578 Tannins for suppression of internal parasites. B.R. Min* and S.P. Hart, *E (Kika) dela Garza Institute for Goat Research, Langston University, OK, 73050, USA.*

Condensed tannins (CT) have biological effects that may aid in the control of dewormer-resistant internal parasites (IP). It is increasingly evident that control programs based on dewormers are failing to control IP as dewormer resistance has become more prevalent. Thus, alternative IP control strategies are necessary. The CT in forages have potential to be a component of IP control programs. The CT bind proteins and other molecules tightly at near neutral pH, such as occurs in the rumen, with dissociation in the acidic pH of the abomasum, freeing them for digestion. Effects of CT on parasitism can be assessed by grazing ruminants on forages that contain different levels of CT but otherwise are of similar nutritive value. Plant CT may have direct or indirect effects on IP. Direct effects might be mediated through CT-nematode interactions affecting physiological functioning of IP. Recently, *in vitro* and *in vivo* studies have shown that CT in several temperate and tropical forages (*Hedysarum coronarium, Onobrychis viciifolia, Lotus pedunculatus, L. corniculatus, Lespedeza cuneata*, and Quebracho CT) can inhibit infective gut worm larvae of sheep and goats and both gut and lung worms in farmed deer, with effects influenced by both concentration and structure of CT. Furthermore, preliminary research showed a 57% reduction in fecal egg counts (2,722 *vs* 1,162 eggs/g) and a 74% reduction in total fecal egg output (173 *vs* 45 x 10^4 eggs/d) in goats consuming forage Sericea lespedeza (4.6% extractable CT/kg DM) compared with rye/crabgrass. Indirectly, CT can improve protein nutrition by binding to plant proteins in the rumen and preventing microbial degradation, thereby increasing amino acid flow to the duodenum. Several ovine studies have shown that improved protein nutrition reduces parasite infestation. This is assumed to be mediated by enhanced host immunity, which may be especially important with selection for immunity to IP. In conclusion, CT in forages may have potential to aid in the control of IP.

Key Words: Condensed tannins, Internal parasites

579 Pasture and animal management for control of gastrointestinal nematodes. Daniel Miller*[1] and T. M. Craig[2], [1]*E (Kika) de la Garza Institute for Goat Research, Langston Univ. OK,* [2]*Texas A & M University.*

Parasitism is a numbers game, a few parasites may stimulate a level of resistance to greater numbers. However, an excessive number of parasites will cause disease. Weather conditions determine how successfully parasites are transmitted. Sufficient moisture for the movement of infective larvae from the fecal pellet onto the vegetation is essential. Tactical treatment 2 weeks following rain may aid in controlling worms. Daily management of the flock results in different levels of exposure to parasites. Exposure may be limited by strategies that use alternate species grazing or resting of pastures. A diversity of forage producing plants and the commingling of grazing species may serve to dilute the number of gastrointestinal parasites ingested. Rotational grazing systems may result in greater numbers of parasites to which animals are exposed, however, the effects on the host may be lessened due to improved nutrition. In the humid tropics rotation is useful in controlling parasitic disease. However, in conditions of drought or cool weather, larvae may survive 6 months or longer on pasture. Therefore, if there is going to be a meaningful reduction of parasite numbers in a pasture the susceptible goats must remain off the pasture for 2 to 6 months. A pasture on which animals may safely graze during the winter becomes dangerous during the spring. Worms which infect goats in the spring are those which survive on pasture or are the progeny of arrested larvae that overwintered inside the goats. Larvae acquired during autumn grazing cease development but remain in the digestive tract without feeding or reproducing. Parturition and spring grass growth are associated with emergence of arrested larvae. Eggs passed in the feces and subsequent development of infective larvae coincide with the time when kids begin to graze. Strategic (winter) use of anthelmintics protects goats from catastrophic numbers of worms. A few individuals have a large portion of the entire worm population and selective removal or treatment of these goats may aid in controlling disease in the entire flock.

Key Words: goats

Physiology
Developmental Endocrinology

580 Integration of nutrient supply and growth during fetal life: roles of leptin and the IGF system. R.A. Ehrhardt*[1], A.W. Bell[1], and Y.R. Boisclair[1], [1]*Dept. of Animal Science, Cornell University, Ithaca, NY.*

Extracellular signals integrate somatic growth with nutrient supply growth during fetal life. Several components of the IGF system are regulated by nutrient supply during late fetal life in sheep and are likely to be important determinants of size at birth. Conversely, nutrient supply regulates maturation of the endocrine IGF system. For example, underfed fetuses have lower hepatic expression of the ALS and IGF-1 genes than well fed fetuses. The novel hormone leptin has been suggested as a possible regulator of fetal growth. To address this, we examined the spatial and developmental regulation of leptin in fetal sheep as well as the nutritional regulation of leptin during late pregnancy and early postnatal life. Fetal plasma leptin concentration increased steadily from early fetal life to near term and was not related to fetal or placental weight. Leptin mRNA was detected in fetal brain and liver during most of pregnancy and in fetal adipose tissue during the last trimester, suggesting that fetal plasma leptin originates mostly from non-adipose sources early in pregnancy and in addition, from fetal adipose tissue nearer term. Moderate maternal undernutrition during late pregnancy did not alter fetal plasma leptin despite an acute reduction in maternal concentration. In contrast, during early postnatal life, plasma leptin was acutely regulated by energy status and closely associated with the rate of fat accretion. Overall, these data do not support the hypothesis that leptin is a growth factor during fetal life. Instead, leptin expression in non-adipose tissue may promote developmental processes such as hematopoiesis and angiogenesis. In summary, the IGF system has an important functional interplay with nutrient supply during late fetal in regulating fetal growth and development. The role of fetal plasma leptin is less certain but the sheep fetus provides an ideal model to test its functional role(s).

Key Words: Fetal life, Leptin, IGF system

581 Integrated roles of growth factors, integrins, and matrix proteins in conceptus development and implantation. Laurie A. Jaeger*[1], Greg A. Johnson[2], Robert C. Burghardt[1], and Fuller W. Bazer[1], [1]*Texas A&M University, College Station, Texas, USA,* [2]*University of Idaho, Moscow, Idaho, USA.*

Maternal recognition of pregnancy, conceptus elongation, attachment, and implantation are critical for embryonic survival in domestic swine and ruminant species. Steroid hormones, growth factors, and cytokines play important in roles in controlling conceptus development and implantation in these species, in part through effects on and interactions with extracellular matrix proteins (ECMs) and their integrin receptors. Results from immunoflourescence and RT-PCR analyses indicate the presence of multiple integrin subunits and potential integrin heterodimers, on conceptus and maternal cells, that are capable of binding ECMs present at the conceptus-maternal interface. TGFβs appear to play multiple roles in implantation; evidence suggests that TGFβs can modulate expression of ECMs as well as participate directly in adhesion. Fibronectin (FN) is present at porcine and ovine conceptus-maternal interface in vivo. Porcine trophectoderm produces FN, and TGFβ1 increases levels of FN mRNA in porcine trophectoderm cells (pTr2). Results of in vitro adhesion assays in which integrin activation is detected by monitoring aggregation of cytoskeletal molecules indicate that FN, the latency-associated peptide (LAP) that comprises part of the latent TGFβ complex, and osteopontin (OPN), a molecule expressed by porcine and ovine endometrial cells during early pregnancy, activate apically-expressed integrins in porcine and ovine uterine and trophectoderm. Mechanisms of the ECM-integrin interactions in the conceptus have been further studied using the pTr2 cells. Integrin β1 is expressed on the apical surface of pTr2 cells, and pTr2 attachment to immobilized LAP is decreased specifically by Arg-Gly-Asp peptide and monoclonal antibody to integrin β1, suggesting that trophectoderm adhesion to LAP is, in part, due to interactions with integrin β1. We hypothesize

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 colostral 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 colostral 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. Tylutki[2], C. Sheaffer[3], and M.D. Stern[3], [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. Muck[2], [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