**Project Descriptions**

Summer Training Opportunity in Precision Livestock Production

South Dakota State University, Brookings, SD

**Title:** Determining feed energy value of alternative feedstuffs for swine

**Project Description (Summer 2018):**

In the swine industry, feed represents up to 70% of the cost of livestock production with dietary energy making up the greatest proportion of that cost. Dietary energy that is lost in the manure as a result of poor digestion reduces production efficiency and profit and increases the risk of environmental contamination. Therefore, optimizing dietary energy use requires formulation of the diet using the net energy value of feedstuffs to match dietary energy supply to the pig’s energy requirement. However, there is little information on the net energy value of common feedstuffs and even less for co-products and alternative ingredients.

As the use of co-products and alternative ingredients in livestock diets increases, livestock nutritionists with a strong knowledge of assessing nutritive value of feedstuffs have the ability to formulate livestock diets to meet the nutrient needs of the animal while minimizing nutrient excretion. This is a critically important skill of the next generation of livestock nutritionists but few college graduates have the opportunity to acquire this essential skill.

This project will give an undergraduate student the opportunity to address 2 critical challenges within the swine industry: 1) provide net energy value of relevant locally available alternative feedstuffs for use in practical swine diet formulation and 2) acquire advanced understanding of nutritional evaluation of feedstuffs and practical diet formulation. The student involved with this project will be responsible for determining the net energy value of alternative ingredients using live animal ingredient digestibility trials combined with published net energy equations in comparison with net energy values determined by near infrared spectroscopy. The data generated will then be incorporated into predictive equations of net energy ingredient value for practical on-farm application through collaboration with our industry partner.

**Co-Mentors:**

Dr. Crystal Levesque, Department of Animal Science (Swine Nutritionist)

Dr. Tofuko Woyengo, Department of Animal Science (Swine Nutritionist)

**Off-Campus Training Site (Summer 2019):** Ralco Animal Nutrition, Marshall, MN

Ralco is a 40+ year old, third-generation family business with distribution in over 20 countries around the world. Since its founding, Ralco has provided producers with innovative solutions built on exclusive technologies for agriculture through animal nutrition, animal health, and enhanced plant performance.

Website: <http://www.ralconutrition.com/>

**Title:** Investigating the effect of stress on the symbiotic microorganisms of the equine gastrointestinal tract

**Project Description (Summer 2018):**

The gastrointestinal tract of horses, like other animals, is populated by very dense and complex communities of microorganisms, also known as microbiota, that play essential roles in the health and nutrition of their host. The equine gastrointestinal tract is particularly prone to upsets, particularly during times of stress, which not only cause pain to animals but also result in additional costs to their owners.  One of the more common causes of stress in horses are extended stays in confined environments, as stalled individuals often exhibit more stereotypic behaviors such as cribbing and weaving than horses that live in pastures. Since stall confinement is a common horse management practice, there is a critical need in the equine industry to gain a better understanding of the effect of confinement on the gut microbiota of horses, so that strategies can be developed to maintain a healthy microbial status during times of stress.

This research team is thus seeking students to work on a project aiming to compare the gut bacterial populations of stalled horses to those of pastured animals, using fecal samples as a proxy for analyzing the composition of the equine hindgut microbiome.  Trainees will learn basic molecular biology techniques (e.g. DNA isolation and PCR), as well as data analysis methods (bioinformatics) that are used in contemporary investigations of gastrointestinal microbiomes. It is anticipated that results from this project will contribute to our basic understanding of the equine microbiota in various environments, and eventually as the basis for management decisions and best practices in the field.  Students who wish to develop strong skills in both molecular biology as well as to partake in conversations related to the application of this science within the horse industry would be a strong fit for the project.

**Co-Mentors:**

Dr. Rebecca Bott, Interim Honors College Dean (Equine Reproductive Physiology)

Dr. Benoit St-Pierre, Department of Animal Science (Gastrointestinal Microbiology)

**Off-Campus Training Site (Summer 2019):** Horse Unit, South Dakota State University, Brookings, SD

The SDSU Horse Unit has about 20 geldings and an active Quarter Horse breeding program that includes young and breeding stock. The University strives to raise all-around Quarter Horses with solid conformation and good minds, as they are handled by many different students at various levels of expertise throughout their academic careers.

Website: <http://www.sdstate.edu/agriculture-biological-sciences/animal-science/equine-teaching-facility>

**Title:** Investigating the effect of a feed additive to mitigate heat stress on the performance of finishing pigs.

**Project Description (Summer 2018):**

The long-term goal of this research is to investigate the effect of a feed additive reported to mitigate the effects of heat stress. The new South Dakota State University Swine Education and Research Facility provides novel swine production rooms for manipulating the thermal environment for wean to finish pigs via conduction, convection, and radiant methods. The student will garner experience in production-scale research of the animal environment and feed efficiency. To further advance our assessment of a feed additive in environments above thermal neutrality for swine, we propose to utilize the novel production rooms to manipulate the thermal environment of the pigs in the finisher stage.

The student intern will utilize and develop skills in animal science as well as gain some experience in agricultural engineering. The student will garner an improved understanding of the interactions of nutrition and barn management.

**Co-Mentors:**

Dr. Ryan Samuel, Department of Animal Science (Swine Nutrition)

Dr. Crystal Levesque, Department of Animal Science (Swine Nutrition)

**Off-Campus Training Site (Summer 2019):** Pipestone System, Pipestone, MN

Pipestone System is a major swine operation consisting of family swine farms in Southwestern Minnesota. Sow barns and nursery-finishers are well represented in this system, giving students an opportunity to work in all phases of pork production. Pipestone Veterinary Clinic ties all of these family farms together in this innovative pork production system.

Website: <http://www.pipestonesystem.com/>

**Title:** Genomic forensics for improving food safety

**Project Description (Summer 2018):**

Use of new technologies to improve food safety is a requirement for precision agriculture. Next generation sequencing (NGS) is a new technology that is being implemented to improve food safety by sequencing the genomes of major bacterial pathogens such as *Salmonella enterica*. NGS-based genome sequencing allows real-time pathogen tracking and prediction of disease outbreaks. With this technology, a bacterial pathogen’s precise source, virulence, and antibiotic resistance profile can be identified. Students will collect samples from Midwest dairy farms and screen samples for disease causing *Salmonella enterica* strains. Salmonella strains isolated using this screen will be used for whole genome sequencing. The NGS data will be used for assembling whole genomes of strains using bioinformatics tools and will be compared with the genomes of other Salmonella strains the FDA “GenomeTrakr” project.

**Co-Mentors:**

Dr. Sanjeev Anand, Department of Dairy Science (Dairy Microbiologist)

Dr. Joy Scaria, Department of Veterinary and Biomedical Sciences (Food Safety Microbiologist)

**Off-Campus Training Site (Summer 2019):** RTI, LLC, Brookings, SD

RTI, LLC is a leading veterinary contract research organization and diagnostic laboratory. Established in 1994, RTI, LLC provides quality veterinary research service and support, with expertise in vaccinology, microbiology, virology, and nutrition.

Website: <http://4rtilab.com/>

**Title:** Genetics of reproductive efficiency

**Project Description (Summer 2018):**

Our research project is aimed at improving bull fertility in beef and dairy herds. Given that bulls can mate with many females during a breeding season, even small differences in bull fertility can impact pregnancy rates and thus profitability of beef and dairy operations. Our research team is utilizing multiple approaches towards addressing mechanisms affecting fertility of bulls. Depending on their interests, students may choose to primarily work with cattle, work in the laboratory, or both. In the field, students may complete the following activities:

* Assist with breeding cattle by artificial insemination, including administering shots;
* Pregnancy check cows and heifers by palpation and ultrasound;
* Collect blood samples from cattle.

In the laboratory, students will have an opportunity to learn about cutting-edge molecular biology techniques. One focus of the laboratory is investigating how small RNAs in sperm and seminal fluid affect bull fertility. Students may complete the following lab assays:

* Nucleic acid (DNA & RNA) isolation;
* Polymerase chain reaction (PCR) and real-time reverse transcription-PCR;
* Gel electrophoresis;
* Radioimmunoassays for hormones of importance in cattle reproduction.

Regardless of the focus of their work, students will learn about bovine reproductive physiology and genomics. Students will also be exposed to how data in these disciplines is analyzed and interpreted.

**Co-Mentors:**

Dr. Michael Gonda, Department of Animal Science (Beef Cattle Geneticist)

Dr. George Perry, Department of Animal Science (Beef Cattle Reproductive Physiologist)

**Off-Campus Training Site (Summer 2019):** USDA Meat Animal Research Center, Clay Center, NE

Scientists at the Roman L. Hruska U.S. Meat Animal Research Center (MARC) are developing scientific information and new technology to solve high priority problems for the U.S. beef, sheep, and swine industries. Objectives are to increase efficiency of production while maintaining a lean, high quality product; therefore, the research ultimately benefits the consumer as well as the production and agri-business sectors of animal agriculture. The comprehensive program includes research on genetics and breeding, reproduction, nutrition, meats science, production systems, biological engineering, and animal health.

Website: <https://www.ars.usda.gov/plains-area/clay-center-ne/marc/>

**Title:** Effect of ambient temperature on water intake in cattle

**Project Description (Summer 2018):**

Students will be involved with an experiment that seeks to evaluate the effect of organic or inorganic sources of copper, manganese, and zinc, and environmental conditions on the water intake of growing beef heifers. Much of the research on the water intake of beef cattle was conducted in 1950’s and 1960’s. While this research was well designed and provided highly meaningful data to the industry, the genetics of beef cattle has changed significantly over the past 60 years. Prudent use of limited water resources requires a re-evaluation of water requirements with modern genetics. A recent investment in a new cow-calf education and research facility that is equipped with Insentec RIC feed and water intake monitoring systems uniquely positions SDSU to generate and disseminate impactful data to the industry. Students will be intimately involved in data collection, analysis, and interpretation, and development of an iGrow article.

**Co-Mentors:**

Dr. Julie Walker, Department of Animal Science (Beef Cattle Nutritionist)

Dr. Cody Wright, Department of Animal Science (Beef Cattle Nutritionist)

**Off-Campus Training Site (Summer 2019):** Cargill Animal Nutrition, Wayzata, MN

Cargill provides food, agriculture, financial and industrial products and services to the world. Together with farmers, customers, governments, and communities, we help people thrive by applying our insights and 150 years of experience. Cargill is involved with agriculture trading and processing, feed ingredients, meat, poultry, and eggs, farmer services, and animal nutrition and feeds. Cargill sells nutritional products for the aquaculture, beef, dairy, poultry, pork, and pet food industries.

Website: <http://www.cargill.com/index.jsp>

**Title:** The Extension mission: Providing education across the state and nation

**Project Description (Summer 2018):**

Students will work with mentors to identify informational and/or evaluation needs in the area of livestock production and education. They will design and implement extension curriculum covering current issues targeted for youth and/or adult audiences to address these needs. Interns will carry out the land-grant mission of making scientific based information available to all audiences by participating in at least one outreach activity. Quality student work will be published through SDSU Extension or other venues. An example of an identified need in youth education is poultry production with emphasis on selection, nutrition, management and exhibition. Interns would contribute to educational and organizational planning and execution of state and/or regional workshops, events, and/or shows. Opportunities with other livestock species are also available. Examples of an evaluation focus including evaluation of the National 4-H Livestock Skillathon Contest, National 4-H Livestock Quiz Bowl or Western National 4-H Round-up Horse Classic contests.

**Co-Mentors:**

Dr. Rebecca Bott, Interim Honors College Dean (Equine Extension)

Dr. Rosemarie Nold, Department of Animal Science (Livestock Extension)

**Off-Campus Training Site (Summer 2019):** South Dakota State University Extension, Brookings, SD

SDSU Extension is the indispensable outreach link to people growing South Dakota’s, and the nation’s, future by providing solutions and creating opportunities. We foster learning communities that empower citizens to advocate for sustainable change and strengthen agriculture, natural resources, youth, families and communities. South Dakotan farmers, ranchers, agri-business people, families, and youth are provided with research-based information they need to succeed by SDSU Extension.

Website: <http://igrow.org/>

**Title:** Examining the relationships of efficiency of feed digestion and rumen microorganisms in beef cattle

**Project Description (Summer 2018):**

The ability of ruminants to convert fiber-rich plant biomass into high quality protein products has long been a key component of human food production, and it is expected to play an even greater role in addressing the future needs of an ever-increasing human population. While ruminant production has improved dramatically in the last few decades, more insights are needed in ruminant nutrition in order to increase efficiency and meet future goals. Essential to ruminant physiology is the symbiosis of the host with microorganisms that reside in its rumen, a specialized compartment of the ruminant stomach where digestion of feed takes place from the combined metabolic activities of rumen bacteria, methanogenic archaea, protozoa and anaerobic fungi.

Students who select this research track will be involved in experiments that seek to develop new knowledge on nutrient digestion and microbial metabolism in ruminants. Trainees will use cannulated beef cattle as an experimental model to monitor the digestion rate of different feedstuffs, as well as determine the composition of rumen microbial populations in response to changes in substrates. Trainees will learn to properly perform and interpret the results from common experimental methods used in ruminant nutrition (e.g. volatile fatty acid and amino acid profiles, quantification of nutrient metabolism using stable isotopomers) and gastrointestinal microbial ecology (DNA extraction, PCR, bioinformatics analyses).

**Co-Mentors:**

Dr. Derek Brake, Department of Animal Science (Beef Cattle Nutritionist)

Dr. Benoit St-Pierre, Department of Animal Science (Gastrointestinal Microbiologist)

**Off-Campus Training Site (Summer 2019):** Cargill Animal Nutrition, Wayzata, MN

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Website: <http://www.cargill.com/index.jsp>

**Title:** Evaluation of the nutrient utilization of new and alternative feedstuffs for dairy cattle

**Project Description (Summer 2018):** The undergraduate research will conduct their own in situ projects with cannulated dairy cows or heifers to determine the ruminal degradation and intestinal digestibility of newly developing oilseed meals from new biodiesel crops, distillers grains from developing processing methods in the ethanol industry, or microbially-enhanced (fungally-treated) protein sources. This will help determine the protein fractions (i.e. ruminally degradable protein, ruminally undegradable protein) of the protein sources for optimization of use in dairy cattle ration formulations for future feeding trials. It will also allow us to determine rumen degradation rates of dry matter and fiber. As new types of feedstuffs are developed it is a critical initial step to establish how they behave in the dairy ruminant digestive system to assure that nutrients are being utilized efficiently in cattle diets and also to limit nitrogen excretion the environment. It is hypothesized that these newly developing feeds will have improve utilization in the ruminant digestive system compared to traditional feedstuffs. There will also be an opportunity for the student to conduct some in vitro experiments to determine the effects of new feedstuffs on rumen gas production. Dr. Anderson will have 2-3 larger feeding studies going on with dairy cows, heifers, and calves during summer 2017. So in addition to gaining valuable laboratory and research skills the undergraduate researcher will also gain valuable experience with dairy cattle feeding and handling by assisting graduate students running the feeding trials with day to day responsibilities and sample collections.

**Co-Mentors:**

Dr. Jill Anderson, Dairy and Food Science Department (Dairy Cattle Nutritionist)

Dr. Derek Brake, Animal Science Department (Beef Cattle Nutritionist)

**Off-Campus Training Site (Summer 2019):** Alltech Inc., Nicholasville, KY

Headquartered in Kentucky, Alltech trades in [128 countries worldwide](http://www.alltech.com/about/locations) and has more than 4,700 employees. They have 77 production facilities strategically positioned across the globe and three bioscience centers, dedicated to research and education, two located in the USA and one in Ireland. During the internship the student will work with Dr. Kamal Mjoun. Senior Research Scientist at the Alltech South Dakota IFM Lab. The Alltech South Dakota office includes a lab that features the In Vitro Fermentation Model (IFM), which is a diagnostic tool that simulates rumen fermentation and evaluates the nutritive value of total mixed rations (TMR) in terms of digestibility and end-products formation. Using IFM technology, feed samples are incubated within a standardized rumen fluid and a buffer system to mimic natural rumen fermentation in an oxygen-free environment. IFM then measures gas production, identifies TMR inefficiencies, and provides additional information on the nutritive value of the feed.

Website: [www.Alltech.com](http://www.Alltech.com)

**Title:** Using essential oils in swine production – research and outreach

**Project Description (Summer 2018):**

Consumers demand high quality meat products that can consistently deliver an enjoyable eating experience while being affordable. However, with changes in antibiotic use in livestock production the ability of producers to ensure efficient production may be limited. New and natural feed additives such as essential oils are being investigated to determine if production efficiencies can be improved in pork production. Nonetheless, there is minimal information on how essential oils affect pork carcass traits and palatability. Therefore, by examining carcass and palatability traits early postmortem we may be able to determine how applicable essential oils are in pork production. This is important for precision livestock production as new methods to increase pork production are necessary.

The undergraduate student recruited to assist with this project will work with Dr. Underwood, Dr. Nold, and Dr. Bob Thaler on collecting carcass data and pork samples for palatability analysis. The student will also be involved in determining best supplementation practices for using essential oils in pork production. The student will gain improved understanding of precision management of pigs to increase growth and ensure high quality pork products.

Providing research based information in a format that is easy to read and understand is essential to implementing changes in the industry. Also, because most of today’s consumers are multiple generations removed from production agriculture, providing accurate consumer-focused information about industry practices and changes is important for public understanding and acceptance of these practices. The use of essential oils as a potential replacement of antibiotics is one example of where providing consumer oriented information in the form of articles and/or fact sheets could affect consumer acceptance. Therefore, in addition to collection of data, the student will be involved in developing two types of literature – 1) articles appropriate for producers and the agricultural community who want to know and understand more about the practice, and 2) articles or other literature designed for consumers without an agricultural background. Literature will be published through SDSU Extension, including iGrow.org.

**Co-Mentors:**

Dr. Rosie Nold, Department of Animal Science (Meat Scientist, Extension)

Dr. Keith Underwood, Department of Animal Science (Meat Scientist)

**Off-Campus Training Site (Summer 2019):** SDSU Extension, Brookings, SD

SDSU Extension is the indispensable outreach link to people growing South Dakota’s, and the nation’s, future by providing solutions and creating opportunities. We foster learning communities that empower citizens to advocate for sustainable change and strengthen agriculture, natural resources, youth, families and communities. South Dakotan farmers, ranchers, agri-business people, families, and youth are provided with research-based information they need to succeed by SDSU Extension.

Website: <http://igrow.org/>

**Title:** Understanding immune responses

**Project Description (Summer 2018):**

Vaccines are important part of a preventive medicine program. To determine vaccine protection and efficacy, immune responses must be measured. This involves both the innate and adaptive immune response. This project will give an undergraduate student training in the laboratory to measure in vitro innate immune responses and to measure specific antibody responses to bovine viral diarrhea virus and bovine herpesvirus from nasal and serum samples using ELISA along with determining IgG1 and IgG2 and Total IgG using ELISA.  In addition, the test antigen, ovalbumin (OVA) is used as a test antigen so the student would also be trained OVA ELISA detection in serum.  Cell trafficking and cellular phenotypes are another response that is measured.  The student would be trained in surface marker phenotype analysis for innate and acquired immune cells.  With this training, the student would be prepared for year 2 working on animals.

**Co-Mentors:**

Dr. Chris Chase, Department of Veterinary and Biomedical Sciences (Veterinarian and Immunologist)

Dr. Alan Young, Department of Veterinary and Biomedical Sciences (Ruminant Immunologist)

**Off-Campus Training Site (Summer 2019):** Medgene and RTI, LLC Brookings SD

Medgene, a vaccine development company and RTI , a contract research organization are Brookings based companies.  Medgene has developed vaccines for the cervide and swine industries using a platform-basaed technology.  RTI, LLC is a leading veterinary contract research organization.  Established in 1994, RTI, LLC provides quality veterinary research service and support, with expertise in vaccinology, microbiology, virology, and nutrition.

At the company in 2019, the student would be involved in a clinical study involving vaccines and a challenge model.  They would learn how to make clinical observations of healthy animals and collect the samples necessary to perform the assays that the student was trained on in the first year.  The animals would be vaccinated and serial samples collected and the student trained how to process and document samples using good clinical practice procedures.  Assays would be batched and the student would assist in the performance of the various assays.  The animals would then be challenged and the same clinical and immunological parameters would be measured.  The data would then be analyzed and the student would assist in the statistical analysis.  The research report would be written and a presentation prepared.

Website:  <http://4rtilab.com/>

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