COLLEGE OF
AGRICULTURAL SCIENCES
COLORADO STATE UNIVERSITY

College of Agricultural Sciences Undergraduate Research Fellowship

Project Application

The College of Agricultural Sciences has developed an Undergraduate Research Fellowship for up to ten students per year from across the College. We aim to provide opportunities for undergraduates to find purpose, mentorship and community within their academic discipline and we aspire to facilitate self-discovery through research engagement and increase access for all undergraduates to impactful science.

Student are encouraged to compete for the Fellowship by identifying a project of interest from the list available online. Each fellowship will last for one semester (Fall, Spring, or Summer) and will pay the Fellow $2,000/semester for the hours worked. At approximately $13/hour, students will be allotted 10 hours per week over a 15-week semester to complete their unique project. Project leaders will be given $300 to assist with purchasing project supplies. All Fellows are encouraged to present their final project at the Multicultural Undergraduate Research Art and Leadership Symposium (MURALS) or the Celebrate Undergraduate Research and Creativity (CURC) Showcase in spring of each year

INSTRUCTIONS FOR SUBMITTING A FELLOWSHIP PROJECT

STEP 1) Faculty, lab staff and other qualified leaders are encouraged to outline a one-semester project below. Please include the following to allow students a broad understanding of how this project may align with their interests and skill development:

a) Fellowship Mentor name and Project title
Octavio Guimaraes
Project Title – ***Characterizing the influence of trace mineral source and diet type on nutrient digestion and mineral availability in beef cattle***

b) Justification or broad impact of project on the field of science it resides within.
With the intense population growth, it's our job as scientist to find a sustainable and very efficient way to produce livestock in order to provide protein to the world.
Main objectives of the study:
1) To determine if trace mineral source affects digestion of OM, ADF, NDF, starch, and nitrogen under certain dietary regimes
2) To determine if diet affects rumen soluble concentrations of SO4 vs. hydroxy trace mineral sources
3) To determine the effect of trace mineral source on relative binding strength of trace minerals in the rumen insoluble pellet

c) Tasks to be completed during approximately 150-hour fellowship

The trial is compost of 3 metabolism studies that will be conducted for 3 months. The student will be involved in the day-to-day basis of the project management, sample collection and animal husbandry in general. After the completion of the 3 sets of metabolism studies the student will be heavily involved during all the sample analysis which will be performed in additional 3 months. With that this student will be able to learn from field sampling to laboratorial analysis.

Experimental procedures:

Twelve crossbred steers (approximate BW = 350 kg) fitted with ruminal *cannulae* will be used in three consecutive experiments. Between experiments, steers will be gradually adjusted to the new diet that they will be receiving over a 14 to 21day period prior to initiation of treatments.

In all experiments, steers will be housed in two to three pens (4-6 steers per pen depending on the experiment) and fed the experimental diet with the appropriate trace mineral treatments for 7d. At the initiation of week 2, steers will be housed in individual pens within the metabolism building (2.5m x 2.5m pens equipped with automatic waters, individual plastic feeders, rubber matted floors, and a drain) for 2d to acclimate to the building environment. Steers will then be relocated into individual metabolism stalls (3.0m x 1.1m pens equipped with automatic waters, individual plastic feeders, and rubber matted floors) for a 5d acclimation period. During the acclimation period, DMI for each steer will be determined. At the end of the acclimation period, steers from each treatment will be paired based on their mean DMI over the 5d period. Once animals are appropriately paired by DMI, each steer within a pair will be fed the same amount of feed. Feed delivered to each steer within a pair will be 90.0% of the steer within the pair with the lowest average DMI during the acclimation period. This will ensure equal amounts of feed intake for individual steers within a pair (block) during the 5d total fecal and urine collection period. The next 5d will serve as the urine and fecal collection period. Feed and fecal samples will be analyzed for DM, OM, N, NDF, ADF, and starch (experiments 2 and 3). Urine will be analyzed for N. Following the 5-day fecal and urine collection, rumen samples will be collected at 0, 2, and 4 h post-feeding for determination of VFA's and rumen pH.

At the end of each experiment, steers will be fed the basal diet without supplemental Zn, Cu, and Mn for 3-4 days. Steers will then be pulse dosed with the trace mineral sources being evaluated. Individual trace mineral treatments will be thoroughly mixed with 0.23 kg of ground corn and administered as a single bolus-dose via the rumen fistula. Immediately post administration, the supplement will be thoroughly mixed with the rumen contents by hand. Ruminal samples will be obtained at 2 h intervals starting at -4, and ending at 24 h post dosing. Before each sampling time, the rumen contents will be thoroughly mixed by hand and a grab sample obtained from the geometric center of the rumen (approximately 250 g). Once collected, ruminal samples will be centrifuged 28,000 x g in graduated centrifuge tubes. Once centrifuged, the volume of supernatant will be determined and frozen at -20°C until trace mineral analysis can be performed.

The insoluble fraction will be dried at 60°C for 48 h in a forced air drying oven, ground in a Wiley mill to fit through a 2 mm screen, analyzed for Cu, Mn, and Zn, and dialyzed against 0.01M ethylenediaminetetraacetate in 0.05 M Tris (Tris-EDTA), or 0.01M L-Hisitidine hydrochloride in 0.05M Tris (Tris-His). Fisher regenerated cellulose dialysis tubing 31.8 mm

diameter, 30 µm wall thickness, MWCO 6,000 to 8,000 will be cut into 10 cm segments and treated to remove metal contamination. Dialysis tubing will be stored in 50% ethanol; 50%deionized water; 1mM EDTA at 4oC prior to use. The chelating buffers will be as follows: 0.01M ethylenediaminetetraacetate in 0.05 M Tris (Tris-EDTA), or 0.01M L-Hisitidine hydrochloride in 0.05M Tris (Tris-His). The diluted buffers will be prepared immediately prior to use and the pH adjusted to 6.8 with either 6M HCl (Tris-EDTA) or sodium hydroxide (Tris-His). Samples will be placed into 10 ml of the appropriate buffer, placed into dialysis tubing pre-wet with deionized water, the tubing will then be sealed with clips, and the samples then dialyzed against 1 liter of the same buffer for 16 hours at 4oC with continuous stirring. The buffer will be changed, and dialysis continued for another 6 h. Samples will be removed from dialysis bags, placed into pre-weighed acid-washed crucibles, and dried overnight at 60oC. After drying, samples will be weighed, and then ashed at 600oC in a Thermo-Fisher Thermolyne muffle furnace overnight. After cooling, ashed samples will then be weighed and re-suspended in 5 ml of boiling 1.2 M HCl and analyzed for Cu, Mn, and Zn as described above.

All metals will be quantified via inductively coupled plasma-atomic emission spectroscopy (ICP-AES) methods (Braselton et al., 1997) as described by Ahola et al. (2004) for Zn, Cu, and Mn, concentrations.

d) Major skills and competencies that will be developed during the project execution
The student will learn how to work in group, and without doubt will be able to connect classroom knowledge with the real-life system. In addition to that, the student will learn innumerous procedures that will take place during the trial itself. As example, blood and rumen collection, feeding (animal daily care/ animal husbandry), data collection and spreadsheet input. During the laboratory analysis the student will be trained and in charge of Proximates analysis, ICP-MS and Gas chromatography.

STEP 2) Please share the following to best describe how the Fellowship Mentor plans to support the Fellow throughout the Fellowship:

a) What training will the new Fellow receive to on-board them to community practices?
The student will be trained in all the activities surrounding the project itself. Starting from learn how to drive heavy farm equipment to laboratory analysis.

b) Who will the Fellow be working with directly?
The student will be working directly with Octavio Guimaraes and Terry Engle.

c) Are there weekly/monthly group meetings that may provide additional training and/or connection for the Fellow with the other student employees working on related projects?
The Ruminant Animal Nutrition Group has weekly meetings which the student will be participating. The student will also be working closely to approximately another 4-5 graduate students**.**

d) What specific mentorship is the Fellowship Mentor willing to provide the Fellow (for example, an introduction meeting and two additional meetings throughout the Fellowship)? Starting with an introduction meeting followed by weekly meeting to provide the mentor and student a good connection. Also, adjustment during the trial could be made with proper communication and guidance.

e) Are you interested in receiving a copy of Critical Mentoring: A Practical Guide by Torie Weiston-Serdan from the CAS Student Success Team to access current best practices for mentoring undergraduates?
Yes

Please send your completed project application to Adelle.Thompson@colostate by Nov. 15.

All available projects will be posted on the CAS Undergraduate Research Fellowship webpage and advertised to our undergraduates. Undergraduate applications will be due by December 10 and Spring 2020 Fellows will be announces before the end of the Fall 2019 semester.

If you have any questions, please contact Addy Elliott, Assistant Dean of Academic Advising and Student Success at Adriane.Elliott@colostate.edu or 970-491-6984.