

that successful conceptus development and implantation entail multiple, distinct, temporally-regulated ECM-integrin interactions. Evidence suggests conservation of adhesion mechanisms among species, and that the non-invasive placentation strategies of livestock provide useful comparative models to study fundamental mechanisms of early stages of implantation in humans. (Supported in part by USDA-NRICGP 98-35203-6223, 2000-02290, and NIH 1-F32-HD08501-01A1)

Key Words: Conceptus development, Implantation, Growth factors

582 Nutritional, metabolic and endocrine status of neonatal calves. J. Blum*, *University of Berne, Switzerland.*

Neonatal calves are characterized by high morbidity and mortality rates, in part due to insufficient organ development (as of the gastrointestinal

tract, GIT) and functioning of controlling systems. Time-point and amounts of ingested colostrum influence GTI development and function, and nutritional, immune, metabolic and endocrine status. Optimal amounts of ingested colostrum are not well defined, but ad libitum availability is expectedly best, such as when calves suckle their dam. Colostrum contains high amounts of nutritional and non-nutritional (bioactive) components. For several of the ingested colostrum hormones and growth factors (insulin; insulin-like growth factors, IGFs) the GIT contains specific receptors that are affected by nutrition and exhibit ontogenetic changes. Supplementation of non-nutritional colostrum extracts (with high amounts of IGFs, insulin, lactoferrin and other growth factors), but not IGF-I alone, can slightly stimulate small intestinal development. The sum of all colostrum components exerts optimal effects, but some factors are special importance.

Ruminant Nutrition

New Concepts and Developments in Forage and Feedstuff Analysis and Applications to Ruminant Nutrition

583 Characterizing carbohydrates in feeds? M. B. Hall*¹, ¹*Dept. of Animal Sciences, University of Florida.*

Feed carbohydrates include both fiber and nonfiber carbohydrates that vary in their chemical, physical, and nutritional characteristics. Defining systems to measure the chemical and physical attributes of feeds so that these can be correlated to their nutritional value to the animal and applicable to diet formulation has been a continuing challenge. The non-neutral detergent fiber carbohydrates (NFC) have been estimated by difference as a single fraction. However, NFC are diverse both in composition and in nutritional characteristics. Use of NFC methods that define carbohydrate fractions to reflect differences in digestibility by gut microbes or the cow, and type and yield of products from their digestion have shown some promise for on-farm application. Definitive techniques to measure physical form and rate of fermentation remain elusive as they attempt to describe complex interactions among the animal, its diet, and diet components. Evaluation of physical form, particularly of neutral detergent fiber (NDF), as an indicator of potential to stimulate rumination and good rumen function is essential for formulation of ruminant diets. It has been largely based upon particle size, but would ideally need to include some measure of digestibility for an index of potential retention time in the rumen. Available estimates of fermentation rate and potential digestibility have promise for use in prediction of metabolizable nutrient supply to the animal and animal performance. However, variation in the executions of both *in vitro* and *in situ* techniques, coupled with individual animal variation and diet effects as they affect the results of these methods, may make these values more useful for ranking feeds and diet modification based on relative differences, rather than providing absolute values for use in diet formulation. Current methods hold promise. Improvements in methods coupled with integrated guidelines and systems for diet formulation need to be developed to make better use of values meant to define the nutritional value of feeds under a broad range of conditions. It may also be useful to establish assays that have utility across animal species in order to make research data more useful.

Key Words: Carbohydrates, Methods, Diet Formulation

584 Characterization of proteins in feeds. C.G. Schwab*¹, T.P. Tylutki², C. Sheaffer³, and M.D. Stern³, ¹*University of New Hampshire, Durham, NH,* ²*Cornell University, Ithaca, NY,* ³*University of Minnesota, St. Paul, MN.*

Much effort has been devoted to the development of methods (feed analysis and computer models) to better characterize the nutritive value of crude protein in feedstuffs. This paper will review the approaches that have been (and are being) evaluated to estimate rumen-degradable feed protein (RDP), rumen-undegradable protein (RUP), RUP digestibility, and the amino acid composition of digestible RUP (dRUP). *In situ*-derived protein fractions have been adopted for use in estimating RDP, RUP, and dRUP in the most recent Dairy NRC model (NRC, 2001). *In vitro*, chemically-determined protein fractions were used in the Cornell Net Carbohydrate and Protein System and subsequently adopted for use in the Level 2 of the Beef NRC model (NRC, 1996) and in the Cornell-Penn-Miner (CPM) model (version 1). It is suggested that research should continue to add to the data sets from which these models have been developed. The variability in content of each N fraction within a

class of feedstuffs will be reviewed to help prioritize the need for analysis vs. the appropriateness of using model-default values. The results of sensitivity analysis will also be reported for the two models. This information indicates the importance of each of the required components in the models for estimating RDP and dRUP. The aforementioned methods, along with *in vitro* incubation and near-infrared reflectance spectroscopy (NIRS) methods, will be discussed. Their strengths and weaknesses, their current level of development, and their suitability for commercial application and model-refinements, will be highlighted.

Key Words: Ruminants, Feed Analysis, Protein

585 The end products of silage fermentation and their relationships to forage management. Limin Kung, Jr.*¹ and Richard E. Muck², ¹*The University of Delaware,* ²*The US Dairy Forage Research Center, USDA, ARS.*

The analysis of silages for fermentation end products includes the determination of pH, organic acids (lactic, acetic, propionic, and butyric acids), ethanol, buffering capacity, titratable acidity, and ammonia-N. These fermentation end products are often directly related to various management practices during harvest and storage because fermentation can be dictated by factors that include moisture content, the concentration of fermentable substrates, the amount and rate of elimination of oxygen from the forage mass, and the number and type of microorganisms contributing to the process. For example, alfalfa tends to be the most difficult crop to ensile because of its high buffering capacity. Thus, when harvested at a high moisture content (< 30% DM) the fermentation of alfalfa silage is often dominated by clostridia, which results in large losses of DM, excessive protein and amino acid degradation (thus high ammonia-N), and high concentrations of butyric acid. In high DM (> 45% DM) alfalfa, clostridia are seldom found even though alfalfa undergoes a restricted fermentation because of a lack of moisture for optimum bacterial growth. Forages with very high buffering capacities (e.g. because of high protein or mineral content) often have fermentations that are prolonged and characterized by high concentrations of acetic acid due to enterobacteria or lactic acid bacteria. Slow and poorly packed silages have high amounts of air, which can result in utilization of fermentable substrates by aerobic microbes. Such silages are often characterized by excessive protein degradation and are high in yeasts that contribute to the production of ethanol, large losses of DM, and aerobic instability. In extreme cases, lack of fermentable sugars can also lead to a clostridial fermentation. The end products of silage fermentation cannot be used to balance rations, but they can provide helpful indices of silage quality and they can be used as an educational tool to help producers identify areas for improvement in their harvest and storage practices.

Key Words: Silage analyses, Silage fermentation, Lactic acid

586 Use of new concepts in ration formulation and feeding for high producing cows. R.G. Hinders*, *Hinders Nutrition Consulting, Acampo, CA, USA.*

The new NRC Nutrient Requirements of Dairy Cattle, 2001, and the CPM Dairy models offer excellent tools for formulating rations. They

are dependent on accurate nutrient evaluation of feedstuffs. The extent that different analyses of 4 forages affect predicted milk production was examined. Split samples of low fiber alfalfa hay (LFA), high fiber alfalfa hay (HFA), corn silage (CS), and almond hulls (AH) were sent to two commercial and three research labs for analyses required for the NRC and CPM models. The CP, NDF, lignin, and NSC of both alfalfa samples showed little variation among labs. The percent SP (% of CP) varied from 40 to 6% for HFA and from 40 to 19% for LFA. CP for corn silage was similar from all labs. NDF from CS varied from 53% to 46%; lignin varied from 6 to 3%; NFC varied from 34 to 27%, and SP varied from 70 to 30%. CP, NDF and NFC values from AH were similar from all labs. SP for AH varied from 11 to 5% and lignin varied from 5 to 11%. The CPM model predicted a decrease on ME allowable milk per cow per day of 1.4 lb when NDF of CS increased from 45 to 50%, and lignin increased from 3 to 5%. The NRC model predicted a decrease

of only 0.1 lb milk allowable from NEL from the same change, but an increase of 2.2 lb milk allowable from MP (due to an increase in NFC). The CPM model predicted an increase of 1.4 lb milk allowable from ME when SP of LFA was increased from 20 to 42%, and a decrease of 4.9 lb milk allowable from MP. The ration used for this evaluation contained 10.4% CS, 6.8 alfalfa silage, 21% LFA and 4% AH on a DM basis. The CPM model showed a possible increase of 7 lb ME allowable milk daily and 4.3 lb MP allowable milk by optimizing the original ration which supported 110 lb milk per day. Total milk production, % milk fat and protein, milk fat/protein ratios and MUN can be used by the nutritionist to evaluate the accuracy of model predictions based on feed analyses used.

Key Words: Dairy Ration Formulation, Nutrient Analyses, Evaluating Rations

Breeding and Genetics Applied Animal Breeding

587 Organ weights and internal fat of Angus or Romosinuano steers finished in the feedlot or with grain-on-pasture. S. W. Coleman^{*1}, W. A. Phillips², C. C. Chase, Jr.¹, D. G. Riley¹, B. Morgan³, J. Nelson³, and T. A. Olson⁴, ¹USDA, ARS Sub-Tropical Agricultural Research Station, Brooksville, FL, ²USDA, ARS Grazinglands Research Laboratory, El Reno, OK, ³Oklahoma State University, Stillwater, OK, ⁴University of Florida, Gainesville, FL.

Tropical adaptation is a desired trait for cows located in the sub-tropical regions of the U.S.A., including the Gulf Coast and most of the Southeast. Zebu breeds have traditionally been used for this area, but have some limitations such as reproduction and carcass quality. Criollo cattle from South America, such as the Romosinuano, have been reported to have good reproduction under tropical and sub-tropical conditions. A herd of Romosinuano was established at USDA, ARS, STARS in Brooksville, FL for evaluation. The objective of this study was to characterize organ weights and fat depots in Romosinuano steers as compared to Angus. Following weaning and preconditioning, 12 Romosinuano and 12 Angus steers from contemporary STARS herds were shipped to El Reno, OK (2,025 km) and grown for 224 d (November to June). The steers were then finished under two regimens; either 1) conventional total confinement feedlot or 2) by grazing old world bluestem pastures at a stocking rate of 10 hd/ha with ad libitum access to a finishing diet. Romosinuano steers produced heavier ($P < 0.05$) empty body weight than Angus (467 vs 418 kg) when finished with grain on pasture, but breed types were similar when finished in the feedlot (437 kg). When adjusted to a constant empty body weight, there were no differences ($P > 0.10$) due to breed or finishing treatment for weight of heart or kidney. Romosinuano steers had heavier ($P < 0.05$) hide (37 vs 33 kg), spleen (1.2 vs 0.8 kg), and internal fat (23 vs 18 kg) than Angus, but lighter liver (6.8 vs 7.3 kg, $P = 0.06$), and empty rumen tissue (19.3 vs 21.9 kg, $P < 0.05$). Steers finished in the feedlot had more ($P < 0.05$) internal fat (22 vs 18 kg), and lighter ($P < 0.05$) head (15.1 vs 16.1 kg) and lung (6.4 vs 7.1 kg) weights than those finished on pasture. An interaction ($P < 0.05$) was observed for weight of empty GI tract (minus rumen) weight. These data may explain the observation that Romosinuano cattle appear to carry less finish than conventional breeds and may have implications on how tropically adapted cattle adjust to feast or famine conditions of the wet-dry tropics by storing and mobilizing internal fat.

Key Words: Romosinuano cattle, Organ weights, Internal fat depots

588 Winter and spring performance of steer calves reared in temperate or sub-tropic environments and used as stockers on winter wheat pasture in Oklahoma. W. A. Phillips^{*1}, E. E. Grings², S. W. Coleman³, R. E. Short², D. G. Riley³, C. C. Chase³, H. S. Mayeux¹, and R. K. Heitschmidt², ¹USDA-ARS Grazinglands Research Laboratory, El Reno, OK, ²USDA-ARS Fort Keogh Livestock and Range Research Laboratory, Miles City, MT, ³USDA-ARS Subtropical Agricultural Research Station, Brooksville, FL.

Each fall millions of beef calves are imported into the Southern Great Plains region of the U.S. to graze winter wheat pastures before entering a feedlot for finishing. Rather than owning the calves, winter wheat pasture producers may decide to act as subcontractors, who are paid

according to the gain accumulated by each calf. The objective of this experiment was to compare the weight gains of steers from temperate and sub-humid environments as stockers for grazing winter wheat pastures. On October 23, 2000, Angus (N=34) and Romosinuano (N=36) steers born and reared at Brooksville, FL were transported 2,025 km to El Reno, OK. On November 14, 2000, crossbred steers of temperate breeds born in February (N=24), April (N=11) or June (N=18) and reared at Miles City, MT were transported 1,710 km to El Reno, OK. All calves had been weaned for at least 21 d prior to shipment. Individual BW was taken at arrival and used as the initial BW. Because winter wheat pasture was limited due to drought conditions, all steers were combined into a single group, placed on a 28-ha dormant warm season grass pasture, and given ad libitum access to a mixed diet formulated to support an ADG of 0.8 kg for the winter period (October or November to April). In April, steers were moved to winter wheat pasture for a 63-d spring grazing period. Angus steers were 26 kg heavier (433 vs 407 kg; $P = 0.11$) upon arrival and gained more weight ($P < 0.01$) during the winter (297.5 vs 221.6 kg) than Romosinuano steers. During the spring when temperatures were warmer, Romosinuano steers gained more weight ($P < 0.01$) than Angus steers (36.9 vs 26.0 kg). Crossbred calves born in February were heavier ($P < 0.01$) than calves born in April or June (244 > 197 and 175 kg) and gained more ($P < 0.02$) weight during the winter than calves born in June (139 vs 123 kg). Overall gain (winter + spring) was similar among the three age groups (151 kg). In general, calves from temperate breeds performed better as winter stocker calves than calves from a tropically adapted breed.

Key Words: Tropical breed, Stocker calves, Winter wheat

589 Scrotal circumference in yearling bulls may be related to number of facial hair whorls within a breeding program. M Meola^{*}, T Grandin, P Burns, and M Enns, Colorado State University, Fort Collins, Colorado, USA.

The objective of this study was to determine the relationship between number of facial hair whorls and scrotal circumference in yearling bulls. Scrotal circumference measurements were taken on 129 yearling bulls (mean = 371 ± 1.7 d of age) from the Eastern Colorado Research Center (ECRC) Bull Test Station in Akron, CO and 63 Angus yearling bulls (mean = 350 ± 1.3 d of age) from the John E. Rouse CSU Beef Improvement Center (BIC) in Saratoga, WY. The breeding program at BIC focuses on purebred Black Angus cattle with specific selection criteria for fertility, calving ease and pulmonary artery pressure, while the population of bulls at ECRC comes from various breeds and breeding programs. Scrotal circumference was measured to the nearest 0.5 cm using a scrotal tape and the number of facial hair whorls (0, 1 or 2) was recorded. At ECRC, there was no relationship between breed category (British vs Continental) and number of hair whorls ($P = 0.38$). No relationship was found between scrotal circumference and number of hair whorls ($P = 0.40$) or breed category ($P = 0.39$). Bulls from ECRC with two facial hair whorls had a mean scrotal circumference of 36.3 cm, compared to bulls with one whorl (35.9 cm; $P = 0.25$), and no facial whorls (35.9 cm; $P = 0.69$). However, bulls from BIC with two facial hair whorls had smaller scrotal circumference measurements (33.8 cm) than bulls with one facial hair whorl (35.5 cm) or bulls with no facial hair whorls (36.1 cm; $P = 0.03$). There was no relationship