Project/Activity Number:
NC-2040

Project/Activity Title:
Metabolic relationships in supply of nutrients for lactating cows

Period Covered:
01 October, 2013 – 30 September, 2018

Date of This Report:
09 December, 2018

Annual Meeting Date(s):
1-2 November, 2018

Participants:

P. Piantoni	Cargill Nutrition Inc.
J. McArt	Cornell University
J. McFadden	Cornell University
H. Ramirez	Iowa State University
R. Appuhamy Jayasooriya	Iowa State University
B. Bradford	Kansas State University
L. Mamedova	Kansas State University
M. VandeHaar	Michigan State University
M. Allen	Michigan State University
H. Paz	Mississippi State University
M. Bauer	North Dakota State University
C. Lee	Ohio State University
L. Dias de Moraes	Ohio State University
J. Firkins	Ohio State University
M. Eastridge	Ohio State University
A. Foote	Oklahoma State University
K. Harvatine	Pennsylvania State University
A. Hristov	Pennsylvania State University
S. Donkin	Purdue University
E. Kebreab	UC Davis
H. Rossow	UC Davis
J. Fadel	UC Davis
M. Hess	UC Davis
T. Gressley	University of Delaware
T. Hackmann	University of Florida
A. Laarman	University of Idaho
J. Loor	University of Illinois
K. McLeod	University of Kentucky

B. Crooker	University of Minnesota
L. Caixeta	University of Minnesota
A. Rius	University of Tennessee
S. Arriola Apelo	University of Wisconsin
H. White	University of Wisconsin
M. Hanigan	Virginia Polytechnic Institute

Brief summary of minutes of annual meeting:

1. **Introductions**
2. **USDA Update (Steve Smith)**
   Dr. Sonny Ramaswamy retired. Dr. Scott Angel new director for NIFA. New colleague in Animal Health team.

   Secretary announced moving of USDA offices outside of DC area in 2019. Little details so far; consulting firm has been hired (Ernst & Young). New location announcement 1 January – 31 March.

   Continuing resolution for at least another month. Increased funding by $25m to $400m for AFRI. SARE increased funding.

   AFRI – reduced # RFAs to 3. Education, Foundation & Applied Science.
   DPDB – In final year. May be resurrected, but not in 2019, with likely hiatus
   ECOLOGY – Program funded through 2021. Interagency (NSF, NIH, NIFA); submit to NSF
   COMP GEN – 1 year opportunity.
3. **Discussion – USDA Update**
   Difficulty of discussing future funding without signed budget

   COMPGEN – Genotype-Phenotype. Is there room for nutrition?
   At this point, fairly strict genomics (impression). Unique spin is good.

   Consistency of RFA deadline
   Some streamlining is occurring. 1) Office of Secretary no longer signs off on RFA (removes 2-3 week). 2) Reduce tolerance for timeline failure by writing groups (removes 2-3 weeks). 2019 RFA may be released by end of calendar 2018; will have much longer window for applications.

   Sustainable Ag System insights
   *LOI derailed by extension and education components. Attention to RFA **in full** is important. E.g. "education program for producers" is extension; "education and training for graduate students" is research. Filtering is not about merit of scientific ideas, more about completeness of proposal, fit to the program (25 year goals), adherence to stated requirements. Timeline likely similar to Foundational Program*
4. **Molly Model**
   Molly needs to be migrated from ACSL to something else. Current plan is C++ and R. Currently multiple versions exist in multiple countries.

   Setting up NRC-style panel to adjudicate updates every X years. Julian was proposed, but

very new. Most engineer support is in C++. Needs to be 3-5 years transition. Move to modular mode so only 1 organ at a time can be used. Looking for volunteers.

Set up online portals and interactive point-and-clicks. NRC model may be created first.

Overview of Molly model and how it works. Pools and compartments, current challenges. Inclusion of individual amino acids; data is present, coding is not. Question of fatty acid pools and breaking down by individual fatty acids may have sufficient data, but unsure.

Goal of Molly? Research vs. teaching vs. other? Research tool to help you understand integration, predict diet changes.

Current evaluations of model were discussed extensively. Limitations in data availability, types of data needed; organization integrated data collection.

5. **Station Reports**
   See written reports
6. **Planning 2019 Meeting**
   Secretary – Antonio Faciola
   President – Anne Laarman
   Venue: Change of venue; Holiday Inn Edgewater (old contract w Tim Hackmann, Heather White)
   Date: 21-22 October

   Cost of this meeting is $746.41, works out $39.28 per person. Heather will disburse invoices and acknowledge cash receipts for those paid in cash.
7. **Models**
   JDS editor discussion about what to do with numerous in vitro-only manuscript. Principal reasons to do in vitro:
   - isolation of specific component of in vivo system
   - Overcome cost-prohibitive animal experiments
   - Using tools fatal to animals
   - Screening for in vivo experiments

   Guidelines, checklist, or set of questions to answer?
   What is goal? Publish good data or reject bad data?

   Much discussion and approaches. Jeff highlighted no resistance to publishing in vitro-only articles. Are there universal standards?

   REFLECT standards in vet journals? What is population of inference? Justification and relevance of concentrations

   Will develop article on QC and standards to be published in JDS. Mark, Luis, Agustin, Heather, Anne will contribute.

8. **Station Reports**
   See written reports

Accomplishments:

DE: During this period, we conducted approximately ten experiments evaluating prototype rumen protected methionine, lysine, and histidine products. Experiments were either production trials or bioavailability assessments. Results are being used by industry to refine and market products that can be fed to cows to better meet limiting amino acid requirements and reduce overfeeding of protein. In addition we conducted three experiments to evaluate the impacts of intestinal carbohydrate fermentation on cow performance and inflammatory response. We anticipate that some of the negative effects of sub-acute ruminal acidosis on animal health are due to events in the intestines, and we use an intestinal carbohydrate infusion model to study these effects.

ID: To meet nutrient requirements for lactation, dairy cows must constantly adapt their rumen to changing diets to match nutrient demand with nutrient supply. The transitions between diets and the resulting changes in nutrient transport are one major focus of this work. Another focus is on the development of the rumen and its nutrient transport capacity. At birth, the rumen is non-functional, therefore studying the development of the rumen will offer insights into how rumen transitions are best managed. We saw evidence that the rumen can be primed for diet transitions to help improve feed intake and animal health.

KS: A major theme in the modern science of nutrition is understanding how nutrients can work as nutraceuticals to alter immune function and, in turn, health. It is a goal of both human and animal nutrition to understand and utilize micronutrients that may have outsized impacts on health in this manner. Our work during this project period has contributed to our understanding of feed components including chromium, lysine, methioinine, yeast products, essential fatty acids, and choline influence immune function of dairy cows. We have observed influences on both "arms" of the immune system, which point to potential benefits for animal health.

A second major theme of our work has been to decrease the economic and environmental costs of meeting the dietary fiber requirements of lactating cows. Fiber requirements are generally met by growing dedicated, high-quality forages for lactation diets, but in some cases, land or water constraints can challenge the sustainability of this approach. We have worked to refine utilization of agro-industrial fiber byproducts (e.g., corn distillers' grains and soybean hulls), contributing to an industry-wide increase in byproduct feeding rates. We have also explored use of forages that do not require dedicated land, including wheat straw (crop residue) and winter forages (grown opposite another crop). Our findings have demonstrated that very unconventional diets can support high milk yield and maintain animal health.

KY: Ergot alkaloids in endophyte-infected grasses inhibit prolactin secretion and reduce milk production in lactating cows. However, we previously showed that prepartum consumption of infected seed throughout the dry period did not inhibit subsequent milk production and prior exposure to bromocriptine (ergot peptide) actually increased production in the next lactation. To identify changes in the transcriptome and molecular pathways mediating the mammary gland's response to ergot alkaloids in the diet, RNA sequencing (RNA-seq) was performed on mammary tissues obtained from 22 multiparous Holstein cows exposed to 1

of 3 treatments. Starting at 90 ± 4 d prepartum, cows were fed endophyte-free fescue seed (control; CON),endophyte-free fescue seed plus 3×/wk subcutaneous injections of bromocriptine (BROMO; 0.1 mg/kg of BW), or endophyte-infected fescue seed (INF) as 10% of the diet. Cows were dried off 60 ± 2 d prepartum. Mammary biopsies from 4 (BROMO,INF) or 5 (CON) cows/treatment at each of the 3 phases were obtained: 7 d before dry off during the initial lactation (L1), mid-dry period (D), and 10 d postpartum (L2). Although tissue from the same cow was preferentially used at 3 phases (L1, D, L2),tissue from additional cows were used to as necessary to provide RNA of sufficient quality. Individual samples were used to generate individual RNA-seq libraries. Normalized reads of the RNA-seq data were organized into technical and biological replicates before processing with the RSEM software package. Each lactation phase was processed separately and genes that differed between any of 3 treatments were identified. A large proportion of genes differentially expressed in at least 1treatment (n = 866) were found to be similarly expressed in BROMO and INF treatments, but differentially expressed from CON (n = 575, total for 3 phases). Of genes differentially expressed compared with CON, 104 genes were common to the L1and L2 phases. Consistent with the production findings, networks most affected by treatments in L1 and L2 included lipid metabolism, small molecule biochemistry, and molecular transport, whereas networks related more to developmental and cellular functions and maintenance were evident during D phase. Similar patterns of expression in BROMO and INF during late and early lactation suggest involvement of similar cell signaling pathways or mechanisms of action for BROMO and INF and the importance of prolactin messaging pathways.

MI: In the past year, we continued to analyze and report genomic relationships for feed efficiency and we showed that residual feed intake was repeatable across diets sufficient or marginally deficient in protein. We developed new equations to predict digestibility of nutrients based on diet and animal factors and we also quantified factors that alter feed intake of lactating cows. We reported initial estimates of how feed efficiency could be incorporated into the US national dairy breeding index. We also developed new equations for predicting the energy and protein content of gain in Holstein heifers and the composition of body weight change with body condition changes in Holstein cows. We also report an assessment of methods for detecting changes in BW gain of lactating cows.

NY: Dairy cows remain productive during the energy insufficiency of early lactation by evoking metabolic adaptations sparing available energy and nutrients (e.g., higher metabolic efficiency and induction of insulin resistance). The Cornell team focused its efforts on two hormones produced by adipose tissue and participating in the coordination of these adaptations. First, the Cornell team showed that the periparturient drop in plasma leptin promotes energy sparing mechanisms via its ability to regulate the production of thyroid hormones. Second, the Cornell team studied factors accounting for the reduction of plasma adiponectin around parturition. Adiponectin is an insulin-sensitizing hormone and therefore its falling concentration in transition dairy cows promotes the development of insulin resistance. Overall, we showed that energy balance around parturition regulates plasma adiponectin but do not support regulatory roles for lipid mobilization or for sustained changes in the plasma concentration of leptin, insulin, growth hormone or fatty acids.

OH: Ohio workers have documented for the first time the responses by ruminal protozoa to various compounds used to assess signal transduction in eukaryotic cells. Increasing numbers of Isotrichidae protozoa help to slow the degradation rate of carbohydrates through conversion of sugars and starch to glycogen, which helps limit acid formation and energy spilling (intentional wastage of energy) by bacteria also competing for that carbohydrate. In contrast, the Ophryoscolecidae protozoa integrate motility with phagocytosis to support their ability to synchronize cell growth rate with particulate passage rate. Ophryoscolecids are more numerous and more predatory against ruminal bacteria. Both protozoal types produce the precursors (formate and dihydrogen) for methanogenesis. Current results should be considered by future researchers designing dietary strategies to suppress abundance of ruminal protozoa to improve the efficiency of conversion of dietary protein into milk protein or the amount of methane produced per unit of milk produced. Ohio workers have explained how nitrate can suppress methanogenesis but coincidentally can increase the risk for suppressed feed intake or inhibition of key microbial groups; feeding live yeast culture does not appear to mediate nitrate's risk.

VA: Objective 1. We provided an assessment of feather and blood meal for industry use, and influenced industry perception of the value of those ingredients. We also determined that a common, and popular, in vitro assay of bio-availability dramatically underestimated the value of the feather meal.

In separate work, we have adapted older radioactive isotopic methods of assessing de novo synthesis of volatile fatty acids for use with non-steady state infusions of 13C volatile fatty acids. A model to interpret the data was developed and applied to 1 animal study.

Objective 2. The distribution of absorbed amino acids to the post absorptive tissues is a function of the rate of absorption, the flow of blood through the various tissues, and the affinity of each tissue for blood amino acids. Current ruminant models assume a fixed transfer efficiency from absorbed supplies to each of the productive functions. In the case of milk production, the efficiency has been assumed to be 67%. However, the average across amino acids is less than 67%, varies considerably across amino acids, and is not a fixed value. As such, we need a better understanding of the rate and regulation of amino acid transport by the mammary glands. We devised an improved, in-vitro method for assessment of amino acid bi-directional transport and intracellular metabolic fluxes based on uptake of 13C labelled AA. The data are interpreted using a mathematical model. Unidirectional uptake and release, intracellular transamination and catabolism, and incorporation of 16 amino acids into cellular protein are simultaneously measured in the system. The average errors of determination are approximately 12%. Additionally, we developed a model of post-absorptive distribution of amino acids with representations of gut tissue, liver, mammary, and an aggregated non-splanchnic, non-mammary tissue bed. The model is fairly simple and bridges the gap between absorbed amino acid flux and that made available to the mammary glands or for lean tissue gain.

A method of assessing amino acid transport into mammary cells was adapted from older work and used to assess unidirectional uptake and release, transamination, synthesis, and oxidation.

Assessing the absorption of individual amino acids arising from digestion of each ingredient in the diet is required for ration balancing problems. Current methods for deriving such values are extremely laborious and expensive requiring extensive use of surgically prepared animals. We revised and adapted a previously published method of assessing absorption of individual amino acids by isotope dilution to be applicable to determination of such supplies from individual ingredients contained within mixed diets. The errors of determination are approximately 10% for the essential amino acids, which is considerably better than can be achieved from mixed diets using a regression approach and assessments by disappearance from the small intestine. We completed bioavailability assessments for 9 ingredients commonly used by the industry.

Objective 3. Diet formulation relies on accurate and precise knowledge of the ingredients being fed and the animal responses to the nutrients derived from the diet. Because metabolism is quite complicated, mathematical models of the system are required to interpret new information, integrate knowledge across studies, and provide a basis for development of simpler representations of metabolism for use in field formulation software. The Molly cow model, developed by Baldwin and coworkers as the University of California at Davis, represents an animal level, research model used to integrate information across studies and level of aggregation, and to extend and interpret experimental data. In particular, it has proven useful in identifying areas of knowledge deficit which can then be studied experimentally. We have evaluated the Molly cow model using literature data arising from the study of dairy and beef animals, and found biased predictions of ruminal fermentation, digestion, and absorption. Problems included improper estimates of the degradation of nutrients in the rumen, an inadequate representation of ruminal pH and ammonia concentrations, inadequate representation of ruminal fluid and particle outflow, and bias in predictions of ruminal volatile fatty acid production. Work was undertaken to address the problems. In most cases, the model performed significantly better after the work. However, the representation of ruminal pH remained very poor, indicating that more work is required.

Smaller models representing starch digestion and absorption, phosphorus digestion and absorption, regulation of protein synthesis, and splanchnic blood flow were developed.

We developed:
A model and experimental protocol for determination of absorbed amino acids.
A model and experimental protocol for determination of production and absorption of amino acids and volatile fatty acids.
A revised protocol for assessing amino acid transport and metabolism in vitro.
A model for interpretation of the isotopic data to derive flux measurements.
A model of the postabsorptive distribution of amino acids
The Molly model has been updated.
A model of splanchnic blood flow was developed.
A model of phosphorus digestion and absorption was developed.
A model of starch digestion was developed.
A model of the regulation of protein synthesis was developed.

An existing database of observed animal performance and nutrient flux has been expanded to include more than 1,300 treatment means.

WI: Production of linear and non-linear regression models that predict sub-clinical ketosis (SCK) based on milk spectra analysis. Linear regression models are being implemented by one DHI laboratory already and offer producers a low-cost, low-intensity way to monitor herd-level SCK prevalence.

Identification of mechanisms of regulation of milk protein synthesis for the development of mechanistic requirement models.

Training:
Postdoctoral Fellows: 2
Graduate Students: >20
Undergraduate Students: >40

Impacts:
DE: We characterized bioavailability of rumen protected methionine, lysine and histidine products in development, moving them closer to commercial use. We characterized bioavailability of commercially available methionine and lysine products to increase the opportunity for precision feeding of dairy cattle. We also found that feeding of calcium carbonate and magnesium oxide may help to buffer the intestines, potentially improving health of the intestines.

ID: We developed a model for inducing subacute ruminal acidosis in pre-weaned dairy calves, which will be used in future studies to study the impact of low rumen pH on rumen development.

KS: Bioactive dietary compounds that support immunity promote efficient milk production by preventing disease and the corresponding loss in productivity; utilization of these products has expanded over the course of this project period. Identifying alternative fiber sources compatible with high-producing dairy cows contributes to understanding availability of nutrients and reducing environmental impact. Our work in both areas has been widely recognized in the dairy nutrition community, with popular press articles and dozens of invited presentations on these topics around the country during the life of the project.

NY: Our research shows that the reductions in plasma leptin and adiponectin that occur during the periparturient period drive key metabolic adaptations. Accordingly, both hormones should be regarded as homeorhetic regulators.

OH: We developed a new approach for computing metabolizable protein requirements by lactating dairy cows. We developed a new model for predicting microbial protein synthesis in the rumen. We developed a framework for conducting nonlinear meta-analysis in the dairy science. This framework has the potential to greatly improve the prediction of nutrient supply and requirements for lactating dairy cows.

TN: Graduate students and undergraduate students were involved in these projects and trained in methodology, sample analysis, statistical analysis and presenting their research at ADSA national meeting

We determine the effect of heat stress on nitrogen metabolism in lactating cows. Evidence indicates that increasing MP supply by ~30% does not promote milk and milk protein yield in heat-stressed dairy cows. Insulin may mediate some of the production responses observed on heat stressed cows.

We improved our understanding of the efficacy and the relative effectiveness of rumen-protected amino acids in diets of lactating dairy cows.

VA: A model of the distribution of amino acids within the post-absorptive system was developed and fitted to a large set of literature data. This relatively simple model can be applied within ration balancing systems to better predict the fraction of each absorbed

Methods have been adapted for use with stable isotopes in vivo that can be used to assess absorption of volatile fatty acids and amino acids, and they have been applied to examine amino acid availability from 9 common ingredients used in dairy rations and to assess the impact of ruminal pH on volatile fatty acid production. Application of these methods to additional diets and ingredients will generate more complete knowledge of absorbed nutrients.

The Molly cow model has been updated to more accurately represent recycling of blood urea to the rumen which allowed advancements in the prediction of microbial flow from the rumen and more accurate predictions of fecal and urinary N outputs.

WI: Understanding hepatic and mammary nutrient partitioning is critical to improving nutrient efficiency in the lactating dairy cow. Focus on understanding preferential oxidation and storage of fatty acids in the liver will further our understanding of fatty liver onset and recovery as well as efficiency of energy production in the liver. Furthermore, differences in mammary uptake of energy metabolites (NEFA, BHB, and glucose) during hyperketonemia (aka sub-clinical ketosis) may explain differences in milk components and production in cows with metabolic challenges such as ketosis.

Grants:

CA:

Rossow, H. A. 01/01/2018-01/01/2020 Research: $343,000, Principal Investigator, Effect of Celmanax on prevention of neonatal calf diarrhea and preweaning growth, Scibus

Rossow, H. A. 10/01/2018-12/31/2018 Research: $23,500, Principal Investigator, Effect of substitute feeding a defatted dried distillers product for canola meal on dairy milk production, Novita Nutrition

Rossow, H. A. 07/01/2018-06/30/2019 Teaching and Training: $60,000, Principal Investigator, Feed Industry Fellowship, California Dairy Research Foundation

Rossow, H. A. 0/01/2014-09/30/2015 Research: $20,000, Principal Investigator, Influence of mitochondrial efficiency on feed efficiency: Identification of fatty liver and its impact on mitochondria function of dairy cattle, UC Davis: Vet Med: Center for Food Animal Health (CFAH)

Rossow, H. A. 08/01/2015-03/01/2016 Research: $40,000, Principal Investigator, Effect of Glucose booster on blood glucose and ketone body levels in close-up and fresh cows, Private: Stuhr Enterprises

Rossow, H. A. 07/01/2016-12/30/2016 Research: $27,138, Co-Principal Investigator, Environmental impact of California dairy industry over 50 years, Ermias Kebreab (Principal Investigator), California Dairy Research Foundation

Rossow, H. A. 09/01/2014-11/30/2014 Research: $5,000, Effect of live yeast product on dairy cattle milk production, LeSaffre

Rossow, H. A. 09/01/2014-03/01/2018 Research: $160,000, Co-Principal Investigator, Effect of VistaPreT on milk production responses of dairy cattle, Ian Lean (Principal Investigator), Private-ABVista

Rossow, H. A. 10/01/2015-09/30/2017 Research: $20,000, Principal Investigator, Developing metabolic markers to identify heifer calves that are sustainable in the dairy herd, Center for Food Animal Health (CFAH)

Rossow, H. A.10/01/2015-09/30/2017 Research: $20,000, Co-Investigator, Factors affecting dairy cattle's protective grouping behavior, commonly known as bunching, in response to Stomoxys calcitrans on California dairies, Sharif Aly (Principal Investigator), Center for Food Animal Health (CFAH)

Rossow, H. A. 01/01/2017-09/30/2017 Research: $20,000, Principal Investigator, Impact of nutrient supply on variability in bodyweight and milk production, Center for Food Animal Health (CFAH)

Rossow, H. A. 12/01/2016-11/30/2017 Research: $66,265, Co-Principal Investigator, Demonstrating the resilience and better environmental impact of CA dairy, Ermias Kebreab (Principal Investigator), California Dairy Research Foundation

Rossow, H. A. 06/15/2017-06/01/2018 Research: $28,000, Principal Investigator, Effect of a glucose precursor fed to fresh dairy cows on milk production and ketosis incidence, Innovative Liquids

Rossow, H. A. 07/01/2015-06/30/2016 Teaching and Training: $21,000, Principal Investigator, Feed Industry Internship With a Focus on Dairy Feeding Systems, California Dairy Research Foundation

Rossow, H. A. 07/01/2016-06/30/2017 Teaching and Training: $60,000, Principal Investigator, Feed Industry Fellowship with a Focus on Dairy feeding Systems, California Dairy Research Foundation

Rossow, H. A. 07/01/2017-06/30/2018 Teaching and Training: $60,000, Principal Investigator, Feed Industry Fellowship with a Focus on Dairy Feeding Systems, California Dairy Research Foundation

Rossow, H. A. 03/20/2011-05/30/2011 Research: $20,000, Principal Investigator, Effect of probiotics on milk yield in lactating dairy cows, Donaghy's New Zealand

Rossow, H. A. 06/01/2013-05/30/2014 Research: $110,000, Principal Investigator, Influence of antioxidants on mitochondrial efficiency of lactating dairy cows, Alltech

Rossow, H. A. 01/15/2015-08/31/2015 Research: $32,000, Principal Investigator, Effect of Biomin® Digesterom added to milk replacer on weight gain and body condition in calves, Biomin, Inc

Kebreab E. 2018-2022. $8,700,000. Equip: Strengthening smallholder livestock systems for the future, Gates Foundation/USAID

Kebreab E. and Rossow, H. A. 2017-2018 $50,000 Feed Formulation Variability and Environmental Impact Analysis, California Dairy Research Foundation

Kebreab E. 2017. $100,000. Characterize California-specific Cattle Feed Rations and Improve Modeling of Enteric Fermentation for California's GHG Inventory, California Air Resources Board.

Kebreab E. 2015-2016 $188,000. Effect of B-mannanase Enzyme on Feed Efficiency, Milk Production and Health of Dairy Cattle, CTC Bio, Seoul, Korea

Kebreab E. 2014-2016 $250,000. Enhancing environmental sustainability of dairying in the US., USDA

Kebreab E. 2017-2018. $100,000. Impact of Red Macroalgae (Asparagopsis taxiformis) Supplementation on Methane Emissions in vitro, Elm Innovations

Kebreab E. 2017. $60,000. Impact of Mootral Supplementation on Methane Emissions in Beef, Zaluvida

Kebreab E. 2013. $1,100,000. Bovine innovative GHG emission reduction strategies in U.S., USDA.

Kebreab, E. 2013-2014. $42,000. Nitrogen cycling in ruminant livestock systems: a modeling approach, Ajinomoto Heartland.

Kebreab, E. 2013-2015. $70,000. Ration formulation software for sustainable beef and dairy production in Vietnam, USDA

Kebreab E. 2013. $34,500. Agricultural greenhouse gas mitigation opportunities for California, Packard Foundation.

DE:

Gressley, T. F. Balchem Animal Nutrition & Health. 2018-2020. Estimating bioavailability of a rumen protected lysine prototype and quantifying fecal choline output and changes in plasma choline metabolites in response to feeding rumen protected choline.

Gressley, T. F.. Kemin Animal Nutrition and Health. 2018-2020. Estimating the bioavailability of a rumen protected methionine prototype.

Gressley, T. F. Balchem Animal Nutrition & Health. 2017-2019. Assessment of bioavailability of a rumen protected lysine prototype fed to lactating dairy cows.

Gressley, T. F. Balchem Animal Nutrition & Health. 2017-2019. Evaluation of rumen protected lysine and methionine prototypes in lactating dairy cows.

Gressley, T. F. Chr Hansen, Inc. 2016-2018. Evaluating the impact of Bovamine on performance, nutrient digestibility, and digestive function in lactating dairy cows.

Gressley, T. F. Balchem Animal Nutrition & Health. 2017-2019. Characterization of urea release rates from slow release urea products

Gressley, T. F.. Kemin Animal Nutrition and Health. 2016-2018. Estimating the bioavailability of rumen-protected amino acid products.

Gressley, T. F.. Kemin Animal Nutrition and Health. 2016-2018. Evaluating the availability of a rumen protected histidine prototype.

Dyer, R. M., T. F. Gressley, R. Arsenault, and E. Brannick. CANR 2015 Research Seed Grant. 2016-2018. Crosslinkage between gut fermentation, adiposity and immune response activates mesenteric adipose depot inflammation in cows.

Kung, L., Jr., and T. F. Gressley. Kemin Animal Nutrition and Health. 2016-2018. Evaluating the impact of USA Lysine on performance of lactating dairy cows

Gressley, T. F., and L. Kung, Jr. Kemin Animal Nutrition and Health. 2016-2018. Evaluating the availability of rumen-protected amino acid products.

Gressley, T. F. Balchem Animal Nutrition & Health. 2015-2017. Impact of different formulations of rumen protected methionine and lysine on dairy cow performance, milk composition, and milk casein

Gressley, T. F. Balchem Animal Nutrition & Health. 2015-2016. Comparison of three levels of AminoShure M to Smartamine M on performance of lactating dairy cows

Gressley, T. F., and Kung, L., Jr. Balchem Animal Nutrition & Health. 2014-2015. Effect of AminoShure M and Smartamine M on Performance of Lactating Dairy Cows

Gressley, T. F. Balchem Animal Nutrition & Health. 2014-2015. Comparing the availability of methionine from three protected products

Gressley, T. F. and L. Kung, Jr. Arkion Life Sciences LLC. 2014-2015. Effect of PL-100 on milk production, milk composition, and production efficiency of lactating cows

Kung, L., Jr. and T. F. Gressley. Church & Dwight Co., Inc.; Arm & Hammer Animal Nutrition. 2013-2014. A comparison between two sources of metabolizable protein on milk production, composition, and efficiency of lactating cows

Gressley, T. F. Ab Vista, Inc. 2013-2014. A comparison of three rumen buffers and sodium bicarbonate on milk production, rumen pH, and rumen volatile fatty acids in ruminally cannulated Holstein cows

FL:

Tackling the low efficiency of protein production by rumen microbes: a cellular and whole-animal approach. Hackmann TJ (PI), Faciola A, DiLorenzo N. USDA-NIFA Foundational Program 2017-05861. ($500,000)

Using fluorescent compounds to unveil substrates used by uncultured gut bacteria. Hackmann TJ (PI), Nelson CD, Driver J. USDA-NIFA Foundational Program Exploratory Grant 2016-08336. ($99,961)

Improving efficiency of microbial growth in order to reduce protein feed costs for cows. Hackmann TJ (PI). Southeast Milk, Inc. F002995, Milk Check-off. ($18,801)

ID:

Impact of ProTernative on inflammation and productivity during lactation transition. Lallemand Inc.

Impact of maternal fecal, colostral, and milk microbiome on development of calf microbiome. Lallemand Inc.

Effect of supplemental butyrate on inflammation and gut health in finishing beef cattle. Idaho Beef Council.

KS:

Bradford, B. J., M. Garcia, J. Daniel, and B. Whitlock. Is orosomucoid a mechanistic link between inflammation and impaired intake during the transition period? USDA-NIFA Agriculture and Food Research Initiative. $483,500; 5/15/17 – 5/14/20.

Vipham, J. L., D. L. Pendell, B. J. Bradford, T. O'Quinn, D. Min, Z. P. Stewart, A. Tolera, B. Sinote, S. Yigrem, K. Abegaz, Y. Mummed, and A. Mekasha. Linking cattle nutrition to human nutrition: A value chain approach to improving the production, handling, and consumption of animal source foods in Ethiopia. USAID Feed the Future Innovation Lab for Livestock Systems. $1,040,000; 10/1/16 – 9/30/20.

Bradford, B. J., L. Mendonça, L. Hulbert, and J. McGill. Evaluating impacts of OmniGen-AF on immune/reproductive interactions during the transition to lactation. Phibro Animal Health. $178,978; 7/1/17 – 6/30/19.

Bradford, B. J., and J. McGill. In vitro screening system for immune -modulating feed components. Cargill Animal Nutrition. $114,000; 6/15/17 – 6/14/18.

NY:

MicroRNA regulation of core adipose tissue function through the pregnancy-lactation cycle of dairy cows (PI, Boisclair; USDA-NIFA, $486,000; 05/17-04/20).

Regulation and role of the insulin-sensitizing hormone adiponectin in transition dairy cows (PI, Boisclair; USDA-NIFA, $500,00; 01/14-12/17).

McFadden, J. W. (PI) and N. J. Haughey (Co-PI): USDA NIFA AFRI. Characterizing the relationship between ceramide and insulin resistance in overweight dairy cows transitioning from gestation to lactation.

McFadden, J.W. (PI): Hatch. Methyl donor supplementation to mitigate fatty liver disease in dairy cattle.

McFadden, J. W. (PI): Vetagro. Developing a new approach to prevent leaky gut and heat stressed dairy cows.

McFadden, J. W. (PI): Vetagro. Methyl donor and fatty acid strategies to prevent fatty liver.

McFadden, J. W. (PI): Balchem. Optimizing methyl donor supplementation to mitigate fatty liver disease.

McFadden, J. W. (PI): Berg + Schmidt. Dietary emulsifiers and fatty acid digestibility in lactating cows.

McFadden, J. W. (admin PI): Foundation for Food and Agriculture – Vetagro. Developing nutritional therapies to mitigate heat and metabolic stress in lactating dairy cows.

McFadden, J. W. (admin PI): NSF. Identification of conserved metabolic adaptations to nutrient deprivation in wild and domestic ruminant herbivores using mass spectrometry-based metabolomics.

McFadden, J. W. (admin PI): USDA Northeast Sustainable Agriculture Research and Education. Nutritional therapy to prevent leaky gut in dairy cattle experiencing endotoxemia.

OH:

Nat. Inst. Food and Agr. AFRI Competitive Grant. 2012-1015. $495,658. Co-Principal Invesigator. Interactions of ruminal protozoa with cellulolytic bacteria, methanogens, and hyperammonia-producing bacteria: impact on methane emission and ammonia excretion

Alltech, Inc. 2013.$115,290.Principle Investigator. Efficacy of YeaSacc TS for Lactating Dairy Cattle.

Alltech, Inc. 2013-2014. $152,966. Principle Investigator. Role of Yea-Sacc in Nitrate Metabolism.

Alltech, Inc. 2014-2015. $75,000. Principle Investigator. Measurement of Methane Production using GreenFeed as Influenced by Standard Diets Without and With Nitrate and Without and With Yea-Sacc.

Zinpro, Inc. 2016-2019. $352,800. Principle Investigator. Assessing dietary conditions influencing the requirements by rumen bacteria for branched chain volatile fatty acids.

Zinpro, Inc and OARDC. 2016-2017. $100,000. Co-principal investigator. Improving feed utilization efficiency and decreasing risk for milk fat depression by optimizing ruminal biohydrogenation with supplemental branched chain volatile fatty acids and a methionine analog in dairy cows.

PA:

Effect of Grocery Waste on Intake and Milk Production in Dairy Cows. 2018-2019. Organix Recycling. P.I. K.J. Harvatine

Determination of by-pass fat values for high shear dry extruded soy meals in dairy cattle and ruminants. 2018-2019. Instapro International. P.I. K.J. Harvatine

TN:

Hill N. (Lead-PI), R. Nave (Lead-PI), M. Levi, R. Noland, A.G. Ríus, S. Jagadamma, K. Thompson, and C. Agee. USDA-NRCS. Program: Conservation Innovation Grants. Proposal. Value = $641,749. (Non-Federal match = $1,283,498) (awarded in 2018). Title: Deploying the living mulch crop production system to build soil health.

Rius A.G. (Lead-PI), G. Pighetti, and I.R. Ipharraguerre. BioZyme Inc. (awarded in 2018). Cayuse# A18-1105-001/A18-1105-003 Title: Effect of a prebiotic additive on heat-stressed lactating dairy cows.

Rius A.G. (Lead-PI).Balchem Corporation (Phase 2). (awarded in 2017). Cayuse# A17-0797-003. Title: Impact of different formulations of rumen protected methionine and lysine on dairy cow performance, milk composition, and milk protein.

Pighetti G. (Lead-PI), P. Krawczel, A.G. Rius, D. Battler, G. Bates, K. Burdine, J. Bewley, and R. Smith.USDA-NIFA. Area: Agriculture and Food Research Initiative. Program: Organic Agriculture Research & Extension Initiative. Value = $1,807,044 (awarded in 2015). Cayuse# A16-0340-002. Awardee # NIFA-OREI 2015-5130024140.Title: Develop science-based recommendations to efficiently manage forages, herd health, and productivity on organic dairies in the Southeastern US.

Krawczel P. (Lead-PI), G. Pighetti, A.G. Rius, H. Dann, H. Kattesh, and L. Edwards. USDA-NIFA. Area: Agriculture and Food Research Initiative. Program: Animal Health and Production and Animal Products: Animal Well-Being. Value = $499,827 (awarded in 2015). Cayuse# A16-0741-001. Title: Evaluating the interaction of stocking density and management environment on the behavior, physiology, and rumen health of lactating dairy cows.

VT:

A survey of Virginia dairy nutritionists' practices and attitudes toward formulating low protein rations across a variety of production situations. J. Prestegaard and M. D. Hanigan. 2018. Virginia Agricultural Council. $6,580.

Linking the microbial transcriptome, substrate supply, and epithelial function to ruminal fermentation efficiency. R.R. White, M. D. Hanigan, K. M. Daniels. 2017. USDA-AFRI. $499,617

Testing a novel strategy for evaluating the energy content of feed. M. M. Li, M. D. Hanigan, and R. R. White. 2017. Virginia Agricultural Council. $9,959.

Assessing intestinal absorption of amino acids from individual feed ingredients and microbes. M. D. Hanigan. 2017. Balchem Corp. $221,524.

A field application model for lactation responses to amino acids. M. D. Hanigan, R. R. White, and G. Ferreira. 2016. USDA AFRI. $480,000.

Assessing intestinal absorption of amino acids. M. D. Hanigan, R. R. White, and K. Estes. 2016. Perdue Agricultural Solutions. $4,920.

Assessing intestinal absorption of amino acids. M. D. Hanigan, R. R. White, A. Myers, and K. Estes. 2016. Balchem Corp. $51,361.

Toward improved feed efficiency: understanding factors regulating energy production in dairy cattle. M. D. Hanigan, R. R. White, and L. Harthan. 2016-2017. Virginia Agricultural Council. $9,994

Modeling amino acid metabolism in dairy cattle. M. D. Hanigan. 2015-2018. Perdue Agricultural Solutions. $131,343.

Assessing intestinal absorption of amino acids from various feedstuffs. K. Estes and M. D. Hanigan. 2015-2018. AFIA iFeeder. $74,721.

Identification of biological targets at the tissue level that could be manipulated to achieve improved feed efficiency. M. D. Hanigan, R. R. White, and R. Cockrum. 2015-2017. Virginia Tech Pratt Endowment. $77,650.

Assessing intestinal absorption of amino acids. K. Estes and M. D. Hanigan. 2015-2016. Poultry Protein and Fat Research Council. $25,372.

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Baldin, M., G.I. Zanton, and K.J. Harvatine. 2018. Effect of HMTBa on risk of biohydrogenation-induced milk fat depression. J. Dairy Sci. 101:376-385.

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