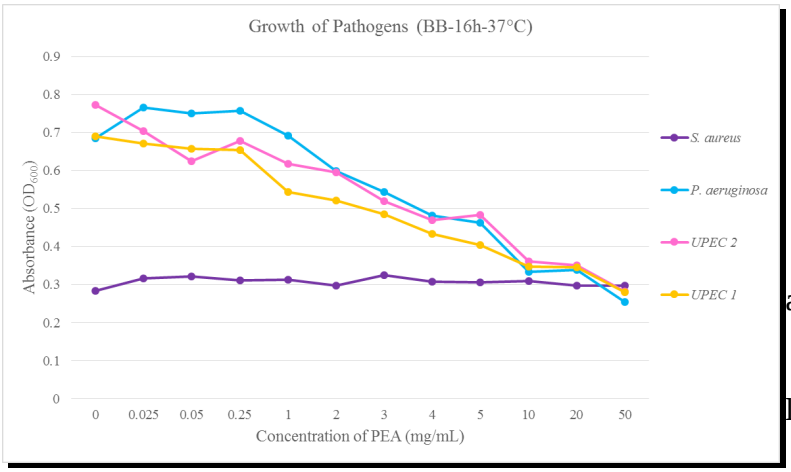
Previous research in our lab has found PEA to be one of the two most effective of 95 carbon and 95 nitrogen sources screened for their effect on *Escherichia coli* O157:H7 growth, bacterial counts, and biofilm amounts on treated pieces of beef (Lynnes et al., 2013). A range of PEA concentrations (0 to 100 mg/ml) was used to test the effectiveness of PEA on pathogens that form bacterial biofilms in the food industry and clinical settings. In TSB at 37°C, PEA was found to be more effective at reducing growth and biofilm amounts of the gram negative pathogens, in comparison to the one gram positive pathogen. In a second experiment, different environmental factors, such as time of incubation, temperature, and growth medium were modified to see how the environment impacts the effect of PEA. In general, the pathogens grown in more nutrient rich media had higher growth and biofilm amounts, but the higher temperature was more effective at reducing growth and biofilm amounts. The addition of PEA at different time points after inoculation was tested in a third experiment, using an *E. coli* K-12 strain. PEA was found to reduce both growth and biofilm amounts when added after long time after the initial inoculation. This leads us to believe that PEA could be used as a preventative measure and treatment of bacterial biofilms in both the food processing industry and clinical setting.



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LATE GESTATION SUPPLEMENTATION OF DISTILLER'S GRAINS PLUS SOLUBLES TO BEEF COWS: IMPACTS ON MAMMARY BLOOD FLOW, COLOSTRUM AND MILK PRODUCTION, AND CALF WEIGHTS

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The objectives of the present study were to investigate the effects of distiller's grains plus solubles (DDGS) supplementation on blood flow to the mammary glands during late gestation and early lactation; colostrum and milk production; and calf weight gain during early lactation and at weaning. To test this, multiparous beef cows were divided randomly into a control group (CON; n = 15) consuming ad libitum a diet containing 90% corn stover and 10% corn silage (DM basis) and a treatment group (SUP; n = 12) consuming the same basal diet and DDGS (0.3% BW). Corn silage inclusion was increased to 30% as gestation progressed to meet increasing requirements. Mammary gland blood flow (BF) ipsilateral and contralateral to the pregnant uterine horn was measured on d 245 of gestation and d 44 of lactation. At parturition, colostrum samples were collected; calves were weighed at 0 and 24 hr and percentage BW loss was calculated. Milk production was assessed on d 44 of lactation. Calves were weighed every 2 wk from birth to d 56 and when weaned (d 205). Contralateral BF ($P = 0.85$) and cross sectional area (CSA; $P = 0.44$) did not differ on d 245 of gestation. Ipsilateral BF of SUP cows was greater than CON cows (2.76 vs. 1.76 ± 0.30 L/min, respectively; $P = 0.03$). Calves from CON dams tended to have a greater loss in percentage of body weight after birth than those of SUP dams (-0.43 vs. -2.75 ± 0.92%, $P = 0.09$). Cows carrying heifers produced more colostrum ($P < 0.01$) than those carrying bulls. No effect of maternal diet was observed on total mammary blood flow ($P = 0.33$) or other measures on d 44 of lactation. The SUP cows tended to produce more milk on d 44 (2.78 vs. 2.13 ± 0.25 kg/5 h, $P = 0.07$). Calves gained weight from birth to d 56 ($P < 0.001$) and those from SUP cows were heavier ($P < 0.05$) and tended to have a heavier ($P = 0.06$) adjusted d 205 weight at weaning than those from CON cows (309.7 vs. 292.0 ± 6.0 kg; 288.4 vs. 274.0 ± 5.4 kg, respectively). In conclusion, we accept our hypothesis that DDGS supplementation during gestation influenced mammary blood flow, milk production and calf weights; underlying mechanisms need to be investigated.

Keywords: beef cow, blood flow, mammary gland, pregnancy

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COCAINE PHOTO-AFFINITY ANALOGS BIND IN THE SUBSTRATE BINDING POCKET OF THE DOPAMINE TRANSPORTER

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The dopamine transporter (DAT) belongs to the SLC6A family of secondary-active Na^+/Cl^--dependent neurotransmitter transporters and functions to terminate dopaminergic signaling through re-uptake of dopamine (DA) from the synapse (1-3)[1]. The psychotropic drug cocaine binds to DAT and inhibits DA uptake resulting in elevated synaptic DA levels (4, 5). This cocaine-mediated blockade of DA uptake is poorly understood and has even been proposed to occur through both competitive and non-competitive mechanisms. Furthermore, pharmacological and computational data are conflicting making it unclear whether DAT has one or two cocaine binding sites (6, 7). To unravel the complexity of cocaine inhibition of DAT and inform our understanding of addiction, cocaine-like photo affinity ligands (PALs) were computationally docked into comparative models of DAT. In parallel, complexes of DAT crosslinked to the PALs were chemically fragmented at methionine residues and analyzed through peptide mapping to identify the sites of adduction for each PAL. By introducing or removing methionine residues in DAT, we unambiguously identified the site of adduction of the PAL to DAT, which was in complete agreement with the computational docking analyses. To biochemically verify the binding pose identified in the docking studies, we performed the substituted cysteine accessibility method to assess the position of cocaine and the PALs in DAT by their ability to protect engineered Cys residues from reacting with methanethiosulfonate reagents. Our data revealed that cocaine and the PALs bind to the core of DAT, which overlaps with the putative DA binding site, supporting a competitive mechanism for cocaine inhibition of DA uptake.

Grant Support: INBRE Program of the NCRR and NIDA-IRP (AHN), DA027845 (LKH & RAV), P20 RR017699 from the COBRE Program of the NCRR, and P20 RR016741 from ND EPSCoR IIG (RAV & JDF).

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A MULTI-TRAIT MIXED-MODEL FOR GENOME-WIDE ASSOCIATION STUDY IN BARLEY POPULATION

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Genome-wide association study (GWAS) is a standard approach for studying the genetics of natural variation, typically focusing on association between single-nucleotide polymorphisms (SNPs) and traits. For GWAS, if multiple traits are correlated, some essential and important information among multi-traits can be lost in marginal analysis. Therefore, fully parameterized multi-trait mixed-model is emerged as a flexible approach that considers both the within-trait and between-trait variance components simultaneously for multiple traits. The phenotype data used in this research is 1100 barley entries with reaction of leaf spot diseases. In this dataset, there are two different traits, RATE (reaction of spot form net) and RATING (reaction of spot blotch). 3941 SNPs makers dataset is used as genotype data. A multi-trait mixed-model was applied for genome-wide association study. The results show that the multi-trait mixed model can detect much more associations between single-nucleotide polymorphisms (SNPs) and traits than single-trait analysis do.

THEORETICAL MODELING OF QUANTUM EFFICIENCY OF HYDROGEN-PASSIVATED SILICON NANOSTRUCTURES

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Nanostructures, such as quantum dots, nanowires and nanofilms, have recently gained popularity in 3rd generation photovoltaics research as they exhibit peculiar electronic properties one of which is higher-than-bulk multiple exciton generation (MEG) rates due to the enhanced Coulomb interaction. MEG in nm-sized hydrogen-passivated silicon nanowires (NWs), and quasi two-dimensional nanofilms depends strongly on the degree of the core structural disorder as shown by the many-body perturbation theory (MBPT) calculations based on the DFT simulations. Here, we use the HSE exchange correlation functional. In MBPT, we work to the 2nd order in the electron-photon coupling and in the approximate screened Coulomb interaction. We also include the effect of excitons for which we solve Bethe-Salpeter Equation. We calculate quantum efficiency (QE), the average number of excitons created by a single absorbed photon, in 3D arrays of Si29H36 quantum dots, NWs, and quasi 2D silicon nanofilms, all with both crystalline and amorphous core structures. Efficient MEG with QE of 1.3 up to 1.8 at the photon energy of about 3Eg , where Eg is the gap, is predicted in these nanoparticles except for the crystalline NW and film where QE $\cong$1. MEG in the amorphous nanoparticles is enhanced by the electron localization due to structural disorder. The exciton effects significantly red-shift the QE curves. Nanometer-sized amorphous silicon NWs and films are predicted to have effective MEG within the solar spectrum range.

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ACETOACETIC ACID IMPACT ON BACTERIAL BIOFILMS AMONG A VARIETY OF STRAINS

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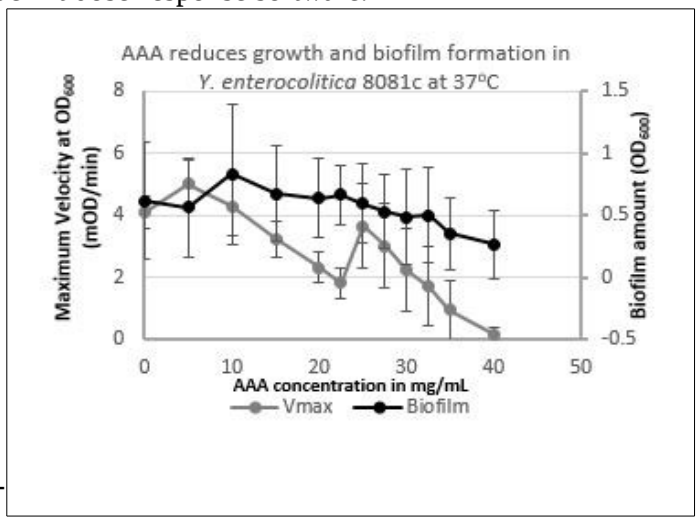
Background: Bacterial biofilms are complex communities of bacteria that may attach to surfaces. A few examples include medical devices, such as catheters and artificial joints, and industrial equipment important in the food processing industry. This intimate association between bacteria and a surface allows for a vastly increased resistance to antibiotics as well as an increased difficulty of removal. Previous work in our lab used *Escherichia coli* O157:H7 in beef broth medium supplemented with a series of carbon and nitrogen sources to identify candidates for biofilm reduction [Lynnes et al., Meat Science, 2014]. Acetoacetic acid (AAA) was shown to reduce biofilm amounts of *E. coli* O157:H7. AAA has also been used in conjunction with other organic acids to inhibit growth of *Listeria monocytogenes* in the food processing industry. [Stasiewicz et al., Appl Environ Microbiol., 2011] The goal of this study is to demonstrate AAA's efficacy as a useful chemical inhibitor of bacterial biofilms.

Methods: Overnight cultures of *Cronobacter sakazakii* 894, *Serratia marcescens* 1591, and *Yersinia enterocolitica* 8081c were inoculated into tryptic soy broth supplemented with AAA at concentrations ranging from 0mg/mL to 40mg/mL. The bacteria were incubated on 24 well polystyrene plates at temperatures ranging from 25°C to 37°C for either 16 or 24 hours. The effect on growth was determined using the maximum velocity rate, effect on biofilm was determined using either a crystal violet assay or an ATP assay, and the 50% inhibitory concentration (IC_{50}) for growth and biofilm amounts was determined using Masterplex ReaderFit dose-response software.

Results: The addition of AAA to the growth medium was shown to have an inhibitory effect for all strains tested in both biofilm formation and growth. The figure to the right shows the effect on *Y. enterocolitica* 8081c at 37°C. This general trend is seen across all other strains and conditions, while the IC_{50} values varied among the strains and different growth temperatures. The *Y. enterocolitica* 8081c incubated at 25°C had lowest IC_{50}, showing the most sensitivity to AAA, while this strain at 37°C and the *S. marsescens* strain had the most resistance to the supplement.



Conclusion: AAA can be an effective supplement at decreasing the growth and biofilm amounts for various bacterial strains at specific incubation temperatures. The inhibitory effects are more pronounced in *Y. enterocolitica* incubated at lower temperatures. This information may be useful when considering the use of AAA in food processing environments verses use in a medical setting.

SYNTHESIS AND CHARACTERIZATION OF SILICA THIN FILMS

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Sponsor: ACS PRF 54179-ND5

Silicon was vapor deposited on oxidized Mo(112) and subsequently oxygen annealed to form an ultra-thin silica film at ultra-high vacuum (UHV). The surface structure was investigated by low energy electron diffraction (LEED), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS). The overall goal is to fabricate Zeolite-like films (Al-doped silica) and deposit Mo nano-clusters. This model catalyst has potential applications in hydrodesulphurization.

DETERMINE THE EFFICACY OF VACUUM STEAM PASTEURIZATION TO INACTIVATE *SALMONELLA* PT30, *ESCHERICHIA COLI* 0157:H7, AND *ENTEROCOCCUS FAECIUM* ON LOW MOISTURE FOODS

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There has been increasing demand for nutritious foods among consumers. Low moisture foods such as flaxseeds, sunflower seeds, quinoa, and sesame seeds have been studied a great deal for their nutritious value. However, such foods are minimally processed and are usually consumed raw and several outbreaks due to Salmonella, and E.coli O157:H7 have been attributed to them. Several studies have shown that these pathogens are more resistant to dry heat in low moisture foods, and processes such as chemical treatments and blanching may have negative effects on product quality and functionality. Vacuum steam pasteurization is a technology that injects saturated steam under vacuum to supply heat which can be controlled to achieve desired temperature. We wanted to determine the efficacy of this technology in inactivation of pathogens on low moisture foods. Flaxseeds and quinoa seeds were separately inoculated with bacterial lawns of Salmonella PT30, E. coli O157:H7, and E. faecium to obtain a homogenous distribution. The inoculated flaxseeds (25g) were pasteurized at 75°C, 85°C, 95°C and 105°C after 24 and 48 hours post inoculation. Three 25g samples were run at each condition, and the experiment was repeated three times totaling nine samples at each pasteurization parameter. Similar average log reductions of 5.5±1.2, 5.7±0.4, and 5.3±0.5 was observed after pasteurization for 1 minute at 75°C for Salmonella, E. coli O157:H7, and E. faecium respectively ($P>0.05$) on flaxseeds. Steam vacuum pasteurization is an effective method for inactivation of these pathogens on flaxseed achieving a 5 log after just 1 minute at 75°C. Also, the result suggests that Enterocuss faecium may be used as a surrogate for Salmonella, and E. coli O157:H7 when evaluating vacuum steam pasteurization for flaxseeds.

GENETIC VARIATION OF ROOT AND STALK TRAITS FOR DROUGHT RESISTANCE IN EARLY MATURING MAIZE (*ZEA MAYS* L.)

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Drought stress in the reproductive growth stages during grain filling is most important yield-limiting factor in maize in western North Dakota and eastern Montanta. Although there is increasing trend of cultivation of maize in these regions development of new varieties has been slow due to lack of useful genetic variation for short season drought. The useful genetic variation in North Dakota State University Corn Breeding Program could be potential source of new genes for improving genetic diversity in these regions. This study was conducted to study the genetic variation in root and stalk traits and to develop new method of breeding drought in these environment. A short season representative early maturing maize population with forty-seven diverse inbred lines from North Dakota State University continuing recurrent selections, public and private sources was crossed in a partial diallel mating design. 94 partial diallel crosses with six different commercial top checks were tested in 6 environments in drought, irrigated and random drought conditions of North Dakota and Montana in years 2013 and 2014. 42% and 21% reduction in mean grain yield in drought condition and random drought conditions respectively was observed compared to the well-irrigated condition. The change in rank was significant at 0.05 level of significance across different moisture regime showing specific adaptation of traits to different environments. The results showed that the new constitutive traits brace root counts, brace root spread width, stalk diameter and root lodging are useful traits for adapting maize to short season drought. The research showed tremendous potential to increase the genetic diversity of late season drought resistance in maize.

SMALL MOLECULES ADSORPTION ON GRAPHENE: A KINETIC APPROACH

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Among different forms of carbon, graphene is one of the widely studied allotropes. Graphene is a monolayer of graphite, which has a wide spectrum of applications. Lately, many studies have focused on the interactions of various small molecules on graphene. However, a kinetic approach in this aspect is yet scarce in literature. Hence, this study focused on the adsorption kinetics of the interaction of polar (water) and non-polar hydrocarbons (pentane and benzene) with graphene. Two different chemical vapor deposited (CVD) graphenes (graphene/SiO_2 and graphene/ Cu) were studied in an ultrahigh vacuum (UHV) chamber. The surface of the CVD graphene was characterized by Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), and Raman spectroscopy. The kinetic study was carried out using thermal desorption spectroscopy (TDS) with a focus on the hydrophobicity, transparency, and substrate effects. This study showed that the water interaction with graphene is hydrophobic and that the substrate (SiO_2 vs Cu) influenced the water interaction on graphene. In contrast, the substrate did not influence the adsorption of the non-polar molecules on graphene. However, both polar and non-polar molecule interactions evidenced that the graphene is not a transparent material. Overall, this study could be considered as one of the first UHV kinetics studies on graphene.

PATHOGEN SENSING TRIGGERS EARLY UPREGULATION OF NLR, WHICH PRIMES LATER EFFECTOR TRIGGERED IMMUNITY RESPONSE IN BARLEY

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Stem rust caused by the biotrophic fungal pathogen *Puccinia graminis* f. sp. *tritici* (*Pgt*) results in devastating disease epidemics on barley and wheat. Recently a new potential threat to barley and wheat production in the world emerge out as *Pgt* race TTKSK (Ug99) and its variants. These new races of *Pgt* are virulent on most of world's commercial wheat and barley cultivars. A single source of *Pgt* race TTKSK resistance, the *rpg4*/*Rpg5* locus in barley line Q21861 (1), has been cloned and shown to harbor at least four tightly linked genes required for resistance including the *HvRpg5*, *HvRga1*, *HvAdf3* and yet to be characterized *Rme1* (2). The predicted RPG5 protein has a N-terminal nucleotide-binding site (NBS), leucine rich repeats (LRR) and C-terminal protein kinase domain. The predicted HvRGA1 protein has the typical NBS-LRR R-gene structure and the *HvAdf3* gene is predicted to encode an actin depolymerization factor. *rpg4/Rpg5* locus resistance for Ug99 is recessive and temperature sensitive in nature. Genetic analysis for crosses between the resistant line Q21861 and different susceptible lines linked the recessive nature of the *rpg4* resistance to the presence of a dominant susceptibility factor *HvPP2C.1*, present in the place of RPG5 kinase domain. For functional characterization of *HvPP2C.1* we are using barley stripe mosaic virus induced gene silencing (BSMVIGS) in heterozygous (*Rpg5 +/HvPP2C.1+)* F_2 plants. Expression analysis suggest that early upregulation of Rpg5 is prehaustorial. We hypothesize that ADF3 protein is not only required for plant actin cytoskeleton rearrangement but also upon phosphorylation responsible for early upregulation of RPG5 (3). Early upregulated RPG5 primes later ETI response upon effector recognition from its kinase domain. RPG5-RGA1 proteins act together in defense response in an integrated decoy manner (4).

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USING IMRE AND ANOVA TO SELECT MICRORNAS FOR PREDICTING PROSTATE CANCER RECURRENCE

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Imputed microRNA regulation based on weighted ranked expression and putative microRNA targets (IMRE) is a method to predict microRNA regulation from genome-wide gene expression as well as predict microRNA putative targets. A p-value for each microRNA is calculated using the expression of the microRNA putative targets to analyze the regulation between different conditions. The dataset used in this study is GSE10645, which is the gene expression microarray of tumors from 596 men with prostate cancer. In this dataset, it includes the information of three different phenotypes: PSA (Prostate-Specific Antigen recurrence), Systemic (Systemic disease progression) and NED (No Evidence of Disease) and the expression level of the 1024 unique genes in the tissue of the 596 men. We used the IMRE and ANOVA method to analysis the GSE10645 dataset and got several microRNA candidates that might be responsible for the PSA recurrence and Systemic disease progression.

FABRICATION OF HIGHLY FLUORESCENT GRAPHENE QUANTUM DOTS USING L-GLUTAMIC ACID FOR IN VITRO/IN VIVO IMAGING AND SENSING

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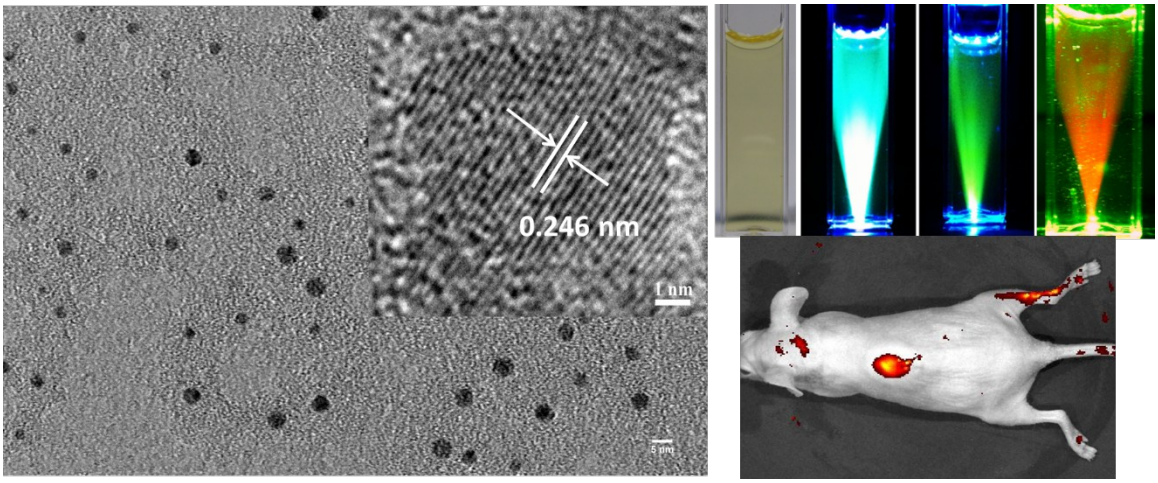
A facile bottom-up method for the synthesis of highly fluorescent graphene quantum dots (GQDs) has been developed using a one-step pyrolysis of a natural amino acid, L-glutamic acid, with the assistance of a simple heating mantle device. The developed GQDs showed strong blue, green and red luminescence under the irradiation of ultra-violet, blue and green light, respectively. Moreover, the GQDs emitted near-infrared (NIR) fluorescence in the range of 800-850 nm with the excitation-dependent manner. This NIR fluorescence has a large Stokes shift of 455 nm, providing significant advantage for sensitive determination and imaging of biological targets. The fluorescence properties of the GQDs, such as quantum yields, fluorescence life time, and photostability, were measured and the fluorescence quantum yield was as high as 54.5 %. The morphology and composites of the GQDs were characterized using TEM, SEM, EDS, and FT-IR. The feasibility of using the GQDs as a fluorescent biomarker was investigated through in vitro and in vivo fluorescence imaging. The results showed that the GQDs could be a promising candidate for bioimaging. Most importantly, compared to the traditional quantum dots (QDs), the GQDs is chemically inert. Thus, the potential toxicity of the intrinsic heavy metal in the traditional QDs would not be a concern for GQDs. In addition, the GQDs possessed an intrinsic peroxidase-like catalytic activity that was similar to the graphene sheets and carbon nanotubes. Coupled with 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS), the GQDs can be used for the sensitive detection of hydrogen peroxide with a limit of detection of 20 μM.

Scheme 1. The synthesized graphene quantum dots (GQDs). Left panel: TEM images of GQDs; Right up panel: fluorescence images of GQDs; Right-down panel: fluorescence *in vivo* imaging of GQDs.



ROAD UNEVENNESS MEASUREMENT: A NEW METHOD WITH IN-PAVEMENT SENSORS

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Pavement roughness or ride quality is characterized by the international roughness index (IRI) that transportation agencies most often report. Data acquisition requires instrumented vehicles and technicians with specialized training to interpret the results. The high cost of labor and facilities limits data collection to at most once per year for portions of the national highway system. Agencies characterize roughness only for some secondary roads but much less frequently, such as once every five years. This research developed a method that links the output of durable in-pavement strain-based sensors to prevailing indices of roughness summary. After their initial installation and calibration during road construction, the strain-based sensors will report roughness continuously. Thus, after agencies recover the initial cost of sensor deployment by obviating the need for future expensive profiling activities, they will begin to eliminate roughness monitoring related expenses over the remaining lifecycle of the pavement asset.

Purpose: to development a new method to evaluate the road unevenness with in-pavement deployed strain-based sensors, and therefore save the cost for road condition evaluation.

Methodology: The theoretical analysis based on the thin-plate theory linked the strain distribution inside the pavement structure with the road unevenness and the corresponding indices. Numerical simulation and the sensitivity study shows the accuracy of this method at a specific sampling interval and the influencing factors. Field testing compared the road roughness measured by the connected vehicle method and the strain-based method.

Results and conclusions: The road unevenness can be reflected by the strain distribution inside the pavement structure. The developed strain-based method has almost the same accuracy with the popular profiling method at a specific sampling interval. Table 1 shows the comparison at different road conditions. This method is considerable immune to noise interference. At a noise level of 3 dB (SNR), the relative error is only 1.8%. The field testing results show that the results of the two method are consistent with each other, which approves the validity of the road unevenness evaluation method with the in-pavement sensors. So for future, this method can be used to calculate the required roughness index. Figure 1 shows one imagined series of strain distribution in the road section of 50 m at an interval of 0.5 m. By calculation, the IRI is 2.7 for this section.

Table 1. Profiling Intervals Required for an Accuracy of 90%

$S_\xi(\kappa_0)$, 10^{-6} m^3/cycle	2	4	8	16	32	64	128	256	512	1024	2048
IRI at 0.3 m, m/km	1.12	1.57	2.23	3.19	4.55	6.33	8.92	12.76	17.95	25.04	36.14
Profiling Interval, m	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Sampling Interval, m	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5

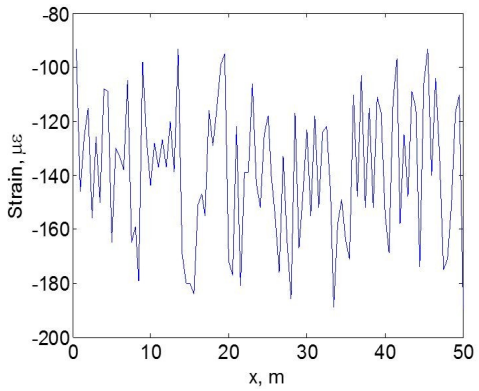

Figure 1. Imagined Strain Distribution

PROFESSIONAL COMMUNICATIONS

(Communications are listed alphabetically by the last name of the presenting author)

LOCALIZATION PATTERN OF PROGESTERONE RECEPTOR (PGR) AB IN SHEEP PLACENTA DURING EARLY PREGNANCY

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Uteroplacental vascular development and remodeling in early pregnancy is critical for embryonic growth and if impaired, it is associated with 30-50% embryonic loss during pregnancy in mammals including humans. We have previously demonstrated increased placental angiogenesis and significant changes in mRNA expression of selected steroid receptors during early pregnancy in ewes. Because uterine vascular development and remodeling is mediated by steroids, we hypothesized that expression of steroid receptor proteins would change during utero-placental development as early pregnancy progresses. Hence, the objective of our present study was to determine the localization pattern of PGRAB protein in utero-placental vasculature and other compartments during early pregnancy.

Uterine tissues were collected on days 14, 16, 18, 20, 24, 26, 28, and 30 after mating (n = 4/day; length of gestation ~145-150 days) and on day 10 after estrus (n = 4; non-pregnant control). Cross sections of uterus and utero-placenta were fixed in formalin and embedded in paraffin. Tissue sections were then immunofluorescently stained to detect PGRAB followed by image analysis to determine intensity of staining in selected utero-placental compartments including luminal epithelium (LE), endometrial glands (EG), endometrial stroma (ES), endometrial blood vessels (EBV), myometrium (MYO), myometrial blood vessels (MBV), and fetal membranes (FM, fetal placental tissues).

PGRAB was detected in non-pregnant uterus and utero-placenta during pregnancy, but intensity of fluorescence differed between stages of pregnancy and uterine compartments. Strong immunofluorescence staining of PGRAB was detected in EG (both luminal and deep) and faint staining in EBV and MBV. Compared to non-pregnant controls there was a ~1.4-fold increase in fluorescence intensity of PGRAB in EBV and MBV on days 28-30 of pregnancy ($p<0.02$ and $p<0.03$, respectively). As early pregnancy advanced, a progressive decline of staining intensity for PGRAB in EG and LE was observed. Compared to nonpregnant controls, in EG a ~2 fold decrease ($p<0.0002$) was observed from days 16 to 30. In LE, intensity of staining tended ($p=0.17$) to decrease from day 14 to 28 of pregnancy. Intensity of PGRAB staining in ES, MYO, and FM was similar across the days of pregnancy. For intensity of staining, there were positive correlations 1) between EBV and EG ($p=0.05$), ES ($p=0.0007$), MBV ($p=0.02$) and LE ($p=0.04$); 2) between ES and EG ($p=0.03$); and also 3) between MYO and MBV ($p=0.01$).

Our data demonstrate a differential localization pattern of PGRAB protein in uterine glands (decrease) and vasculature (increase) throughout early pregnancy. The decrease in endometrial glandular expression of PGRAB protein indicates a decline in PGRAB-mediated progesterone action in endometrial glands from days 14 to 30 of early pregnancy, which could influence secretion of histotroph. Conversely, the increase in PGRAB expression in utero-placental blood vessels is associated with increased placental blood flow and angiogenesis in early pregnancy, and these are essential for establishment of pregnancy and healthy fetal growth. Complete understanding of the role(s) of PGRAB in utero-placental development and conceptus growth during early pregnancy will require further studies.
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NOVEL SEQUENCES OF THE C-REACTIVE PROTEIN GENE AMONG AN AMERICAN INDIAN POPULATION

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Background and Objectives: The etiology of pre-eclampsia (PE) is unknown; but is intimately related to many of the same risk factors for atherosclerosis; PE has become recognized as a risk factor for subsequent cardiovascular disease. Normal pregnancy represents a distinctive challenge to the maternal immune system; and C-reactive protein (CRP) is a prominent component of the innate immune system. Recently reported observational and experimental findings support the role of CRP as a causal factor in PE. We previously reported an association between three *CRP* variants and PE in this cohort. Our aim was to sequence the *CRP* gene for a subset of the study, to potentially identify variants that are more directly associated or etiologic of PE. The present report characterizes the new variants found in this population.

Methods: These data are derived from a case-control study of 140 PE cases and 305 matched controls. The region sequenced began 8,920 base pairs (bp) 5' of the gene and included a total of 18,300 bp. Of this total 2,301 bp of the 5', 3' untranslated regions, the two coding exons and the single intron, and an additional 7,078 bp in the 3' flanking region were sequenced. Sequencing was performed using an Illumina TruSeq Custom Amplicon project (amplicon size 250bp) on a MiSeq Personal sequencer with the MiSeq Control and Reporter softwares generating base calls, assembly and alignment of reads to the human reference genome (hg19), and variant calls, 91% (61 of 67) of which had a quality score of >/=Q30. GoldenHelix SVS software assembled a file containing the genotype calls for all detected variant positions.

Results: We sequenced 95 cases and detected a total of 67 single nucleotide variants (SNVs) with a call rate >90%. Of this total, 61 variants were recorded in genome build GRCh38; and the remaining 6 SNVs have not been reported. None of the newly identified variants were within the coding or untranslated regions of the gene. All 6 of the novel SNVs were located within a 4,800 bp region located 2597 bp upstream of the 5' untranslated region. Of the 6 novel SNVs, one was detected in two cases and all others were represented once.

Discussion and Conclusions: These results show that a significant degree of novel genetic variation remains to be discovered among minority populations and further analysis of these additional variants will improve our ability to identify which variants are directly influencing the pathophysiology of pre-eclampsia as opposed to simply being associated through linkage disequilibrium.

CONTINUED SLEUTHING OF PROBLEMATIC CONTINENTAL MOLLUSCAN TAXA – THE CRETACEOUS DAKOTA FORMATION

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Introduction. Somehow, nineteenth century geologists and paleontologists were able to find freshwater fossils that have alluded later field investigations, which means there are a number of old, poorly documented species of western North America Mesozoic and Cenozoic continental mollusks. Rare mussel occurrences described from the Cenomanian Cretaceous of eastern Nebraska include *"Unio (Baphia?) nebrascensis"* Meek (1) and *"Unio Barbouri"* White (2) from the Dakota Formation in Dakota and Jefferson Counties, respectively. Significantly, these taxa and just a few others are from isolated deposits east of the Western Interior Seaway.

Taxon Overview. Meek (1) assigned *Unio nebrascensis* to *Margaritana* (now *Margaritifera*) with the knowledge that he lacked certain morphological evidence and a convincing philosophical argument. He delayed publication of *M. nebrascensis* in the hope that additional specimens of the taxon would be found to better understand its internal shell morphology. Subsequently, other mussels were found (Hicks, 3; L3321), preserved as impressions, which White (2) described as *U. barbouri* on the basis of plaster casts. Unlike *M. nebrascensis*, *U. barbouri* was found with taxa considered to be freshwater (2). Modell (4) reassigned this taxon to *Ligumia*.

Locality Context. Publications (e.g., 5), specimen labels, and Smithsonian records all indicate that F.V. Hayden collected *Margaritifera nebrascensis* (1). A three-specimen syntype series has been recognized (USNM-PAL 7119), but Meek (5) identified a type specimen, representing his choice of a lectotype. *M. nebrascensis* was reported from a type area (L4281, L7220, L7222): Opposite Sioux City, Dakota City area, Dakota County (possibly in sec. 8, T. 28 N., R. 9 E.). Upham (6, L7218) compared Meek's species to a specimen found near the confluence of Two Rivers and the Mississippi River, Minnesota, which was subsequently figured (7). Upham also made reference to taxa otherwise known from the Campanian Judith River Formation of Montana. A comparatively diverse assemblage of continental and brackish taxa, including a two specimen syntype series of *Unio barbouri* (USNM-PAL 23123, plastocasts; originals at University of Nebraska-Lincoln), was reported by White (2) and here interpreted as sec. 28, T. 3 N., R. 2 E., east of River Road, west of NB 15.

Stratigraphic Context. The "Dakota" was originally described as "yellowish, reddish and occasionally white sandstone, with at places, alternations of various colored clays and beds and seams of impure lignite" (8). The first *"Unio"* specimens were collected by Hayden (1, 5) from Dakota or Woodbury Counties and lack sedimentological context. Hicks (3) collected the second fossil record described as from ferruginous sandstone, largely of impure, partly oolitic, limonite, considered typical of the area. Hattin (9) also recovered *Ligumia* from the upper part of the Dakota of Russell County, Kansas. All of these records are interpreted as from the upper to uppermost part of the Dakota Formation/Group (10). White (11) first subdivided the Dakota, with the Woodbury unit of Woodbury County, Iowa, representing the type Dakota Formation of today (not Omadi Formation, 12; see 13).

Fossil Deposits. Dakota Formation freshwater mussels are known from only a handful of specimens. They are not, however, inconspicuous. *Margaritifera nebrascensis* is 10 cm long and massive. This rarity is because of loess and otherwise covered exposures and the serendipitous preservation of continental environments, even if leaves and stems are relatively common. Specimen assemblages variously composed of freshwater, freshwater-tolerant, brackish, and marine taxa indicate mixing on a floodplain with limited sediment accumulation through deltaic progradation or river avulsion as, in part, envisaged by Ludvigson and Witzke (14).

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THE ECOLOGICAL IMPACT OF FLOODING: A STUDY OF TREE DAMAGE

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The objective of this research was to identify factors affecting tree damage in the historical Minot flood of 2011. We hypothesized that tree height, identity, origin, and maximum water height abject in the severity of damage sustained by a tree in a flood event. The patterns observed suggest several conclusions. First of all, the assumption of a greater tolerance to flooding of native species than nonnative species is not supported by the data. Others have observed a relationship between indigenous species and damage resistance in response to locally common disasters (Zamora-Arroyo et al. 2001), but this was not supported by our flood data. This is probably because at least some of the foreign species originated from areas with similar flooding occurrences as the Minot flood plain. A significant inverse relationship between tree height and damage sustained was found. While tree height contributes greatly to the amount of damage trees sustain after a flood, the data also shows the separate relationships between the taxonomy and damage. The result that certain genera show greater resistance to flooding than other genera is consistent with previous research (Parolin & Wittmann 2010; Kozlowski et al., 2015). Conifers (Pinopsida) and *Pyrus* and *Prunus* (both of Rosaceae family) sustained significantly more damage than other genera. These results allow for educated decisions in the future when planting trees inside a flood zone. The factors measured were highly interactive in determining flood damage. Water level, tree height, and genus all had significant effects on tree damage; the removal of any of these terms from the model decreased optimality. While it appears that a combination of all factors determines damage, tree height seems to exhibit the greatest influence.

Supported by Department of Biology of Minot State University. Thank you to Joe Super (Minot High School) for providing equipment and motivation. Many thanks to the students of Minot State University Biology 154 class for their contributions in data collection.

The pre-print was deposited to arXiv.org. All data files and R script are available in the open data repository at http://ashipunov.info/shipunov/open/ecol_impact_flooding.zip

NDSU CENTER FOR PROTEASE RESEARCH CORE BIOLOGY FACILITY SUPPORTS REGIONAL BIOMEDICAL RESEARCH

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Abstract: The NDSU Core Biology Facility was created by the Center for Protease Research COBRE program in 2003 to aid in the *in vitro* testing of inhibitors of matrix metalloproteases and histone deacetylases. Since its inception, the core has served as a biomedical research center for a wide variety of research projects on NDSU campus and throughout the region, and become a hub for connecting scientists for collaboration. The core provides state-of-the-art equipment and technical support for molecular biology applications, bioassay development/analysis, and cell biology techniques. The core is equipped with flow cytometers, cell sorter, real-time PCR machines, microarray scanner, fluorescence/absorbance/bioluminescence microplate readers, GE Storm 865 imaging system, Agilent 2100 Bioanalyzer, thermocyclers, fluorescence microscope with digital color camera, NanoDrop spectrophotometer, and protein electrophoresis and blotting systems, in addition to basic molecular biology, biochemical, and tissue culture instrumentation. Assays performed at the core include: apoptosis, cell cycle, cellular bioenergetics, DNA/RNA/protein quantity and quality control, DNA damage and repair, enzyme assay, fluorescence microscopy, gene expression, genome size determination, immunophenotyping, and Western blot. The core provide services at four levels: consultation and experimental design, training clients to use instruments by themselves, running experiments for clients and data analysis, and collaboration.

Acknowledgement: The NDSU Center for Protease Research Core Biology Facility is supported through NIH Grant P30 GM103332-01 from the National Center for Research Resources.

POSTER COMMUNICATIONS

(Communications are listed alphabetically by the last name of the presenting author)

RAPID SYNTHESIS OF N,N-DIPIPERONYLFORMAMIDE

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Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of various benzylformamides. We also used acetamide as an alternative solvent for the Leuckart reaction. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, N-(4-chlorobenzyl)formamide was produced only as a minor product. The use of acetamide resulted in a substantial shift towards the products of the secondary and tertiary Leuckart reactions. Specifically, N,N-di-(4-chlorobenzyl)formamide appeared to be the main product of the reaction with the isolated yield of 33.5%. N,N,N-tri-(4-chlorobenzyl)amine was produced with the isolated yield of 12.4%.
Hypothesis: The reaction conducted on benzaldehydes with electron-donating substituents should result in even larger shifts towards the products of the secondary and tertiary Leuckart reactions. In this work the hypothesis was tested by conducting the reaction on piperonal (3,4-methylenedioxybenzaldehyde).
Methods: The reaction was conducted on 10 mmol scale at 200ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: The reaction was fully completed in 1 minute and produced N,N-dipiperonylformamide as the main product with the isolated yield of 34.1%. The tertiary reaction product, N,N,N-tripiperonylamine, was produced in substantially larger amount with the isolated yield of 20.0%. The combined yield of the di- and tri-products was 54.1%, significantly higher than the combined yield of the di- and tri-products in the 4-chlorobenazaldehyde reaction (45.9%).
Conclusions: A new approach to the rapid synthesis of N,N-dipiperonylformamide was developed.

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ACETAMIDE AS A SOLVENT IN THE RAPID SYNTHESIS OF N-(2,4-DICHLOROBENZYL)FORMAMIDE

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Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of various benzylformamides. We also used acetamide as an alternative solvent for the Leuckart reaction. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, N-(4-chlorobenzyl)formamide was produced only as a minor product. The use of acetamide resulted in a substantial shift towards the products of the secondary and tertiary Leuckart reactions. Specifically, N,N-di-(4-chlorobenzyl)formamide appeared to be the main product of the reaction with the isolated yield of 33.5%. N,N,N-tri-(4-chlorobenzyl)amine was produced with the isolated yield of 12.4%.
Hypothesis: The reaction conducted on benzaldehydes with electron-withdrawing substituents should result in a less pronounced shift towards the products of the secondary and tertiary Leuckart reactions. In this work, this hypothesis was tested on 2,4-dichlorobenzaldehyde.
Methods: The reaction was conducted on 10 mmol scale at 198^{o}C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: The reaction was fully completed in 1 minute. It produced N,N-di-(2,4-dichlorobenzyl)formamide and N,N,N-tri-(2,4-dichlorobenzyl)amine with the yields of 22.6% and 5.6%, only. N,N'-(2,4-dichlorobenzylidene)-bis-acetamide appeared to be the major product of the reaction with the yield of 36.1%.
Conclusions: Electron-withdrawing substituents reduced the shift towards the products of the secondary and tertiary Leuckart reactions.

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THEORETICAL APPROACH TO ENERGY TRANSFER IN SILICON QUANTUM DOTS AND ENHANCED ON-TIME BLINKING

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We investigated the effect of a surface defects, such as losing ligands and external charge, on the electronic structure and the energy transfer between methyl passivated silicon quantum dots (QDs). We have simulated different silicon quantum dots that consists of either 29, 35 or 66 silicon atoms as the QD model with a diameter ranging from 1.2 to 1.6 A to perform DFT and linear response TDDFT calculations. Our calculations show that the surface defects introduce mid-gap states that are weakly optically active resulting in a lowest energy red shifted absorption band. We then have explored the Forster resonance energy transfer (FRET) rates between QDs of different sizes, different surface passivation, and at different distances. Our results show that removal of ligands from the QD surface increases the rate of energy transfer by 100 folds compared to ideal QDs separated by a distance of 1 nm. Also, introducing charge on the QD increases the rate by at least 10 folds. The higher rates of energy transfer between QDs due to surface defects when packed closely facilitate occupation of the mid-gap trap states leaving the room for direct emission from higher-energy bright states. Such ultrafast energy transfer between QDs with imperfect surface might explain the nature of on-time increase in quantum blinking of closely packed Si QDs observed experimentally.

THE TROPICAL ROACH *BLAPTICA DUBIA* AS A NOVEL SURROGATE HOST FOR *FRANCISELLA TULARENSIS*.

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Invading pathogens first interact with the innate immune system of the host, which presents significant barriers to survival and growth of microorganisms, including physical sequestration of the pathogen, nutrient limitation, enzymatic degradation of pathogen cell walls and membranes, actions of antimicrobial peptides, and engulfment and subsequent destruction by phagocytes. Since insects lack an adaptive immune system, they rely exclusively on innate immunity to prevent infection. A number of studies have demonstrated the robust nature of insect innate immune systems and the many structural and functional similarities with mammalian systems. It is therefore not surprising that a wide range of human-specific and zoonotic pathogens have been shown to use similar mechanisms of innate immune evasion and pathogenicity in insect and mammalian hosts. Here we present a novel insect model of Francisellosis using the tropical roach, Blaptica dubia, as a host animal. Like the popular insect host Galleria mellonella (wax moth larvae), B. dubia survives well at mammalian body temperatures and is large enough to easily inoculate with a known dose of bacteria. But in comparison to G. mellonella, B. dubia individuals are (1) longer lived, (2) do not pupate, (3) are easier to rear in a laboratory setting, and (4) can be inoculated using plastic pipette tips instead of needles, reducing sharps hazards—an important feature for investigators working with undergraduate researchers. We found that B. dubia is susceptible to infection by Francisella tularensis LVS strain and that several genetic deletion strains that are attenuated in mice are also attenuated in this assay. Moreover, we show that B. dubia can be rescued from F. tularensis LVS toxicity by both systemic and oral delivery of antibiotics. This latter feature is especially relevant for investigators seeking novel therapeutics since it requires absorption across the insect intestinal mucosa, gives immediate whole-animal toxicity information, and can be accomplished in relatively high throughput. In summary, our findings demonstrate substantial improvements over more commonly used insect host assays of Francisellosis.

EFFECT OF ALKYL SIDE GROUP ON INTERACTIONS BETWEEN CONJUGATED POLYMERS AND CARBON NANOTUBES

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Efficient applications of Single Walled Carbon Nanotubes (SWCNTs) in electronic and photovoltaic devices require a selective geometry, in particular, chirality of nanotubes, which is still a great challenge for synthetic techniques. To this end, post-synthetic functionalization of SWNTs by conjugated polymers such as various derivatives of poly(9,9-di-n-octylfluorenyl-2,7-diyl) (PFO) is promising in selectivity of a special chirality of SWNTs. Our computational research focuses on how modification of the side alkyl chains on the PFO olygomers changes the morphology and SWNT-PFO interactions and, thus, affects the nanotube's chirality selectivity. Starting with various initial wrapping geometries, the optimized structures of the polymer-SWCNT composite as well as isolated PFO oligomers and SWCNTs is determined using molecular mechanics within MM3 force field that has been parameterized based on density functional theory (DFT) calculations for short oligomers. Our calculations demonstrate that the SWNT-PFO binding energy tends to increase as the length of the side chain increases reaching the optimal value for octyl groups. We attribute this affect to the interaction between the side chain and the SWCNT. For short side groups, the SWNT-polymer interaction is dominated by pi-pi stacking. However, as the side chains get longer (up to 8 units) a single side chain interacts with the SWCNT creating loops around the tube and increasing the binding energy between the polymer and the SWNT. It is observed that very long side groups (> 9 units) tend to prefer interaction with both side chains, resulting in broken pi-pi stacking and therefore decreasing binding energy. As a result of these two competing effects, our research suggests that the octyl side chain is the most preferential for favorable binding between the PFO and SWCNT resulting in the significantly stronger interactions with (7,5) SWNTs compared to other four SWNTs we studied.

COMPUTATIONAL STUDY OF THE PROPERTIES OF CHLORINATED CARBON NANOTUBES

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Carbon nanotubes have been a topic of much research due to their wide variety of potentially useful properties. Of particular interest are their optical and electronic properties, which could be useful in many practical applications, such as solar cells. These properties can vary dramatically depending on the type of tube, especially between tubes of different chiralities. They can be further modified by covalently functionalizing the outside of the tube with different atoms or molecules. This research aims to theoretically determine the electronic properties of single walled carbon nanotubes functionalized with charged or uncharged chlorine atoms using Density Functional Theory calculations. Different arrangements of multiple chlorine atoms were compared, such as ortho or para dichlorination. The geometries of these arrangements were optimized using Gaussian software to determine their binding properties, which allows us to gauge which configurations are most likely to occur in a practical experiment. And how these Cl-defects affect the electronic structure resulting in either strongly localized or delocalized mid-gap states with optically dark or semi-bright character.

EFFECTS OF AUXILIARY SUBSTITUENTS ON OPTICAL PROPERTIES OF BIPYRIDYL PLATINUM (II) BISSTILBENYLACETYLIDE COMPLEXES: DFT STUDY.

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Absorption spectra of number of bipyridyl platinum (II) bisstilbenylacetylide complexes with different possible auxiliary substituents are studied using the density functional theory (DFT) and linear response time-dependent DFT (TD-DFT). A strong electron donating group at the stilbenylacetylide ligands, such as $N(Ph)_2$, destabilize the highest occupied molecular orbital that is mostly localized on stilbenylacetylides. Simultaneous attachment of withdrawing groups to bipyridine leads to strong stabilization of the lowest occupied molecular orbital localized on bipyridine. This results in red-shifted and well separated charge transfer peak from the main π,π* band. This lowest energy transitions are dominated by ligand-to-ligand charge transfer (LLCT) with some admixture of metal-to-ligand charge transfer (MLCT) and exhibit much smaller oscillator strength as compared to the main band. Wide and lower-intensive red shifted charge-transfer peak that is well separated from a main π,π* band promises enhanced non-linear properties in these molecules, which we examine by calculating transit absorption.

RAPID SYNTHESIS OF N,N,N-TRI-(1-NAPHTHYLMETHYL)AMINE

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Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of various benzylformamides. We also used acetamide as an alternative solvent for the Leuckart reaction. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, N-(4-chlorobenzyl)formamide was produced only as a minor product. The use of acetamide resulted in a substantial shift towards N,N-di-(4-chlorobenzyl)formamide and N,N,N-tri-(4-chlorobenzyl)amine that were produced with the isolated yields of 33.5% and 12.4%. N,N-di-(4-chlorobenzyl)formamide appeared to be the main product of the reaction.
Hypothesis: The reaction conducted on electron rich benzaldehydes should result in even larger shifts towards the products of the secondary and tertiary Leuckart reactions. In this work the hypothesis was tested by conducting the reaction on 1-naphthylcarboxaldehyde.
Methods: The reaction was conducted on 10 mmol scale at 200ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: The reaction was fully completed in 1 minute and produced N,N,N-tri-(1-naphthylmethyl)amine as the main product with the yield of 40.9%. The secondary reaction product, N,N- di-(1-naphthylmethyl)formamide, was produced with the yield of 31.5%. The combined yield of the di- and tri-products was 72.4%, significantly higher than the combined yield of the di- and tri-products in the 4-chlorobenazaldehyde reaction (45.9%).
Conclusions: A new rapid method for the synthesis of N,N,N-tri-(1-naphthylmethyl)amine was developed. The method comprises the first example of a successful refocusing of the Leuckart reaction towards the predominant formation of the tertiary products.

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EXPLORING THE EVOLUTIONARY HISTORY OF A NOVEL TRAIT IN SEPSIDAE

Dacotah Melicher, Julia H. Bowsher

Novel traits allow us to investigate the evolutionary mechanisms that lead to the gain of new morphological structures or physiological functions. The novel abdominal appendage in male sepsid flies (Diptera: Sepsidae) has a complex evolutionary history of primary gain, loss, and regain which we explore using fluorescent microscopy to compare the size, volume, and number of cells in the histoblast cell nests that produce the appendage during pupation across six genera including an ancestral outgroup which describe evolutionary history of the appendage. Data was also collected in females which lack the appendage. Nest size and cell number in each segment differs significantly between species and male and females.

THEMIRA BILOBA NOVEL APPENDAGES MATING EXPERIMENT ABSTRACT

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In the species sepsid fly species *themira biloba* there are evolutionarily novel appendages on the males that may be linked to their reproductive success. These appendages have evolved in a relatively short time, and the characteristics of the appendages vary greatly between sepsid species. In our study we looked at the effects shortening the bristle lengths would have on the reproductive success of male *themira biloba*. Trimming bristles resulted in less eggs being fertilized, with no eggs being fertilized if bristles were trimmed to a certain point. This adds evidence to the claim that the bristles are used for a reproductive function, and may suggest that sexual selection is involved.

RAPID SYNTHESIS OF N-(4-CHLOROBENZYL)-N-METHYLFORMAMIDE

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Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of substituted N-benzyl-N-methylformamides. Interestingly, in the reaction conducted on piperonal (3,4-methylenedioxybenzaldehyde), a large amount of a by-product, N-methyl-N,N-dipiperonylamine was produced with an isolated yield of 32.8%. N-methyl-N-piperonylformamide was produced as the main product with an isolated yield of 51.4%.
Hypothesis: The reaction conducted on benzaldehydes with electron-withdrawing substituents may produce lower yields of the by-products (substituted N,N-dibenzyl-N-methylamines) and higher yields of the main products, substituted N-benzyl-N-methylformamides. In this work the hypothesis was tested by conducting the reaction on 4-chlorobenzaldehyde.
Methods: The reaction was conducted on 10 mmol scale at 175ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.
Results: The reaction was fully completed in 10 minutes and produced N-(4-chlorobenzyl)-N-methylformamide as the main product with an isolated yield of 52.0%. N,N-di-(4-chlorobenzyl)-N-methylamine was produced as the main by-product with an isolated yield of 31.3%.
Conclusions: A new rapid method for the synthesis of N-(4-chlorobenzyl)-N-methylformamide was developed.

Supported by NIH grant 8 P20 GM103442-12 from the National Institute of General Medical Sciences.

RAPID SYNTHESIS OF N,N'-(4-CHLOROBENZYLIDENE)-BIS-FORMAMIDE

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Background: In our lab, we have been extensively using the Leuckart reaction for the synthesis of novel antifungal compounds. Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of substituted N-benzylformamides. We also found that the reaction typically produces three minor byproducts, specifically, substituted N,N-dibenzylformamides, substituted N,N,N-tribenzylamines, and substituted N,N'-benzylidene-bis-formamides. It was interesting to investigate if the procedure could be modified towards the selective production of any of these by-products.
Hypothesis: Replacing formic acid as the catalyst and the reducing agent with oxalic acid that can act only as a catalyst may lead to a selective production of substituted N,N'-benzylidene-bis-formamides. In this work the hypothesis was tested by conducting the reaction on 4-chlorobenzaldehyde.
Methods: The reaction was conducted on 10 mmol scale at 133ºC. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: The reaction was fully completed in 1 minute and produced N,N'-(4-chlorobenzylidene)-bis-formamide as the main product with the isolated yield of 67.4%.
Conclusions: A new rapid method for the synthesis of N,N'-(4-chlorobenzylidene)-bis-formamide was developed.

Supported by NIH grant 8 P20 GM103442-12 from the National Institute of General Medical Sciences.

RAPID SYNTHESIS OF N,N,N-TRI(4-T-BUTYLBENZYL)AMINE

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Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of various benzylformamides. We also used acetamide as an alternative solvent for the Leuckart reaction. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, N-(4-chlorobenzyl)formamide was produced only as a minor product. Instead, N,N-di-(4-chlorobenzyl)formamide was produced as the main product of the reaction with the isolated yield of 33.5%. N,N,N-tri-(4-chlorobenzyl)amine was produced with the isolated yield of 12.4%.
Hypothesis: The reaction conducted on benzaldehydes with electron-donating substituents should result in even larger shifts towards the products of the secondary and tertiary Leuckart reactions. In this work the hypothesis was tested by conducting the reaction on 4-t-butylbenzaldehyde.
Methods: The reaction was conducted on 10 mmol scale at 200ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: The reaction was fully completed in 1 minute and produced N,N,N-tri(4-t-butylbenzyl)amine as the main product with the isolated yield of 29.8%. The secondary reaction product, N,N- di-(4-t-butylbenzyl)formamide, was produced with the isolated yield of 22.3%. The combined yield of the di- and tri-products was 52.1%, significantly higher than the combined yield of the di- and tri-products in the 4-chlorobenazaldehyde reaction (45.9%).
Conclusions: The reaction comprises a successful example of refocusing the Leuckart reaction towards the predominant formation of the tertiary products. The reaction provides an important step towards a new rapid method for the synthesis of N,N,N-tri-(4-t-butylbenzyl)amine.

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RAPID SYNTHESIS OF N,N-DI-(4-CHLOROBENZYL)FORMAMIDE

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Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of various benzylformamides. We also used acetamide as an alternative solvent for the Leuckart reaction. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, N-(4-chlorobenzyl)formamide was produced only as a minor product with an isolated yield of only 14.4%. The use of acetamide resulted in a substantial shift towards the products of the secondary and tertiary Leuckart reactions. Specifically, N,N-di-(4-chlorobenzyl)formamide appeared to be the main product of the reaction with the isolated yield of 33.5%. N,N,N-tri-(4-chlorobenzyl)amine was produced with the isolated yield of 12.4%.
Hypothesis: Increased concentration of 4-chlorobenzaldehyde may result in an even larger shift towards the products of the secondary and tertiary Leuckart reactions and may lead to higher yields of N,N-di-(4-chlorobenzyl)formamide and N,N,N-tri-(4-chlorobenzyl)amine
Methods: Four reactions with different ratios of the reagents were conducted. Column chromatography was used for the isolation of the products of the reactions. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.
Results: All of the reactions produced N,N-di-(4-chlorobenzyl)formamide as the main product. The highest isolated yield of N,N-di-(4-chlorobenzyl)formamide was 39.7%. The same reaction produced N,N,N-tri-(4-chlorobenzyl)amine in a substantially larger amount with the isolated yield of 16.7%. The combined yield of the di- and tri-products was 56.4%, which is significantly higher than the combined yield of the di- and tri-products in the original reaction (45.9%).
Conclusions: An improved method for the rapid synthesis of N,N-di-(4-chlorobenzyl)formamide has been developed.

Supported by NIH grant 8 P20 GM103442-12 from the National Institute of General Medical Sciences.

INCREASED ROLE FOR LARGE CONDUCTANCE, CALCIUM-ACTIVATED K CHANNELS (BK_{Ca}) IN ENDOTHELIUM-DEPENDENT RELAXATION OF NITRATE TOLERANT MESENTERIC ARTERIES

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Prolonged exposure to nitroglycerin (NTG) leads to tolerance and impaired endothelium-dependent vasodilation. Causes of endothelial dysfunction in nitrate tolerant arteries are well studied, but little is known about mechanisms that underlie the responses to endothelium-derived mediators in nitrate tolerant blood vessels. Here we evaluated the role of BK_{Ca} in acetylcholine (ACh)-induced relaxation of isolated mesenteric arterial rings from rats treated with or without application of transdermal NTG patches (0.6 mg/hr) for 3 days. Nitrate tolerance was confirmed by the impaired relaxation response to NTG (1 nM – 100 μM) observed in rings from rats treated with NTG patches (pD_2= 5.6 ± 0.1 vs 4.9 ± 0.1, E_{max}= 86 ± 7 vs 53 ± 5% relaxation; control vs treated, respectively). ACh-induced (1 nM – 3 μM) relaxation was also impaired in tolerant rings (pD_2= 7.1± 0.1 vs 6.5 ± 0.1; control vs tolerant, respectively). Incubation with nitro-l-arginine (30 μM) or indomethacin (10 μM) had no effect on the response to ACh in control or tolerant arteries, consistent with the release of a non-NO, non-prostanoid endothelium-derived mediator in both control and tolerant arteries. ACh-induced relaxation was unaffected by the selective BK_{Ca}-blocker, iberiotoxin (IbTx), in control rings, but was nearly abolished in tolerant rings (E_{max} = 78 ± 9 vs 8 ± 8% relaxation; without vs with IBT, respectively). Protein expression of BK_{Ca} -subunits was increased by 50% in nitrate tolerant arteries, while BK_{Ca} -subunit expression was unchanged. The data provide evidence that nitrate tolerance unmasks a pivotal role for BK_{Ca} in the smooth muscle relaxation evoked by a non-NO, non-prostanoid endothelium-derived mediator in mesenteric arteries.

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ELECTRONIC AND OPTICAL PROPERTIES OF CORE/SHELL $PB_{16}X_{16}/CD_{52}X_{52}$ (X=S, SE, TE) QUANTUM DOTS

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The electronic and optoelectronic properties of semiconductor quantum dots (QDs) are mediated by surface defects due to the presence of dangling bonds producing trap states within the HOMO-LUMO energy gap, and contributing to fluorescence quenching. Surface capping ligands are generally used to alleviate this problem and increase the quantum yields of QDs. An alternative way is to synthesize core-shell QD structures; i.e., a QD core with a shell of another semiconductor material. We have investigated the effects of $Cd_{52}X_{52}$ shells on the photoexcited dynamics of $Pb_{16}X_{16}$ (X=S, Se, Te) QDs. The thin (≈ 0.50 nm) shells were found to result largely in type I core/shell structures and a blue shift of the absorption spectra. Our studies revealed fairly strong core-shell hybridization in the electronic states close to the conduction band (CB) edge for $Pb_{16}S_{16}$ and $Pb_{16}Se_{16}$ cores, whereas for the $Pb_{16}Te_{16}$ core, such CB states were largely shell-like in nature. Nonadiabatic DFT-based dynamics, coupled with the surface hopping method, was used to study the effects of the core and shell compositions on energy relaxation rates in these systems.

EFFECTS OF REALIMENTATION ON UMBILICAL BLOOD FLOW, FETAL AND PLACENTAL MEASUREMENTS, AND BIRTH WEIGHT IN NUTRIENT RESTRICTED PREGNANT EWES

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Nutritional restriction (60% of total nutritional requirement) from day 50 to 130 applied in nulliparous ewes has shown to reduce umbilical blood flow (UBF; Lemley et al., 2012;AJP 302:R454-R467). We hypothesized that during restriction, UBF and fetal and placentome measurements would be less than in adequately fed ewes, but upon realimentation, ewes would have similar UBF as ewes that were never restricted. Second parity Dorset ewes were assigned either to an adequate nutrition group (CON, n = 7) or a restricted (60% of CON) group (RES, n = 8), from days 50 to 90 of gestation. On day 90, all ewes were fed 100% of nutritional requirements according to body weight. Ewe body weight and conceptus measurements via ultrasonography were recorded every 10 days from d 50 to 130 of gestation. Every 10 days, length and width from 10 random placentomes were averaged and then multiplied to obtain placentome area. Fetal biparietal and abdominal lengths were recorded. Doppler mode was used to obtain UBF, pulsatility index (PI), and resistance index (RI). At birth, lambs and placental measurements were obtained. The data was analyzed using the Proc Mixed procedure of SAS. Treatment and day were treated as fixed effects, ewe as random. By d 70, RES ewes were lighter ($P < 0.01$), and remained lighter than CON ewes throughout the experiment. While there were no treatment by day interactions or main effects of treatment ($P > 0.13$) for any measurements obtained by ultrasonography, there were some interesting observations. On d 80, UBF and placentome area were decreased, and PI, RI, and biparietal distance increased in RES vs CON ewes ($P \leq 0.05$; means separation of unprotected F test). On d 90, prior to the realimentation, all ultrasound measurements were similar. After realimentation, there was no effect of treatment on any of the ultrasound measurements. At birth, lambs and placental measurements were similar ($P > 0.43$). Perhaps the increased resistance indices and smaller placentome size on day 80 were a trigger to the dam to enhance UBF to the growing fetus. Further studies are needed to determine the impact of maternal age and parity in the face of nutrient restriction on UBF.

PHENOTYPIC DIVERGENCE BETWEEN TWO REFUGE POPULATIONS OF THE ENDANGERED PAHRUMP POOLFISH (*EMPETRICHTHYS LATOS*).

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The establishment of refuge populations has been an important tool for managing endangered species, but recent research has suggested that refuge populations may undergo rapid evolutionary divergence. To evaluate potential change, we quantified phenotypic divergence of key life history traits between two refuge populations of the endangered Pahrump poolfish (*Empetrichthys latos*) in Nevada: Spring Mountain Ranch and Shoshone Stock Pond (Shoshone). These two populations occupy habitats that differ considerably in latitude and elevation, with Shoshone being approximately 300 km north and 660 m higher than Spring Mountain Ranch. The fish were collected during June 2014, sacrificed, and the females were subsequently measured and dissected. Spring Mountain Ranch fish were both significantly longer and larger (62.9 ± 2.5 mm (total length ± CI) and 1.02 ± 0.14 g (dry weight ± CI)) than Shoshone (50.1 ± 1.5 mm and 0.39 ± 0.04 g; $F = 72.46$, $P << 0.001$, $F = 64.70$, $P << 0.001$, respectively). Further, Spring Mountain had significantly higher condition (Fulton's K = 2.0 ± 0.4%) than Shoshone (Fulton's K = 1.7 ± 0.03; $F = 112.68$, $P << 0.001$). In addition Spring mountain Ranch had higher fat content (20.1 ± 1.1 %) and higher reproductive allocation (12.3 ± 0.8%) than Shoshone (9.8 ± 1.4% and 7.7 ± 0.8%, respectively; $F = 131.99$, $P << 0.001$; $F = 58.89$, $P << 0.001$). Finally, Spring Mountain Ranch had significantly larger eggs (0.67 ± 3.2 mg) compared to Shoshone (0.55 ± 2.1mg; $F = 34.99$, $P << 0.001$). These differences suggest either rapid evolutionary divergence and/or plastic responses of major life history characteristics to the local conditions.

CONSTITUTION OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Founded 1908, Official State Academy 1958

ARTICLE I - *Name and Purpose*

Section 1. This association shall be called the NORTH DAKOTA ACADEMY OF SCIENCE.

Section 2. The purpose of this association shall be to promote and conduct scientific research and to diffuse scientific knowledge.

ARTICLE II - *Membership*

Membership in the Academy shall be composed of persons who share the stated purpose of the Academy and who are active or interested in some field of scientific endeavor.

ARTICLE III - *Council*

The officers of the Academy shall be a President, a President-Elect, and a Secretary-Treasurer. The Council, consisting of the officers, the retiring President, and three elected Councilors, shall be responsible for the fulfillment of the scientific and business obligations of the Academy.

ARTICLE V - *Dissolution and Limits of Action*

Section 1. In the event of dissolution of the Academy, any remaining assets shall be distributed to organizations organized and operated exclusively for education and scientific purposes as shall at the time qualify as exempt organizations under Section 501(c) (3) of the Internal Revenue Code of 1954.

Section 2. No substantial part of the activities of the Academy shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the Academy shall not participate in or intervene in, any political campaign on behalf of any candidate for public office.

Section 3. No part of any net earnings shall inure to the benefit of, or be distributable to, Academy members or officers, or other private persons, except that the Academy may authorize the payment of reasonable compensation for services rendered.

ARTICLE VI - *Amendments*

Section 1. This Constitution may be amended at any annual Business Meeting of the Academy by a two-thirds vote. Proposed amendments shall be submitted in writing to the Secretary-Treasurer who shall send them to the members at least two weeks before the meeting at which such amendments are to be considered.

Section 2. Bylaws may be adopted or repealed at any regular business meeting by a two-thirds vote.

BYLAWS

BYLAW 1. *Meetings*

Section 1. *Scientific Meetings*. The Academy shall hold at least one annual scientific meeting each year at a time and place determined by the Council. Other scientific meetings, regional, state, or local, may be held at times and places determined by the Council. The Council shall establish regulations governing the presentation of papers at Academy sessions. Such regulations shall be made available to members at least three months before any meeting at which they are to apply.

Section 2. *Business Meetings*. A Business Meeting of the membership shall be scheduled at the regular, annual scientific meeting of the Academy. Ten percent of the active members shall constitute a quorum at the annual business meeting.

Section 3. *Special Meetings*. Special meetings shall be called by the President upon the request of ten percent of the active members and require twenty percent of the active members for a quorum. Notice of the time and place of such meetings shall be sent to all members of the Academy at least four weeks in advance of the meeting. Only matters specified in the call can be transacted at a special meeting.

Section 4. *Procedure*. Parliamentary procedures to be followed in all business meetings shall be those specified in "Standard Code of Parliamentary Procedure" by Alice F. Sturgis.

BYLAW 2. *Financial*

Section 1. *Fiscal year*. The fiscal year shall run concurrently with the calendar year from January 1 to December 31.

Section 2. *Dues and Assessments*. The annual dues and assessments may be changed from time to time by the Council, subject to approval by a two-thirds vote of the members at an annual Business Meeting. These dues are payable by January 31 for the current fiscal year or by the Annual North Dakota Academy of Science Meeting for those registering for the meeting

Section 3. *Supporting Members*. Council shall maintain a program to encourage members to voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

Section 4. *Sustaining Members*. Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at $50 or greater may be invited by the President or designee to become a Sustaining Associate.

Section 5. *Audit and Reports*. The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year. The Secretary-Treasurer shall report on the financial affairs of the Society, including the results of an annual audit, as may be requested by the Council.

BYLAW 3. *Membership*

Section 1. *Membership Categories*. Classes of membership shall include the following: (a) Regular, (b) Student, (c) Emeritus, (d) Honorary, (e) Supporting, (f) Sustaining, and (g) Lifetime Members.

Section 2. *Eligibility and Procedure for Membership*. Candidates for membership, except Sustaining Member, may be proposed by any regular or emeritus member of the Academy by submitting the candidate's name to the chairman of the Membership Committee.

(a) *Regular Members*. Any person who is active or interested in some field of scientific endeavor shall be eligible for regular membership. A majority vote of Council shall elect to regular membership.

(b) *Student Members*. Any student who is an undergraduate or graduate student in some field of science shall be eligible for student membership. A majority vote of Council shall elect to regular membership.

(c) *Emeritus Members*. Any member in good standing upon formal retirement is eligible for emeritus membership. A majority vote of Council shall elect to emeritus membership.

(d) *Honorary Member*s. The Academy may recognize, by awarding honorary membership, any person (nonmember or member) who has in any way made an outstanding contribution to science. It shall be the responsibility of the Membership Committee to be aware of individuals whom it would be fitting for the Academy to honor in this fashion. A two-thirds vote of members attending the annual business meeting shall elect to honorary membership.

(e) *Supporting Members*. Regular or student members may voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

(f) *Sustaining Associates*. Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at $50 or greater may be invited by the President or designee to become a Sustaining Associate.

(g) *Lifetime Member*s. Any regular member in current good standing for at least one year may become a Lifetime Member by paying an assessment equal to 18 times the current annual dues in one lump sum or in two equal payments over the current and following year.

Section 3. *Privileges of Membership*.

(a) Voting at the annual business meeting is permitted of regular and emeritus members.

(b) Members of all categories may attend business meetings of the Academy.

(c) The Secretary-Treasurer and members of Council must be regular members in good standing.

(d) Regular, student, and emeritus members may submit abstracts or communications for scientific meetings of the Academy.

(e) Emeritus and Honorary Members shall be exempt from payment of dues.

(f) A Sustaining Member is provided a display area at the annual scientific meeting of five linear feet per $50 donation up to a maximum of 20 linear feet.

(g) Every member in good standing shall receive a printed copy or an electronic copy (if available and of equal or lesser cost than the printed copy) of the annual *Proceedings of the North Dakota Academy of Science*, the form to be determined by the member.

(h) Special offices such as Historian may be created by the unanimous vote of the regular members at the annual Business Meeting.

(i) All student research participants shall receive a properly inscribed certificate.

Section 4. *Forfeiture of Membership*.

(a) *Nonpayment of dues*. Members shall be dropped from the active list on 31 November following the nonpayment of dues during the membership year commencing the previous 1 December. A member may return to the active list by paying the current year dues.

(b) *Expulsion for Cause*. Membership may be terminated for conduct injurious to the Academy or contrary to the best interests of the Academy. The accused member shall be given an opportunity for a hearing before the Council. If a majority of the Council votes to expel the member, the action must be ratified by at least two-thirds of the members present at the next annual business meeting of the Academy. An expelled member shall forfeit all paid dues and assessments.

BYLAW 4. *Duties and Responsibilities of the Council and Council Members*

Section 1. *Council*. The Council shall meet, at the call of the President, at least twice a year. The Council shall:

(a) be the governing board of the Academy, responsible only to the membership.

(b) arrange for programs, approve committee appointments, be responsible for the fiscal affairs of the Academy, and transact such business as necessary and desirable for function and growth of the Academy.

(c) determine the location of the annual meeting three years in advance.

(d) annually appoint an Academy representative to the National Association of Academies of Science and to Section X (General) of the American Association for the Advancement of Science.

(e) shall appoint and may compensate a Secretary-Treasurer.

(f) shall appoint and may compensate an Editor of the PROCEEDINGS and other publications.

(g) shall be empowered to charge a publication fee of authors on a per page basis.

(h) shall control all activities of the Academy including grant applications.

Section 2. *President*. The President shall preside at meetings of the Council and over the annual business meeting of the Academy at the close of the regular term office. The President shall vote only to break a tie. Unless otherwise specified, the President shall, with the approval of the Council, appoint members to serve on Standing Committees and *ad hoc* Committees, designate the chair of each Committee, and appoint representatives to other organizations. The President serves as Coordinator of the Local Arrangements Committee for the annual meeting that occurs at the end of the President's term.

Section 3. *President-Elect*. The President-elect shall be considered a vice president and shall serve as such in the absence of the President.

Section 4. *Past-President*. The retiring President shall serve as Past-President and chair of the Nominating Committee. The Past President shall serve ex officio on those committees designated by the President and shall serve in the absence of the President and President-elect.

Section 5. *Secretary-Treasurer*. The Secretary-Treasurer shall:

(1) Assist Council in carrying on the functions of the Academy including the receipt and disbursement of funds under the direction of Council.

(2) Manage the Academy Offices under Council's general supervision.

(3) Serve as Managing Editor of the *Proceedings of the North Dakota Academy of Science*.

(4) Prepare a summary of the most recent audit and a report of the Academy's current financial status. This information shall be shared with the membership at the annual business meeting and published in the PROCEEDINGS following the business meeting.

(5) Perform all other duties of the Secretary-Treasurer listed in the Bylaws.

(6) Serve as archivist and be responsible for all official records, archives, and historic material which shall be in reposit with the Secretary-Treasurer.

BYLAW 5. *Appointment, Nomination and Election of Members of Council*

Section 1. *Eligibility for Office*. All candidates for election or appointment to the Council must be regular members in good standing. Nominees for President-elect must be members who reside within easy commuting distance of the site of the annual meeting selected by the Council that occurs when the President-elect serves as President.

Section 2. *Nomination Procedures*. The Nominating Committee shall be responsible for all nominations to elective office, shall determine the eligibility of nominees, shall ascertain that nominees are willing to stand for office, and shall be required to advance to the Secretary-Treasurer at least two names for each open position as needed. Academy members shall have been encouraged to suggest nominees to the committee prior to the Committee submitting its report.

Section 3. *Election Procedures*. Election shall be by secret mail ballot. The Secretary-Treasurer shall prepare a printed ballot that bears all names submitted by the Nominating Committee, that contains a brief biography of each candidate, and that has space for write-in candidates for each office. This ballot is to be mailed to all members no later than 1 November. Each member wishing to vote must return the marked ballot in a sealed signed envelope to the Secretary-Treasurer postmarked not more than thirty days after the ballots were mailed out to members. The President shall appoint tellers, who shall count the ballots that have been received by the Secretary-Treasurer and the tellers shall present the results in writing to the President. A plurality of the votes cast shall be necessary to elect and in the case of a tie vote, the President shall cast the deciding vote. The results of the election shall be announced at the annual Business Meeting.

Section 4. *Term office*. A President-Elect shall be elected annually by the membership and the following years shall succeed automatically to President and Past President to constitute a three-year nonrenewable term. Three Councilors shall be elected by the membership to three-year, non-renewable terms on a rotating basis. All elected Council members shall take office at the end of the next annual Business Meeting following election and shall continue until

relieved by their successors. Council is empowered to appoint and compensate a Secretary-Treasurer to successive three-year terms that commence with the beginning of the fiscal year.

Section 5. *Removal from office or position.* If for any reason any elected member of Council is unable to fulfill his/her duties, the Council member may be removed from office by two-thirds vote of Council. If for any reason the Secretary-Treasurer is unable to fulfill his/her duties, the Secretary-Treasurer may be relieved of all duties by a majority vote of Council.

Section 6. *Interim vacancies*. Should a vacancy occur in the Presidency, the Council by a majority vote shall appoint a member of the Academy able to coordinate the next annual meeting to fill the unexpired term. A retiring interim President shall succeed automatically to Past President. Should a vacancy occur in the Presidency-elect, the Council shall reassess and change the location of the coinciding annual meeting as necessary and then call for a special election by mail ballot. An interim vacancy in the Past-Presidency shall be filled by the most recently retired Past-President able to fill the duties of the Past-President. Persons appointed to fill the unexpired term of Secretary-Treasurer are expected to remain in the position for a minimum of three years. A vacancy in the office of Councilor shall be filled by a majority vote of Council until the following election at which time the interim Councilor may stand for a full three year nonrenewable term.

BYLAW 6. *Committees*

Section 1. *Standing Committees*. Standing committees shall include but not be limited to, the following: Editorial, Education, Denison Award, Necrology, Nominating, Resolution, Membership, and Audit Committees. The President shall appoint members of committees other than the Nominating and Audit Committees.

Section 2. *Editorial Committee*. The Editorial Committee shall consist of three regular members appointed to three year terms. The duties are explained in BYLAW 7 (Publications).

Section 3. *Education Committee*. The Education Committee shall consist of five regular members and two high school teachers appointed to five year terms. The Education Committee shall work with high school students and teachers in the state, in visitation programs, Science Talent Search programs, and other programs to stimulate an interest in science by the youth of the state. It shall operate the Junior Academy of Science program and administer the AAAS high school research program.

Section 4. *Denison Awards Committee*. The Denison Awards Committee shall consist of six regular members appointed to three year terms. The Denison Awards Committee shall have as its prime duty the judging of student research and paper competitions, both undergraduate and graduate, and any other similar competitions. The committee shall also maintain the criteria to be used in the judging and selection of papers, such criteria to be circulated to prospective competitors.

Section 5. *Necrology Committee*. The Necrology Committee shall consist of three regular members appointed to three year terms. The Necrology Committee shall report to the annual meeting on those deceased during the preceding year. Obituaries may be included in the minutes of the annual meeting and/or published in the Proceedings.

Section 6. *Nominating Committee*. The Nominating Committee shall consist of the five most recent past-presidents. The major duties of the Nominating Committee are listed in BYLAW 5 (*Appointment, Nomination and Election of Members of Council*). The Nominating Committee will also administer the selection process, develop a separate funding source for a monetary award, and develop, for Executive Committee approval, the criteria for the North Dakota Academy of Science Achievement Award.

Section 7. *Resolution Committee*. The Resolution Committee shall consist of three regular members appointed to three year terms. The Resolution Committee shall prepare such resolutions of recognition and thanks as appropriate for the annual meeting. Further, the Committee shall receive suggested resolutions for the membership and transmit such resolutions and the Committee recommendation to the membership.

Section 8. *Membership Committee*. T he Membership Committee shall consist of unlimited numbers of regular members appointed annually.

Section 9. *Audit Committee*. The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year.

Section 10. *State Science Advisory Committee*. The State Science Advisory Committee (SSAC) shall consist of five regular or emeritus members appointed to four year terms. The SSAC shall serve to direct questions of a scientific nature to the appropriate expert as requested, shall inform regional granting agencies and state and national science policymakers of its expertise and availability and shall counsel those agencies and persons upon their request. The SSAC shall adhere in particular to the guidelines described in Article V, Section 2 of the Constitution.

Section 11. *Ad hoc Committees*. The President may appoint such additional committees as may be needed to carry out the functions of the Academy. Ad hoc committees serve only during the tenure of the president who appointed them. Reports of ad hoc committees shall be presented to Council or to the annual meeting.

BYLAW 7. *Publications*

Section 1. *Editorial Committee*. Three regular members are appointed to the Editorial Committee for renewable three year terms. The Editorial Committee shall develop and recommend the Academy publication program and policies to the Council. It will assist the Editors of each official publication in reviewing manuscripts for those publications that include the *Proceedings*. Chairs of symposia will review manuscripts written for relevant symposia.

Section 2. *Managing Editor*. The Secretary-Treasurer shall serve as the

Section 3. *Editor*. Editors shall serve three year terms. The Editors shall edit all official publications of the Academy including the *Proceedings*.

BYLAW 8. *Memorial Fund*

The Council of the Academy shall establish a J. Donald Henderson Memorial Fund and administer this fund so that the proceeds will be used to promote science in North Dakota.

BYLAW 9. *Fiscal Year*

The fiscal year of the North Dakota Academy of Science, for the purpose of financial business, shall be 1 January to 31 December.

BYLAW 10. *Achievement Award*

The Academy establishes the North Dakota Academy of Science Achievement Award to be given periodically to an Academy member in recognition of excellence in one or more of the following:
a. Nationally recognized scientific research.
b. Science education.
c. Service to the Academy in advancing its goals.
The Nominating Committee will administer the selection process, will develop a separate funding source for a monetary award, and will develop, for Council approval, the criteria for the award.

BYLAW 11. *Research Foundation*

The **North Dakota Science Research Foundation** is established as an operating arm of the Academy. The purposes of the Foundation are:
(1) to receive funds from grants, gifts, bequests, and contributions from organizations and individuals, and (2) to use the income solely for the making of grants in support of scientific research in the State of North Dakota. Not less

than 50% of the eligible monies received shall be placed in an endowment from which only the accrued interest shall be granted.

The foundation shall be responsible for soliciting the funds for the purposes described. The Foundation funds shall be in the custody of the Secretary-Treasurer of the Academy and shall be separately accounted for annually. The Foundation Board of Directors shall be comprised of five members of the Academy, representing different disciplines. Members shall be appointed by the President of staggered five year terms. The chairperson of the Board shall be appointed annually by the President. The Board shall be responsible for developing operating procedures, guidelines for proposals, evaluation criteria, granting policies, monitoring procedures, and reporting requirements, all of which shall be submitted to the Executive Committee for ratification before implementation.

The Foundation shall present a written and oral report to the membership of the Academy at each annual meeting, and the Secretary-Treasurer shall present an accompanying financial report.

BYLAW 12. *Affiliations*

The Academy may affiliate itself with other organizations which have purposes consistent with the purposes of the Academy. Such affiliations must be approved by the Council and by a majority of those attending a regularly scheduled business meeting of the membership.

BYLAW 13. *Indemnification*

Section 1. Every member of the Council or employee of the North Dakota Academy of Science shall be indemnified by the Academy against all expenses and liabilities, including counsel fees, reasonably incurred or imposed upon him/her in connection with any proceedings to which he or she may be made part, or in which he or she may become involved, by reason of being or having been a member of the Council, or employee at the time such expenses are incurred, except in such cases wherein the member of the Council or employee is adjudged guilty of willful misfeasance or malfeasance in the performance of his or her duties. Provided, however, that in the event of a settlement of the indemnification herein shall apply only when the Council approves such settlement and reimbursement as being for the best interests of the Academy. The foregoing right of indemnification shall be in addition to and not exclusive of all other rights to which such members of the Council or employee may be entitled.

ACADEMY OFFICERS AND COMMITTEES

Executive Committee Membership
President
Past-President
President-Elect
Secretary-Treasurer (three-year term)
Councilors (three-year terms)

Secretary-Treasurer
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President
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President-Elect
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COMMITTEES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Executive Committee
Editorial Committee*
Education Committee – Dr. Doug Munski
Denison Awards Committee*
Necrology Committee*
Nominating Committee
State Science Advisory Committee*

*indicates available openings

Resolution Committee – Kaylee Dockter, Joel Collins, Dr. Paul Lepp
Membership Committee*
Audit Committee*
North Dakota Research Foundation Board of Directors – Dr. Birgit Pruess, Dr. Jerzy Bilski, Dr. Paul Lepp*
Historian – Dr. Alexey Shipunov

PAST PRESIDENTS AND THE LOCATIONS

OF THE ANNUAL MEETING OF THE NORTH DAKOTA ACADEMY OF SCIENCE

1909	M A Brannon	Grand Forks
1910	M A Brannon	Fargo
1911	C B Waldron	Grand Forks
1912	L B McMullen	Fargo
1913	Louis VanEs	Grand Forks
1914	A G Leonard	Fargo
1915	W B Bell	Grand Forks
1916	Lura Perrine	Fargo
1917	A H Taylor	Grand Forks
1918	R C Doneghue	Fargo
1919	H E French	Grand Forks
1920	J W Ince	Fargo
1921	L R Waldron	Grand Forks
1922	Daniel Freeman	Fargo
1923	Norma Preifer	Grand Forks
1924	O A Stevens	Fargo
1925	David R Jenkins	Grand Forks
1926	E S Reynolds	Fargo
1927	Karl H Fussler	Grand Forks
1928	H L Walster	Fargo
1929	G A Talbert	Grand Forks
1930	R M Dolve	Fargo
1931	H E Simpson	Grand Forks
1932	A D Wheedon	Fargo
1933	G C Wheeler	Grand Forks
1934	C I Nelson	Fargo
1935	E A Baird	Grand Forks
1936	LR Waldron	Fargo
1937	J L Hundley	Grand Forks
1938	P J Olson	Fargo
1939	ED Coon	Grand Forks
1940	J R Dice	Fargo
1941	F C Foley	Grand Forks
1942	F W Christensen	Fargo
1943	Neal Weber	Grand Forks
1944	E A Helgeson	Fargo
1945	W H Moran	Grand Forks
1946	J A Longwell	Fargo
1947	A M Cooley	Grand Forks
1948	R H Harris	Fargo
1949	R B Winner	Grand Forks
1950	R E Dunbar	Fargo
1951	A K Saiki	Grand Forks
1952	Glenn Smith	Fargo
1953	Wilson Laird	Grand Forks
1954	C O Clagett	Fargo
1955	G A Abbott	Grand Forks
1956	H B Hart	Jamestown
1957	W E Comatzer	Grand Forks
1958	W C Whitman	Fargo
1959	Arthur W Koth	Minot
1960	H J Klosterman	Fargo
1961	Vera Facey	Grand Forks
1962	J F Cassel	Fargo
1963	C A Wardner	Grand Forks
1964	Fred H Sands	Fargo
1965	P B Kannowski	Grand Forks
1966	Paul C Sandal	Fargo
1967	F D Holland, Jr	Grand Forks
1968	W E Dinusson	Fargo
1969	Paul D Leiby	Minot
1970	Roland G Severson	Grand Forks
1971	Robert L Burgess	Fargo
1972	John C Thompson	Dickinson
1973	John R Reid	Grand Forks
1974	Richard L Kiesling	Fargo
1975	Arthur W DaFoe	Valley City
1976	Donald R Scoby	Fargo
1977	Om P Madhok	Minot
1978	James A Stewart	Grand Forks
1979	Jerome M Knoblich	Aberdeen, SD
1980	Duane O Erickson	Fargo
1981	Robert G Todd	Dickinson
1982	Eric N Clausen	Bismarck
1983	Virgil I Stenberg	Grand Forks
1984	Gary Clambey	Fargo
1985	Michael Thompson	Minot
1986	Elliot Shubert	Grand Forks
1987	William Barker	Fargo
1988	Bonnie Heidel	Bismarck
1989	Forrest Nielsen	Grand Forks
1990	David Davis	Fargo
1991	Clark Markell	Minot
1992	John Brauner	Grand Forks
1993	John Brauner	Jamestown
1994	Glen Statler	Fargo
1995	Carolyn Godfread	Bismarck
1996	Eileen Starr	Valley City
1997	Curtiss Hunt	Grand Forks
1998	Allen Kihm	Minot
1999	Joseph Hartman	Grand Forks
2000	Mark Sheridan	Moorhead, MN
2001	Ron Jyring	Bismarck
2002	Jody Rada	Grand Forks
2003	Richard Barkosky	Minot
2004	Anna Grazul-Bilska	Fargo
2005	Holly Brown-Borg	Grand Forks
2006	Andre Delorme	Valley City
2007	Chris Keller	Minot
2008	Van Doze	Grand Forks

2009	Birgit M Prüβ,	Fargo	2012	Michael A. Bingle-Davis	Wyoming
2010	Paul W. Lepp	Minot	2013	Keith Henry	Grand Forks
2011	Lyle Best	Belcourt	2014	Jerzy Bilski	Valley City

MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

ANNUAL BUSINESS MEETING 2014

President Bilski called the annual business meeting to order in the Rhoades Science Center in Valley City, North Dakota on April 24, 2014 at 4:00 PM. President Bilski welcomed all and thanked them for their attendance.

The first items addressed were the voting of a new President and a new President-elect. Dr. Chris Keller nominated Dr. Stuart Haring of North Dakota State University to serve as President for 2014-2015. Dr. Haring accepted the nomination and was unanimously elected. Dr. Haring then nominated Dr. Nathan Fisher, also of North Dakota State University to the position of President-elect. The motion was seconded by Dr. Paul Lepp and unanimously approved.

The NDAS budget was presented by Dr. Paul Lepp. The NDAS currently has a total value of $145,689.20. Of this, $2310 is in checking, $7959 is the PayPal accound, $10,310 in the Scholarship Fund, and $120,563 is the value of stock shares in Sempra Energy held in the Research Foundation Fund. Expenses for last year totaled &8779. Dr. Joseph Hartman motioned that an outside account be hired to balance the books. This was seconded by Dr. Ron Jyring. Dr. Hartman questioned how the large stock holdings would affect the non-profit status of the academy. Dr. Stuart Haring suggested approaching an accounting school at one of the NDUS system schools for a free audit. Dr. Lyle Best suggested the North Dakota Community Foundation could provide a similar service. Dr. Haring motioned to have the incoming president (himself) inquire about auditing at the accounting department at NDSU and the Secretary-Treasurer make similar inquiries at Minot State University. The motion was seconded by Dr. Jyring and unanimously approved.

The departure of Dr. Chris Beachy from Minot State University left an opening for a councilor. Dr. Andre Delorme of Valley City University nominated himself for the position. The nomination was seconded by Dr. Paul Lepp and was unanimously approved.

Dr. Chris Keller commented on the low participation at the current meeting and suggested more encouragement for attendance at next year's meeting. Dr. Jyring suggested the NDAS annual meeting be held in conjunction with another meeting as a means to boost attendance, such as the Minnesota Academy of Science or the South Dakota Academy of Science. Dr. Haring suggested establishing a North Dakota University System listserv that contains all science faculty to increase awareness of the meeting. Dr. Corrine Brevik suggested a point of contact be established for primarily undergraduate universities and tribal/community colleges. Dr. Haring suggested the establishment of a NDAS fellowship or grant to boost student participation. Dr. Haring suggested hiring a web designer to update the NDAS website to be a more effective means of information dissemination. No motions were made on any of these suggestions.

We had 2 professional talks, 12 Denison graduate student talks and 12 Denison undergraduate student talks. The Denison Awards were presented by President Bilski. The award winners were:

Denison Undergraduate Award			Denison Graduate Award		
2nd runner-up	Janelle Beske	$100	2nd runner-up	Deepti Tyagi	$100
1st runner-up	Aaron Burgad	$150	1st runner-up	Karl Effertz	$150
Winner	Thomas Dodson	$200	Winner	Erica Mueller	$200

At 5:00 PM, Dr. Bryan Schmidt motioned to adjourn the meeting. Dr. Ron Jyring seconded the motion. Motion carried and the meeting was adjourned.

Respectfully submitted,
Bryan Schmidt, Secretary-Treasurer

Lifetime Members

F. D. “Bud” Holland
Ron Jyring
Allen Kihm