Stein Monogastric Nutrition Laboratory Alumni Newsletter

December, 2016

Dear Former Students and Employees

I want to wish all of you a joyful, prosperous, and productive 2017. I hope you are all doing well and that you have entered the New Year in good health and with happy memories of 2016. I hope your families are also doing well.

We have had a reasonably good 2016. As usual, I am spending the Holidays with my family in Florida – we all enjoy that and it really is a good way for us to end the year and welcome the New Year. I have actually managed to do very little work for the last 14 days. The kids are doing well – Mike as a PhD student in immunology at Oxford University in the UK, Patrick at Reed College in Portland, Oregon, where he is studying history and environmental sciences, and Nathalie in high school in Urbana. Nicklas has slowly recovered from his injuries and he started as a full time student in high school in August – after having missed 3 years of school. So we are hopeful he can continue to recover and one day get his exam. Marianne is busy as always at her job and engaged in many hobbies.

I hope you will enjoy this little update from our Lab. You are all still a very important part of our family and you all contributed in different ways to the accomplishments and the reputation of our Laboratory. I will never forget that. It is not a secret that every time a student graduates and leaves I think to myself that it will be impossible to continue being effective in the Lab after losing such a great student. But someone else always steps up and fills the gap and we continue to be efficient. That is the real advantage of having great students.

Best of luck to all of you – once again, I wish you a fantastic 2017.

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Hans H. Stein.

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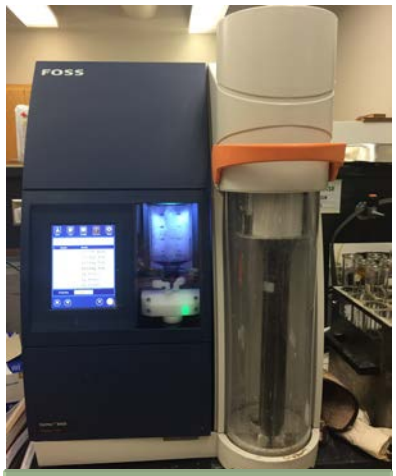
Status of the Stein Monogastric Nutrition Laboratory

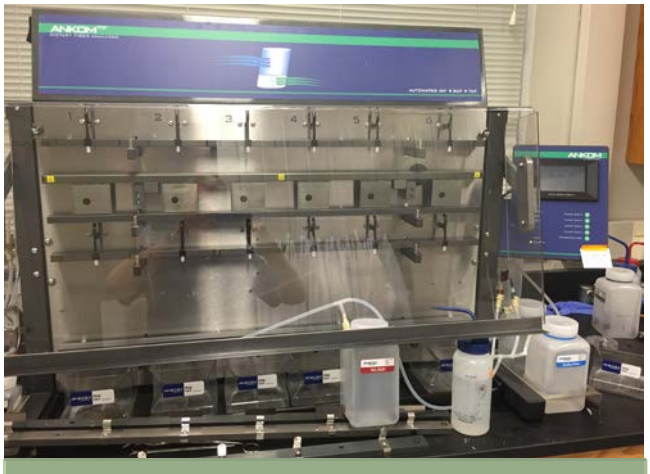
As I sit here on the last day of the year and look back I think it is fair to say that 2016 was a reasonably productive year for our group. We have continued to complete a large number of experiments, we have had a good year in terms of publications, we graduated 3 PhD students from our team, and we were able to attract enough funding to make it all happen. We use every group of weaned pigs for nursery experiments, the individual barns have been full most of the year and we have also completed several grow-finish experiments. So there are not many pigs born at SRC that are not used for research – and many of them are used several times before they reach market. We have a total of 76 metabolism crates and 32 pens for cannulated pigs – and both metabolism crates and cannulated pig pens are usually full. So students in our Laboratory are still given the glorious job of collecting ileal digesta and other valuable research samples – I am sure you all remember those exciting activities. A few years ago we were also able to purchase a unit with 6 calorimeter chambers – and we believe that we will be able to get all remaining equipment that we need purchased and installed in 2017. That will allow us to conduct calorimetry work and determine net energy of diets and feed ingredients and we are very excited about that.

Calorimeter Unit at SRC

After Dr. Pettigrew's retirement in 2013 we were given access to both his graduate student office (Room 208) and his lab in Room 218. We also still operate the labs in Rooms 205, 293, 220, and 222 – so we now have a total of 5 labs and sufficient space for our activities. During the last few years, we have been able to purchase more lab equipment and among other things, we have installed a freeze drier in Room 218. We also purchased equipment to determine soluble and insoluble dietary fiber and got that installed in Room 218. A few years ago we purchased an ADF-NDF analyzer (Room 220) and we are, therefore, now able to determine most fiber components in feed ingredients and diets. A Kjeldahl Nitrogen analyzer is also among the newer pieces of equipment we have; we still have the Elementar combustion system for N analysis, but the Kjeldahl system allows us to easily analyze N in urine and other fluids and in the ash-rich residues from the total dietary fiber analysis system.



Kjeldahl Nitrogen Analyzer



Total Dietary Fiber Analyzer

Kate Stewart is still in charge of our research activities at SRC. She is in charge of all experiments that do not have a graduate student involved and she also helps new graduate students find their way around the farm – and how to mix diets, feed pigs, collect samples and take care of the animals. Kate has now been with us for almost 10 years and she is the reason we never have problems with inspections from the Animal Care and Use Committee – the Animal Care and Use Committee often give us praise for the standard we are setting in terms of keeping our records. Great job, Mrs. Stewart! Kate and her husband Brad expect their first child this coming April so she has asked for a few months off next spring. We will need to find a way to get through that period.

Kate and Brad

Jennifer Roth is the other long-time presence in our Laboratory. Jennifer continues to take care of our website at http://nutrition.illinois.edu and makes sure we publish a newsletter every month. We have subscribers to our monthly newsletter from 45 countries around the world – that means that there are a large number of people around the world who get instant access to all our research results, and we usually get many of our stories spread around via other websites who pick them up from our newsletter. The strong website presence we have would not have been possible without Jen's efforts. She is also responsible for many other communication needs in our group including recording and publishing of our podcasts, writing of our research reports, and writing and publishing of our press releases. Jen also makes sure our activities are posted on Facebook and YouTube.

Diego A. Rodríguez is the stable helper at SRC who assists Kate in conducting a large number of research projects. Some of you may remember Diego from 2011-2012 when he spent 18 month as an intern in our Lab. He then returned to his native Colombia, where he received his BS degree from Universidad Nacional de Colombia. After that, he worked in the agricultural industry in Colombia for 3 years, but in 2015 he returned to our team where he is much appreciated – particularly among the graduate students who do not have a car! Diego will continue working at SRC until next summer when he will transition into a new role as a MS student. We look forward to having Diego with us for many years to come.

Highlights from 2016

We participated as usual in the Midwest Animal Science Meetings in Des Moines in March where we presented 12 abstracts. There is a considerable time commitment involved in preparing and practicing that number of presentations before the meetings. However, - as usual - everyone did a great job presenting their paper so it was worth all the efforts. **J. Caroline Gonzalez** was selected as a Midwest Young Scholar and gave a 30-min presentation about her research on digestibility of Ca and requirements for digestible Ca by pigs – so we were proud of Caroline for being selected for this honor. Caroline also received the Dr. Tim S. Stahly Outstanding Swine Nutrition Midwest Graduate Student Award – it is the first time a student from our group has received this award. So the Midwest Meeting was a great way for Caroline to conclude her career as a graduate student. Those awards are very well deserved and justifies some of the long hours Caroline spent in the lab.

PhD student **Diego M. D. L. Navarro** received the Evonik Internship Award, which came with an all payed for 4-day trip to South Carolina to learn about Evonik's activities in amino acid research and for interactions with Graduate Students from other Universities in the U.S. and Canada.

Six graduate students from our Laboratory also participated in the Joint Annual Meeting in Salt Lake City in July, and we presented 6 abstracts at the meeting. We also had a chance to catch up with former PhD student Dong Yong Kil, who is now a professor at Chung-ang University in Korea. At the meeting we also celebrated PhD student **Gloria A. Casas** for winning the "Wilson G. Pond International Travel Award". She used the award to travel to Northern Ireland in August to participate in the Annual Meeting for the European Association for Animal Production (EAAP). Gloria presented a poster about her research with rice co-products at the EAAP meeting. Gloria also received the "Department of Animal Sciences Fellowship Award", so 2016 brought very well deserved recognition to Gloria for her work.

Having students receiving the kind of recognition that comes with these awards is a very welcome reminder of the high quality of the work the students in our Laboratory conduct – and something we all take pride in.

We continue to prioritize publication of our research and in 2016, we published 22 peer-reviewed journal articles, 19 abstracts, 6 conference proceedings papers, 3 popular press articles, 12 press releases, 13 podcasts, and 2 book chapters. Having this kind of productivity requires an extraordinary effort by everyone on our team, but it is very satisfying to know that the quality of our research is such that our peers are willing to recommend that it gets published. Along with the

awards our student are awarded, I consider our publication record our biggest achievement and we will continue to prioritize efforts to get our research published in a timely manner.

PhD student **John K. Mathai** and I participated in the 5th International Symposium on Energy and Protein (ISEP) in Krakow, Poland, in September where we discussed John's research on amino acid digestibility in human foods.

One of the more fun experiences during the year was a "Stein Lab Breakfast" at the Midwest Meeting in Des Moines in March and all alumni from our group, along with current graduate students, were invited. The idea came from some of the former graduate students and former PhD student **Oscar J. Rojas** – assisted by **Jennifer Roth** – took care of the practical arrangements. A total of 22 former and current students showed up for the breakfast – including Tanawong and Orawan who came from Thailand and Nestor from the Netherlands – and although the time was short, we had a couple of enjoyable hours together. My mentor and former PhD advisor, **Dr. Robert A. Easter** also participated. I hope we can repeat this event at the 2017 Midwest Meeting.

Participants in the Stein Lab Breakfast at the Midwest Meeting in Des Moines. Tanawong and Orawan brought new "Stein Monogastric Lab" caps for everyone.

As always, I had the opportunity to travel a little bit during the year. Among other things I served on 2 PhD committees in Canada – at Univ. Alberta and Univ. Manitoba, respectively. It is always interesting to learn how PhD studies are conducted at other universities. I also was on a 3-week trip to Europe in the fall, where I visited 7 countries. The trip ended in Spain where I had the honor of participating in the wedding for our former visiting scholar, **Dr. Julio D. Berrocoso**. That was a very entertaining event; the party lasted – almost nonstop – for 36 hours and it has been a long time since I had that much fun. Thanks much, Julio and Fatima, for inviting me.

In early December, I was in the Philippines for a combination of private and business meetings and among other things I had a chance to meet our 3 former Filipino students who live in the Philippines: **Sarah, Ameer,** and **Rommel**. Always good to see former students so I enjoyed that a lot – thanks much to all of you for taking the time to visit and to show me around.

Professor Rommel C. Sulabo at UPLB

Drs. Sarah and Ameer Pahm and son Ethan

PhD students **Jerubella J. Abelilla** and **John K. Mathai** travelled to Shanghai in November to participate in the 4th Chinese Swine Industry Symposium where Jerubella presented a posted on "Composition and degradation of carbohydrate fractions in feed ingredients" and John gave a presentation entitled "Effects of fiber on the requirement for threonine in diets fed to pigs". Both presentations were very successful and gave us a chance to showcase our work in China – the largest swine producing country in the world.
Being prepared to work with people with many diverse backgrounds is a must to be successful in our industry. Providing international experiences for our students, therefore, continues to be a high priority and we try to take advantage of the opportunities as they present themselves.

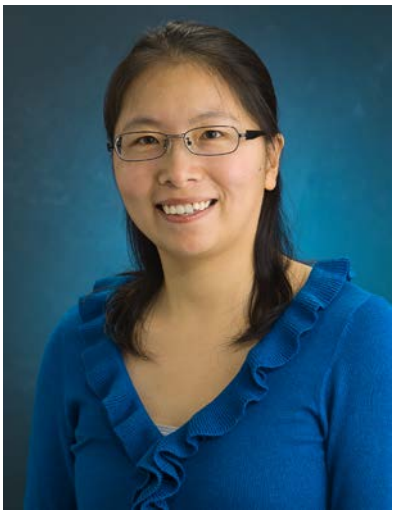
Jerubella and John met up with former PhD student Neil Jaworski in Shanghai.

Thanksgiving dinner for International students and employees

Of all highlights during the year, nothing is better than Graduation day – and 2016 was indeed special because we had 3 PhD students getting hooded that day. That is the most we have ever had. It is no secret that I am extremely proud every time I can hood a student – so being able to do it 3 times in one day is fantastic. Seeing students work and grow and develop and finally reach their goal is, without comparison, the best part of being a professor. As my mentor once told me, "The biggest impact you will have is via the people you train." Laura, Neil, and Caroline - I am extremely proud of your accomplishments.

Ready for the big event

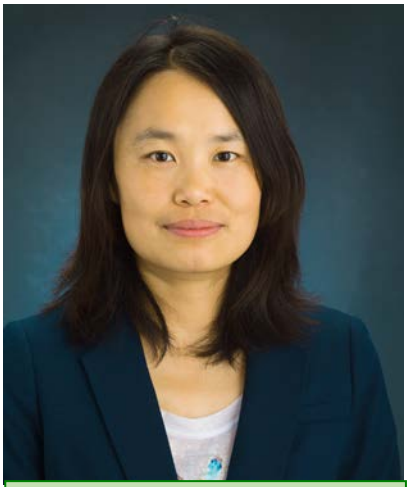
Personnel Changes, 2016



By the end of 2015, we – reluctantly - said goodbye to **Dr. Yanhong Liu**, who had been our effective and hard-working post doc for more than 3 years. Yanhong had obtained a position as an assistant professor at the University of California, Davis, and she started her duties there in Dec. 2015. Yanhong completed a large number of experiments during her time with us and she was instrumental in our ability to getting our research published. She also introduced a number of new laboratory techniques to us – techniques that are now routine in the work we conduct. Yanhong also was a valuable help to our graduate students, who still benefit from her unique ability to explain statistical analysis and use of the SAS Statistical Package. We still miss Yanhong in our group, but are happy that she was able to get the position at UC Davis. We hope we can continue to work with her in the future.

In early 2016, we also said goodbye to our second post-doc, **Dr. Chengfei Huang.** Chengfei spent 11 month with us and completed several experiments to evaluate effects of reducing the particle size of soy protein concentrate. She also helped summarize data from other experiments and had a productive time with us. She returned to MAFIC at China Agricultural University in Beijing, where she continues to conduct research in swine nutrition.

Laia Blavi



Dr. Chengfei Huang

In January, 2016, we welcomed **Laia Blavi** as a visiting scholar in our group. Laia is from Universitat Autònoma de Barcelona in Barcelona, Spain, - although she prefers being recognized as coming from Catalonia rather than from Spain. Laia conducted 2 experiments during the time she spent with us. She left our group in May, but returned during the month of July to complete writing the manuscripts from her experiments. One of these manuscripts, in which Laia determined effects of pharmacological levels of zinc oxide on effects of microbial phytase, was recently accepted for publication in Journal of Animal Science. Laia will defend her PhD dissertation in Barcelona in February, 2017, and she will return to our group in March, 2017, as a post-doc. We look forward to having Laia join our team again.

By the end of January, 2016, we said goodbye to **Cristhiam J. Muñoz** and **L. Vanessa Lagos**, our 2 Colombian interns who arrived in August, 2015. They both returned to the National University of Colombia in Bogota, where both of them received their BS degrees in April, 2016. However, they apparently were not tired of us so both of them returned after graduation. Vanessa became a Graduate student in our group and Cristhiam is now our Laboratory manager. He is, therefore, responsible for making sure laboratory analyses are completed for all experiments that do not have a Graduate student involved. He also oversees the undergraduate students working in the lab and he writes most of our IACUC protocols. If needed he also helps at the farm where he spent some time while he was an intern in our lab. So we are happy to have Cristhiam back in our group.

J. Caroline Gonzalez defended her PhD dissertation in February. She completed both her MS thesis and her PhD dissertation by working to determine the digestibility of Ca and the requirements for digestible Ca by growing pigs. Caroline joined our group in August, 2009 as an intern from the National University of Colombia. She returned in August, 2010, as a Graduate student so the defense of her dissertation was the culmination of a relatively long career in our laboratory. Caroline completed a large number of experiments in our group and has an impressive publication record. When she left us she moved to Kennesaw, GA, after accepting a position as Technical Service Manager at Evonik, U.S.

Caroline with her PhD committee after her defense

Neil W. Jaworski was another "old-timer" who completed his PhD dissertation in 2016. Neil defended his dissertation on "Utilization of energy in high-fiber diets fed to growing pigs" in March. Neil is from one of the Chicago suburbs and he did not come to the Univ. of IL with a desire to study pig production. However, he started working for us as an undergraduate student in 2008 and – intelligent as he is - over time he realized how exciting swine nutrition really is. He gained hands-on experience with swine production during 2 summer-internships at JBS United in Sheridan, IN, and he started as a MS student in our Laboratory January, 2011, and later continued as a PhD student. The defense of Neil's dissertation was the culmination of a lot of work – as is the case for all PhD students. Among many accomplishments, Neil was instrumental in setting up the fiber analyses systems in our lab and he truly became our expert on fiber and fiber analysis. Following

his graduation, Neil moved to the Netherlands, where he now works as a researcher in the research division for Trouw Nutrition – also known as Nutreco. Not surprisingly, Trouw Nutrition quickly made the decision to put Neil in charge of their research on fiber – he is certainly well prepared for that challenge – and we may even be able to collaborate with Neil on a few projects over the next few years.

Neil with his PhD committee after defending his dissertation

Laura A. Merriman defended her dissertation entitled "Factors affecting the digestibility of calcium in feed ingredients and requirements for digestible calcium by pigs" in April and graduated in May. Laura is from central Illinois and she came to our team as a PhD student and completed a large number of experiments in a relatively short period of time. Her work complements that of Caroline and we now have a relatively robust database for digestibility values for calcium and we have some very exiting data for the requirements of calcium by pigs. This is a very interesting area of research and Laura's data helped us increase our understanding of how detrimental to growth it is to over-feed calcium to growing-finishing pigs. Shortly after graduation, Laura was hired as a Swine Nutritionist by ADM Animal Nutrition in Decatur, IL – so she stayed close to home, which was her plan all along so that worked out well for her.

Laura was all smiles after her defense – here with her committee

Our laboratory manager, **Haley Spangler**, married her fiancé, Jeremiah, in July and became Mrs. Bower. That in itself was not really a disqualifying activity. But the really bad news was that Jeremiah got a new job shortly before the wedding – and he and Haley, therefore, moved to the suburbs of Chicago. So Haley left our team in August after obtaining a new job. Although she only spent a year with us, she left a lasting imprint and will be remembered for a long time. We tried to convert her from a poultry nutritionist to a swine nutritionist – but we would have needed more time

to make the transition complete. We still miss Haley's never-ending smiles and laughs, but we are happy that she and Jeremiah were able to start a new life together.

Last summer, we also said goodbye to **Kelsey Duensing**. Kelsey had worked as an undergraduate student helper in our lab for several years and became a full time employee in the lab after completing her BS degree in Dec. 2015. Kelsey was, however, accepted into veterinary school at Univ. of MO, so she left for MO in August. She completed her first semester in MO a few weeks ago and was able to participate in our annual Christmas party before the Holidays.

Kelsey Duensing

Yue She

Haley Bower

By the end of August, we also said goodbye to **Yue She** who spent a year as a visiting scholar in our group. Yue She is a PhD student at China Agricultural University in Beijing, China, and the goal for her during the year with us was to gain experiences in conducting digestibility experiments. She worked in the area of calcium digestibility and effects of microbial phytase on digestibility of calcium and phosphorus and other nutrients. She completed 2 experiments in our lab and she is now back in China and trying to complete her dissertation.

To take over some of Haley and Kelsey's duties in the lab, we hired **J. Paola Lancheros**. Paola is from Zipaquira in Colombia and she has a background as a chemical engineer. After working a few years as an engineer in Bogota, she decided it was time to explore opportunities in the U.S. and she joined our team in September. She is helping Cristhiam making sure that all samples get to where they need to be in the lab and get analyzed. Paola has not previously worked with animals or with nutrition, but she has been a fast learner and now is proficient in all our laboratory analyses – she has even started to become interested in nutrition so maybe one day we will be able to convert her! Paola also shares her smiles with everyone.

Current Graduate Students

Diego M. D. L. Navarro is our senior student and we hope he can complete his PhD dissertation sometime in 2017. Diego is a native of the Philippines where his family operates a feed company including a premix business. He joined our Laboratory in August 2012 as a MS Student and defended his MS thesis in 2014 and then continued as a PhD student. He passed his preliminary exam in Dec. 2015. The focus of his research is to determine if there are correlations between physical characteristics of dietary fiber and the energy that pigs can obtain from the fiber and he has completed 3 experiments towards his dissertation with one still to be initiated. His future plans include returning to the Philippines to assist his family in operating the feed business, but he may also get involved in university teaching if time allows.

Gloria A. Casas joined our team in August, 2013, when she was granted sabbatical leave from her job as a professor at Universidad Nacional de Colombia, Bogota, Colombia, and she entered our PhD program in August, 2014. Since arriving, Gloria has worked to characterize the nutritional value of rice co-products including full fat and defatted rice bran, brown rice, broken rice, and rice mill feed. She completed the animal work from her last experiment in November, but still has some lab work to complete. Gloria has been very productive and she has already published 7 peer-reviewed articles since joining us, 5 of these as the senior author. As mentioned above, Gloria also was the recipient of the 2016 Wilson G. Pond International Travel Award and she used the award to travel to Belfast for the EAAP meeting. A few days of vacation in London was also included in the trip. Following her defense next year, she will return to Colombia and her job as a professor at Universidad Nacional in Bogota.

John K. Mathai is from one of the Chicago suburbs and is completing his second year as a PhD student, but he has been associated with our group since 2009 – first as an undergraduate student helper working with Kate at SRC and later as a MS student. Many of you may remember him in one of these roles. John's dissertation will focus on amino acid nutrition in humans and he has completed an experiment to determine the digestibility of AA in 8 human foods – using the pig as the model for amino acid digestibility in humans. He will soon initiate a second experiment in this area, and he has also completed the animal work on a third amino acid experiment. John's plans for the future include working in the developing world for international aid organizations. He also hopes to work abroad during the coming year so we will try to fit that into his program.

Jerubella J. Abelilla is also in her third year as a PhD student. She is from the Philippines, where she obtained her MS degree. Jerubella's research focus is to determine effects of microbial xylanase on fermentation of fiber in diets fed to pigs – an important area where there, despite much effort over the last 20 years, still are many unknowns and much work to do. Among other things, Jerubella has established the breakdown of fibers along the intestinal tract of pigs fed different concentrations of fiber and different types of fiber. This work is exiting and a natural extension of much of the fiber-work we have completed in recent years in our Laboratory. Jerubella looks forward to passing her prelims in 2017 and completing more experiments. During the time she has been with us she has also had opportunities to travel to the UK – and this past year to China.

Charmaine D. Espinosa joined our lab as a PhD student last January. As Jerubella, she is also Filipina and she obtained her MS degree from the National University of the Philippines in Los Baños (UPLB), the Philippines, where she worked in the lab of our former postdoc (and MS student) Dr. Rommel C. Sulabo. She is, therefore, the 7th student from UPLB we have had in our lab – and since 2001, we have always had at least one student or post doc from UPLB. Charmaine's research will focus on determining the nutritional value of tribasic copper chloride. She has already completed 3 smaller experiments and is planning additional experiments to start over the next few months. Although mineral work has been an important part of the research in our Laboratory for many years, Charmaine will be the first student who will focus on micro minerals, so that is exciting for us.

L. Vanessa Lagos joined our team in June, but she was no stranger to our group because – as mentioned above – she spent 6 month with us as an intern in 2015 and early 2016. Vanessa is from Colombia and she obtained her BS degree from the same university where Gloria is a professor and she is the 5th graduate student in our Lab from Universidad National de Colombia. Vanessa will continue the calcium work that Laura Merriman and Caroline Gonzalez started and she will try to complete work to determine requirements for digestible calcium by all groups of pigs from weaning to market. She has completed work on one experiment and will start the next experiment in the spring. Vanessa will also make an attempt to demonstrate that pig growth performance from weaning to market may be improved if pigs are fed diets based on the requirement for digestible calcium and she will conduct research to demonstrate effects of microbial phytase on improving calcium digestibility.

Woong Bi Kwon joined our Laboratory as a PhD student in August. He is from South Korea and he obtained his MS degree from Konkuk University in Seoul where he worked in the laboratory of our former Post Doc, Dr. Beob G. Kim. Woong Bi grew up on a swine farm in S. Korea – he is actually the only one in our Laboratory who grew up on a farm – and his long term plans include returning to the family farm in some capacity. We knew Woong Bi well before he arrived because he spent a year as an intern in our lab in 2011-2012 where he primarily worked with Kate at SRC. Woong Bi will conduct his PhD research in the area of branched chain amino acid metabolism and one of the challenges he will have is to understand the interactions and antagonisms among the three branched chained amino acids. He will start his first experiment this coming spring.

Su A Lee also joined us in August. She is also from Dr. Kim's Lab at Konkuk University in Seoul, S. Korea, where she obtained BS and MS degrees - she actually was a lab-mate of Woong Bi at Konkuk University so she knows him well. Su A will conduct her PhD research in the area of calcium digestibility and requirements for digestible calcium. She is currently conducting an experiment to compare digestibility values for calcium, without and with microbial phytase, in growing pigs and gestating sows. That is a relatively big experiment that will keep her busy for a while. As anyone who knows Dr. Kim would expect, Su A is very well trained in the use of Excel spreadsheets and she can make the spreadsheets do things that a non-Korean would never be able to. She is also – if I remember correct - the first student who has ever complained that the exams in our statistics course are too easy. You trained her well, Dr. Kim!

Carly M. Rundle will officially become a Graduate student in our Laboratory by January 16, 2017. Carly is from the Chicago area and graduated with her BS a few weeks ago. She majored in Integrative Biology with a minor in Animal Science - it is the first time we will have a student with that background. We know Carly well because she has worked in our lab as an undergraduate student helper for the last 2 years and she is very familiar with all our laboratory procedures. As is the case for Vanessa, Carly will also be in the 5-year PhD program in Nutritional Sciences and her research will focus on determining effects of phytobiotics in nutrition. That is an area that we have not focused on in the past, and some of Carly's research will involve assessing intestinal health in pigs so we are excited venturing into that area.

The entire team, October, 2016. From left to right, back row: J. Paola Lancheros, Gloria A. Casas, Charmaine D. Espinosa, Su A Lee, L. Vanessa Lagos, Jennifer Roth, Carly M. Rundle, Kate H. Stewart, and Jerubella J. Abelilla. Front row: Woong Bi Kwon, Cristhiam J. Muñoz, Diego M. D. L. Navarro, John K. Mathai, Hans H. Stein, and Diego A. Rodríguez.

Publications, 2016

Peer reviewed publications

Rojas, O. J., Y. Liu, and H. H. Stein. 2016. Effects of particle size of yellow dent corn on physical characteristics of diets and growth performance and carcass characteristics of growing-finishing pigs. J. Anim. Sci. 94:619-628.

Liu, Y., N. W. Jaworski, O. J. Rojas, and H. H. Stein. 2016. Energy concentration and amino acid digestibility in high protein canola meal, conventional canola meal, and in soybean meal fed to growing pigs. Anim. Feed Sci. Technol. 212:52-62.

Rojas, O. J., E. Vinyeta, and H. H. Stein. 2016. Effects of pelleting, extrusion, and pelleting and extrusion on energy and nutrient digestibility in diets containing different levels of fiber and fed to growing pigs. J. Anim. Sci. 1951-1960.

Casas, G. A., and H. H. Stein. 2016. Effects of microbial xylanase on digestibility of dry matter, organic matter, neutral detergent fiber, and energy and the concentrations of digestible and metabolizable energy in rice co-products fed to weanling pigs. J. Anim. Sci. 94:1933-1939.

Overholt, M. F., J. E. Lowell, E. K. Arkfeld, I. M. Grossman, H. H. Stein, A. C. Dilger, and D. D. Boler. 2016. Effects of pelleting diets without or with distiller's dried grains with solubles on growth performance, carcass characteristics, and gastrointestinal weights of growing-finishing barrows and gilts. J. Anim. Sci. 94:2172-2183.

Overholt, M. F., J. E. Lowell, K. B. Wilson, R. J. Matulis, H. H. Stein, A. C. Dilger, and D. D. Boler. 2016. Effects of feeding pelleted diets without or with distillers dried grains with solubles (DDGS) to fresh belly characteristics, fat quality, and commercial bacon slicing yields of finishing pigs. J. Anim. Sci. 94:2198-2206.

Sotak-Peper, K. M., J. C. Gonzalez-Vega, and H. H. Stein. 2016. Effects of production area and microbial phytase on the apparent and standardized total tract digestibility of phosphorus in soybean meal fed to pigs. J. Anim. Sci. 2397-2402.

Stein, H. H., L. V. Lagos, and G. A. Casas. 2016. Invited review: Nutritional value of feed ingredients of plant origin fed to pigs. Anim. Feed Sci. Technol. 218:33-66.

Jaworski, N. W., D. W. Liu, D. F. Li, and H. H. Stein. 2016. Digestible, metabolizable, and net energy in diets containing 0, 15, or 30% wheat bran and fed to growing pigs. J. Anim. Sci. 94:2843-2850.

Gonzalez-Vega, J. C., Y. Liu, J. C. McCann, C. L. Walk, J. J. Loor, and H. H. Stein. 2016. Requirement for digestible calcium by 11 to 25 kg pigs as determined by growth performance, bone ash concentration, calcium and phosphorus balances, and expression of genes involved in transport of calcium in intestinal and kidney cells. J. Anim. Sci. 94:3321-3334.

Oliveira, M. S., and H. H. Stein. 2016. Digestibility of energy, amino acids, and phosphorus in a novel source of soy protein concentrate and in soybean meal fed to weanling pigs. J. Anim. Sci. 94:3343-3353.

Curry, S. M., O. J. Rojas, and H. H. Stein. 2016. Concentration of digestible and metabolizable energy and digestibility of energy and nutrients by growing pigs in distillers dried grains with solubles produced in and around Illinois. Prof. Anim. Sci. 32:687-694.

Merriman, L. M., and H. H. Stein. 2016. Particle size of calcium carbonate does not affect apparent and standardized total tract digestibility of calcium, retention of calcium, or growth performance of growing pigs. J. Anim. Sci. 94:3844-3850.

Pedersen, C., J. S. Almeida, and H. H. Stein. 2016. Standardized ileal digestibility of protein and amino acids in soy proteins fed to pigs. J. Anim. Sci. 94:340-343.

Gonzalez-Vega, J. C., and H. H. Stein. 2016. Digestibility of calcium in feed ingredients and requirements of digestible calcium for weanling pigs. Anim. Prod. Sci. 56:1339-1344.

Rojas, O. J., and H. H. Stein. 2016. Use of feed technology to improve the nutritional value of feed ingredients. Anim. Prod. Sci. 56:1312-1316.

Kim, B. G., Y. Liu, and H. H Stein. 2016. Effects of collection time on flow of chromium and dry matter and on basal ileal endogenous losses of amino acids in growing pigs. J. Anim. Sci. 94:4196-4204.

Casas, G. A., and H. H. Stein. 2016. Effects of full fat or defatted rice bran on growth performance and blood characteristics of weanling pigs. J. Anim. Sci. 94:4179-4187.

Mathai, J. K., J. K. Htoo, J. Thomson, K. J. Touchette, and H. H. Stein. 2016. Effects of dietary fiber on the ideal standardized ileal digestible threonine:lysine ratio for 25 to 50 kg growing gilts. J. Anim. Sci. 94:4217-4230.

Merriman, L. A., C. L. Walk, C. M. Parsons, and H. H. Stein. 2016. Effects of tallow, choice white grease, palm oil, corn oil, or soybean oil on apparent total tract digestibility of minerals in diets fed to growing pigs. J. Anim. Sci. 94:4231-4238.

Pedersen, T. F., Y. Liu, and H. H. Stein. 2016. Effects of diet energy level and an exogenous carbohydrase on growth performance of weanling pigs fed diets containing canola meal produced from high protein or conventional canola seeds. J. Anim. Sci. 94:5206-5218.

Gonzalez-Vega, J. C., C. L. Walk, M. R. Murphy, and H. H. Stein. 2016. Requirement for digestible calcium by 25 to 50 kg pigs at different dietary concentrations of phosphorus as indicated by growth performance, bone ash concentration, and calcium and phosphorus balances. J. Anim. Sci. 94:5272-5285.

Abstracts

Jaworski, N. W., M. C. Walsh, and H. H. Stein. 2016. Effects of fiber, a direct-fed microbial, and feeding duration on ileal and total tract digestibility of energy and nutrients by pigs. J. Anim. Sci. 94(Suppl. 2):73-74 (Abstr.)

González-Vega, J. C., C. L. Walk, and H. H. Stein. 2016. Requirements for digestible Ca by growing pigs. J. Anim. Sci. 94(Suppl. 2):101 (Abstr.)

Stein, H. H. 2016. Evaluating protein quality of human foods using the pig as a model. J. Anim. Sci. 94(Suppl. 2):20 (Abstr.)

González-Vega, J. C., C. L. Walk, and H. H. Stein. 2016. Digestible calcium requirements for 25 to 50 kg pigs. J. Anim. Sci. 94(Suppl. 2):101 (Abstr.)

Mathai, J. K., Y. Liu, and H. H. Stein. 2016. Amino acid digestibility in dairy proteins compared with plant proteins. J. Anim. Sci. 94(Suppl. 2):104 (Abstr.)

Merriman, L. A., C. L. Walk, and H. H. Stein. 2016. Effect of fat sources on ATTD of minerals. J. Anim. Sci. 94(Suppl. 2):104 (Abstr.)

Navarro, D. M. D. L., N. W. Jaworski, and H. H. Stein. 2016. Amino acid digestibility in six sources of meat and bone meal fed to growing pigs. J. Anim. Sci. 94(Suppl. 2):105 (Abstr.)

Casas, G. A. and H. H. Stein. 2016. Effects of exogenous xylanase on digestibility of dry matter, organic matter, neutral detergent fiber, and energy and the concentrations of digestible and metabolizable energy in rice co-products fed to weanling pigs. J. Anim. Sci. 94(Suppl. 2):107 (Abstr.)

Jaworski, N. W., M. C. Walsh, and H. H. Stein. 2016. Effect of a 3-Strain Bacillus-based direct-fed microbial on relative tissue gene expression in nursery and finishing pigs fed low- or high-fiber diets. J. Anim. Sci. 94(Suppl. 2):83 (Abstr.)

Merriman, L. A., C. L. Walk, and H. H. Stein. 2016. The effect of microbial phytase on the apparent and standardized total tract digestibility of calcium in feed ingredients of animal origin. J. Anim. Sci. 94(Suppl. 2):110 (Abstr.)

Liu, Y., J. C. González-Vega, M. Vázquez-Añón, J. Zhao, J. Escobar, F. N. Almeida, and H. H. Stein. 2016. Effects of a novel phytase on growth performance and metacarpal bone ash in weanling pigs. J. Anim. Sci. 94(Suppl. 2):111-112 (Abstr.)

Kiarie, E., Y. Liu, M. C. Walsh, H. H. Stein, and L. Payling. 2016. Xylanase responses on apparent ileal digestibility of nutrients, fiber and energy in growing pigs fed corn, 30% corn co-products and soybean meal based diets as influenced by microbial phytase and acclimatization period. J. Anim. Sci. 94(Suppl. 2):112-113 (Abstr.)

She, Y., D. Li, and H. H. Stein. 2016. Effects of microbial phytase on the apparent and standardized total tract digestibility of calcium in milk co-products fed to growing pigs. J. Anim. Sci. 94(E-Suppl. 5):436-437 (Abstr.)

Casas, G. A. and H. H. Stein. 2016. Effects of full fat or defatted rice bran and microbial xylanase on growth performance of weanling pigs. J. Anim. Sci. 94(E-Suppl. 5):441 (Abstr.)

She, Y., H. H. Salgado, D. Li, and H. H. Stein. 2016. Effects of high protein canola meal on digestibility of phosphorus and growth performance of weanling pigs. J. Anim. Sci. 94(E-Suppl. 5):457 (Abstr.)

Merriman, L. A., C. L. Walk, C. M. Parsons, and H. H. Stein. 2016. Digestible calcium requirement for 100 to 130 kg pigs. J. Anim. Sci. 94(E-Suppl. 5):458 (Abstr.)

Pedersen, T. F., Y. Liu, and H. H. Stein. 2016. Effects of inclusion of canola meal in weanling pig diets containing different concentrations of energy. J. Anim. Sci. 94(E-Suppl. 5):459 (Abstr.)

González-Vega, J. C., C. L. Walk, M. R. Murphy, and H. H. Stein. 2016. Effect of increasing concentrations of digestible calcium and digestible phosphorus on apparent total tract digestibility of calcium and phosphorus by pigs. J. Anim. Sci. 94(E-Suppl. 5):459 (Abstr.)

Casas G. A., and H. H. Stein. 2016. Use of phytase and xylanase to improve the nutritional value of rice co-products fed to pigs. In Proc. 67th Annual Meeting of the European Federation of Animal Science. Page 230 (Abstr.)

Conference Proceedings

Almeida, J. S., C. Pedersen, and H. H. Stein. 2016. Digestibility of soybean products fed to pigs: a meta analysis. Asian Agribiz Pig Feed Quality Conference, Bangkok, Thailand, March 30, 2016.

Walk, C. L., J.C. Gonzalez-Vega, and H. H. Stein. 2016. Establishing a digestible calcium requirement for pigs: methods and current results. Asian Agribiz Pig Feed Quality Conference, Bangkok, Thailand, March 30, 2016.

Gonzalez-Vega, J. C., L. M. Merriman, and H. H. Stein. 2016. Calcium digestibility and requirement for digestible calcium by growing pigs. Proc. Midwest Swine Nutrition Conference. Indianapolis, IN, Sep. 9, 2016. Pages 46-50.

Stein, H. H., and J. K. Mathai. 2016. Use of the pig to determine digestible indispensable amino acid scores (DIAAS) in human foods. Proc. 5th Intl. Symp. Energy and Protein. Krakow, Poland, Sep. 12 to 15, 2016.

Rojas, O. J., and H. H. Stein. 2016. Effects of feed processing on the nutritional value of feed ingredients or diets fed to pigs. Proc. Chinese Swine Industry Symposium, Shanghai, Oct. 20-21, 2016. Pages 33-49.

Liu, Y., C. D. Espinosa, J. J. Abelilla, G. A. Casas, L. V. Lagos, S. A. Lee, W. B. Kwon, J. K. Mathai, D. M. D. L. Navarro, N. W. Jaworski, and H. H. Stein. 2016. Non-antibiotic feed additives in diets for pigs. Proc. Chinese Swine Industry Symposium, Shanghai, Oct. 20-21, 2016. Pages 263-281.

Extension Publications

Sugui, P., H. H. Stein, and G. A. Casas. 2016. SPC for piglets: Performance and immunity. Pig Progress, March 2016. http://www.pigprogress.net/Piglets/Articles/2016/3/SPC-for-piglets-Performance-and-immunity-2779770W/

Stein, H. H., J. E. Pettigrew, R. A. Easter, and M. Ellis. 2016. Swine Nutrition Insight: Nutrient Requirements of Commercial Pigs. P. 16-21 in Hog Industry Priorities Report, Feedstuffs. May 9, 2016.

Huang, C., H. H. Stein, and G. A. Casas. 2016. Optimizing soy protein concentrate use in pig diets. Pig Progress, July/August, 2016. Page 32-33.

Book Chapters

Stein, H. H., L. A. Merriman, and J. C. Gonzalez-Vega. 2016. Establishing a digestible calcium requirement for pigs. In (eds. C. L. Walk, I. Kuhn, H. H. Stein, M. T. Kidd, and M. Rodehutscord): Phytate destruction — Consequences for precision animal nutrition. Pages: 207-216.

Gonzalez-Vega, J. C., and H. H. Stein. 2016. Calcium transporters and gene expression and absorption in pigs. In (eds. C. L. Walk, I. Kuhn, H. H. Stein, M. T. Kidd, and M. Rodehutscord): Phytate destruction — Consequences for precision animal nutrition. Pages 217-224.

Podcasts, Video

Download from: http://nutrition.ansci.illinois.edu (also available on YouTube)

21 December 2016 – Dr. Laura A. Merriman: Requirements for digestible calcium by 100 to 130 kg pigs

21 November 2016 – Ms. Gloria A. Casas: Effects of full fat or defatted rice bran and microbial xylanase on growth performance of weanling pigs

11 October 2016 – Ms. Charmaine D. Espinosa: Effect of α-galactosidase on the energy value of SBM and growth performance of weanling pigs

27 September 2016 – Ms. Yue She: Effects of high protein canola meal on digestibility of phosphorus and growth performance in pigs

15 August 2016 – Ms. Trine F. Pedersen: Effects of inclusion of canola meal in weanling pig diets containing different concentrations of energy

25 July 2016 – Dr. Y. Liu: Effects of a novel phytase on growth performance and metacarpal bone ash in weanling pigs

14 July 2016 – Mr. John K. Mathai: Amino acid digestibility in dairy proteins compared with plant proteins

28 June 2016 – Mr. Diego M. D. L. Navarro: Amino acid digestibility in six sources of meat and bone meal fed to growing pigs

17 June 2016 – Ms. Gloria A. Casas: Effects of exogenous xylanase on digestibility of energy and nutrients and concentrations of DE and ME in rice co-products fed to weanling pigs

23 May 2016 – Dr. Laura A. Merriman: Effect of fat sources on ATTD of minerals

9 May 2016 – Dr. Neil W. Jaworski: Effects of fiber, a direct-fed microbial, and feeding duration on digestibility of energy and nutrients by pigs

13 April 2016 - Effect of phytase on ATTD and STTD of Ca in feed ingredients of animal origin fed to growing pigs

29 March 2016 – Dr. J. Caroline González-Vega: Digestible calcium requirements and calcium and phosphorus balance for 25-50 kg pigs

When Colombia plays football – our lab is ready!

Completed Research, 2016

1. **Effects of hydrochloric acid on calculated values for ileal digestibility of amino acids in growing pigs**
   Investigators: Almeida, J. S., Y. Liu, D. M. D. L. Navarro, and H. H. Stein

2. **Effects of calculation procedure on values for the standardized ileal digestibility of amino acids in diets fed to growing pigs.**
   Investigators: Mathai, J. K. and H. H. Stein

3. **Effects of synthetic amino acids on calculated values for the standardized ileal digestibility of amino acids in diets fed to growing pigs.**
   Investigators: Jaworski, N. W., J. K. Mathai, and H. H. Stein

4. **Effects of diet energy level and an exogenous enzyme on growth performance of weanling pigs fed diets containing canola meal produced from high protein or conventional canola seeds**
   Investigators: Pedersen, T. F., Y. Liu, and H. H. Stein.

5. **Requirements for standardized total tract digestible calcium and standardized total tract digestible phosphorus to maximize growth performance and bone mineralization in 25 to 50 kg growing pigs.**
   Investigators: Gonzalez-Vega, J. C., C. Walk, and H. H. Stein.

6. **Effects of sucrose and cornstarch on digestibility of calcium in diets fed to growing pigs.**
   Investigators: Merriman, L. A., C. L. Walk, C. M. Parsons, and H. H. Stein.

7. **Comparative total tract digestibility of energy and nutrients in defatted and full fat rice bran fed to growing pigs, gestating sows, and lactating sows**
   Investigators: Casas, G. A., Y. Liu, and H. H. Stein.

8. **Effects of sodium concentration and microbial phytase on digestibility of calcium in diets fed to growing pigs.**
   Investigators: Merriman, L. A., C. L. Walk, C. M. Parsons, and H. H. Stein.

9. **Correlation between the physicochemical characteristics and energetic value of dietary fiber in feed ingredients fed to pigs**
   Investigators: Navarro, D. M. D. L., J. J. Abelilla, N. W. Jaworski, and H. H. Stein.

10. **Requirements of standardized total tract digestible calcium and standardized total tract digestible phosphorus to maximize growth performance and bone mineralization in 100 to 125 kg finishing pigs.**
    Investigators: Merriman, L. A., C. L. Walk, C. M. Parsons, and H. H. Stein.

11. **Complete chemical composition and physical characteristics of 10 feed ingredients.**
    Investigators: Navarro, D. M. D. L., and H. H. Stein.

12. **Amino acid digestibility in co-products from production of threonine and tryptophan.**
    Investigators: Jaworski, N. W., and H. H. Stein.

13. **Total tract digestibility of dietary fiber sources intended for human consumption.**
    Investigators: Spangler, H., Y. Liu, and H. H. Stein.

14. **Effects of different concentrations, form of feeding, and timing of ingestion of a novel fiber source on stool scores of growing pigs.**
    Investigators: Mathai, J. K., and H. H. Stein.

15. **Disappearance of nutrients and energy in the stomach and small intestine, cecum, and colon of pigs fed corn-soybean meal diets containing distillers dried grains with solubles, wheat middlings, or soybean hulls.**
    Investigators: Jaworski, N. W., and H. H. Stein.

16. **Ileal digestibility of amino acids in untraditional feed ingredients fed to weanling pigs.**
    Investigators: Jaworski, N. W., and H. H. Stein.

17. **Effects of phytase on balance and digestibility of Ca and P and on digesta pH and ash concentration in diets without or with phytate-bound P fed to growing pigs**
    Investigators: Merriman, L. A., C. L. Walk, C. M. Parsons, and H. H. Stein.

18. **Digestibility of Ca in feed ingredients derived from milk.**
    Investigators: She, Y., and H. H. Stein.

19. **Effects of microbial xylanase on growth performance of weanling pigs fed diets containing full fat or defatted rice bran**
    Investigators: Casas, G. A., and H. H. Stein.

20. **Effects of different fermentation processing of soybean meal on the ileal digestibility of AA in diets fed to weanling pigs.**
    Investigators: Lagos, L. V., C. Munoz, and H. H. Stein.
    Publication: NA.

21. **Effects of superdosing of microbial phytase on ileal and total tract digestibility of energy and nutrients by growing pigs.**
    Investigators: She, Y., and H. H. Stein.

22. **Effects of different fermentation processing of soybean meal on the total tract digestibility of energy by weanling pigs.**
    Investigators: Munoz, C., L. V. Lagos, and H. H. Stein.

23. **Effects of direct fed microbials and microbial xylanase on ileal and total tract digestibility of fiber components in diets fed to pigs.**
    Investigators: Spangler, H., G. A. Casas, and H. H. Stein.

24. **Effects of fructo-oligosaccharides on growth performance of weanling pigs.**
    Investigators: Spangler, H., and H. H. Stein.

25. **Effects of acidifiers and plant extracts on growth performance of growing-finishing pigs.**
    Investigators: Spangler, H., and H. H. Stein.

26. **Amino acid digestibility in novel corn proteins fed to growing pigs.**
    Investigators: Spangler, H., and H. H. Stein.

27. **Concentration of DE and ME in novel corn proteins fed to growing pigs.**
    Investigators: Spangler, H., and H. H. Stein.

28. **Concentration of DE and ME in pennycress expellers fed to growing pigs.**
    Investigators: Spangler, H., and H. H. Stein.

29. **Amino acid digestibility in 11 sources of wheat middlings fed to growing pigs.**
    Investigators: Casas, G. A., and H. H. Stein.

30. **Concentration of DE and ME and digestibility of fiber in 11 sources of wheat middlings fed to growing pigs.**
    Investigators: Casas, G. A., and H. H. Stein

31. **Effects of country of origin of soybean meal on ileal digestibility of amino acids by growing pigs.**
    Investigators: Lagos, L. V., and H. H. Stein.

32. **The effects of a DFM alone or in combination with an enzyme on growth performance of nursery pigs**
    Investigators: Spangler, H., G. A. Casas, and H. H. Stein.

33. **Effects of dietary fiber on nitrogen balance of growing pigs**
    Investigators: Mathai, J. K., and H. H. Stein.

34. **Effects of dietary synthetic carbohydrates on feed intake and stool scores of growing pigs.**
    Investigators: Mathai, J. K., and H. H. Stein.

35. **Interactions between Ca and Zn and microbial phytase on growth performance and mineral balance of growing pigs.**
    Investigators: Blavi, L., and H. H. Stein.

36. **Effects of a protease on the ileal digestibility of amino acids in soybean meal fed to growing pigs.**
    Investigators: Kwon, W. B., and H. H. Stein

37. **Effects of a direct fed microbial on the ileal digestibility of AA in soybean meal fed to growing pigs.**
    Investigators: Lee, Su A, and H. H. Stein

38. **Efficacy of a novel phytase product on growth performance, bone ash concentration, and total tract digestibility of Ca and P by growing pigs.**
    Investigators: Blavi, L., and H. H. Stein.

39. **Effects of different sources of copper on growth performance and fecal scores by weanling pigs.**
    Investigators: Espinosa, C. D., and H. H. Stein.

40. **Effects of copper sources on total tract digestibility of acid hydrolyzed ether extract and energy by weanling pigs.**
    Investigators: Espinosa, C. D., and H. H. Stein.

41. **Effects of microbial phytase on growth performance of pigs from 25 to 50 kg fed diets with different concentrations of digestible lysine**
    Investigators: Spangler, H. L., J. K. Mathai, and H. H. Stein

42. **Effects of commercial phytases on growth performance and bone ash of weanling pigs**
    Investigators: Espinosa, C. D., and H. H. Stein

43. **Effects of diet composition on responses to microbial xylanase by weanling pigs**
    Investigators: Lagos, L. V., and H. H. Stein

44. **Effects of diet composition on microbial concentrations in the intestinal tract of pigs**
    Investigators: Casas, G. A., L. V. Lagos, and H. H. Stein.

45. **Effects of valeric acid and an organic acidifier on growth performance and fecal score in weanling pigs**
    Investigators: Lagos, L. V., and H. H. Stein

46. **Amino acid digestibility in a novel source of distillers dried grains with solubles fed to pigs**
    Investigators: Lagos, L. V., and H. H. Stein

47. **Effect of Dakota Gold and a conventional source of DDGS on ileal digestibility of amino acids by pigs**
    Investigators: Rodriguez, D. A., and H. H. Stein

48. **Digestibility of energy and concentrations of digestible and metabolizable energy in a novel source of distillers dried grains with solubles fed to pigs**
    Investigators: Lagos, L. V., and H. H. Stein

49. **Digestibility of energy, fiber, and acid hydrolyzed ether extract in Dakota Gold DDGS and conventional DDGS fed to growing pigs**
    Investigators: Rodriguez, D. A., and H. H. Stein

50. **Effects of a high protein corn-product on growth performance of weanling pigs**
    Investigators: Lee, S. A, and H. H. Stein.

51. **Effect of 2 levels of copper (TBCC) on growth performance of weanling pigs**
    Investigators: Espinosa, C. D., and H. H. Stein

52. **Effects of inclusion of valeric acid or zinc oxide on growth performance and fecal score of weanling pigs**
    Investigators: Casas, G. A., and H. H. Stein.

53. **Effects of increasing inclusion level of valeric acid on growth performance and fecal scores of weanling pigs**
    Investigators: Casas, G. A., L. V. Lagos, and H. H. Stein.

Vanessa exploring campus

Ongoing Research, December 2016

1. **Degradability of dietary fiber along the intestinal tract of pigs fed diets containing different concentrations and different types of dietary fiber**
   Investigators: Abelilla, J. J., Navarro, D. M. D. L., and H. H. Stein
   Expected completion: January, 2017.

2. **Effects of graded levels of defatted or full fat rice bran on growth performance and carcass characteristics of growing-finishing pigs.**
   Investigators: Casas, G. A., and H. H. Stein.
   Expected completion: March, 2017.

3. **Effects of isomer of methionine on N-balance, growth performance, and blood characteristics of weanling pigs.**
   Investigators: Mathai, J. K., Y. Liu, and H. H. Stein.
   Expected completion: June, 2017.

4. **Effects of the fiber fraction of feed ingredients on digestibility of nutrients and energy in mixed diets fed to growing pigs.**
   Investigators: Navarro, D. M. D. L., and H. H. Stein.
   Expected completion: March, 2017.

5. **Effects of different levels of probiotics on growth performance and intestinal health of weanling pigs.**
   Investigators: Casas, G. A., and H. H. Stein.
   Expected completion: June, 2017.

6. **Concentration of digestible and metabolizable energy in different sources of low-fat DDGS fed to growing pigs**
   Investigators: Lee, S. A, and H. H. Stein.
   Expected completion: February, 2017

7. **Requirements of standardized total tract digestible calcium and standardized total tract digestible phosphorus to maximize growth performance and bone mineralization in 50 to 75 kg pigs**
   Investigators: Lagos, L. V., and H. H. Stein**.**
   Expected completion: April, 2017

8. **Effects of heat treatment of soybean meal on ileal digestibility of amino acids**
   Investigators: Kwon, W. B., and H. H. Stein**.**
   Expected completion: March, 2017.

9. **Effects of microbial phytase on growth performance of pigs fed diets containing graded levels of digestible threonine**
   Investigators: Lee, S. A, and H. H. Stein.
   Expected completion: March, 2017.

10. **Effects of heat treatment of full fat soybeans on ileal digestibility of amino acids**
    Investigators: Lee, S. A, and H. H. Stein**.**
    Expected completion: March, 2017.

11. **Effects of superdosing with different commercial microbial phytases on ileal digestibility of amino acids**
    Investigators: Blavi, L., C. J. Munoz, and H. H. Stein**.**
    Expected completion: March, 2017.

12. **Effects of heat treatment of soybean meal on concentrations of digestible and metabolizable energy**
    Investigators: Kwon, W. B., and H. H. Stein**.**
    Expected completion: March, 2017.

13. **Ileal digestibility of amino acids in mixed animal proteins fed to weanling pigs.**
    Investigators: Abelilla, J. J., and H. H. Stein**.**
    Expected completion: March, 2017.

14. **Effects of heat treatment of full fat soybeans on concentrations of digestible and metabolizable energy**
    Investigators: Fanelli, N. S., S. A Lee, and H. H. Stein**.**
    Expected completion: March, 2017.

15. **Concentrations of digestible and metabolizable energy in mixed animal proteins fed to weanling pigs.**
    Investigators: Abelilla, J. J., and H. H. Stein**.**
    Expected completion: March, 2017.

16. **Effects of graded levels of 2 microbial phytases on growth performance and bone ash of weanling pigs**
    Investigators: Blavi, L., C. J. Munoz, and H. H. Stein**.**
    Expected completion: March, 2017.

17. **Digestibility of amino acids in different sources of low-fat DDGS fed to growing pigs**
    Investigators: Espinosa, C. D., and H. H. Stein.
    Expected completion: February, 2017.

18. **Effects of Dakota Gold DDGS and conventional DDGS on wean to finish growth performance and carcass quality of pigs fed diets that are pelleted or provided in a meal form**
    Investigators: Rodriguez, D. A., and H. H. Stein.
    Expected completion: May, 2017.

19. **Effects of a novel combination of yeast and soy molasses on growth performance and blood characteristics of weanling pigs**
    Investigators: Lagos, L. V., and H. H. Stein.
    Expected completion: February, 2017.

20. Digestibility and retention of Ca and P in sows and growing pigs fed diets without and with microbial phytase

Investigators: Lee, S. A, and H. H. Stein**.**

Expected completion: June, 2017.