following L-amino acids at 0.5, 2, or 5 mM plus their L-[1-^{14}C]- or L-[U-^{14}C]-labeled tracers: His, Ile, Leu, Met, Phe, Lys, Thr, Trp, and Val, as well as 0 or 5 mM L-cycloserine (an inhibitor of transaminase). The use of [1-^{14}C]- and [U-^{14}C]-labeled amino acids allowed for quantification of the oxidation of their carboxyl carbons and remaining carbon skeletons (Wu et al. Int J Biochem 19: 937, 1987). Results indicate extensive transamination of all the three branched-chain amino acids (BCAA) in enterocytes, with their α-ketoacids undergoing limited oxidation by branched-chain α-ketoacid dehydrogenase or the Krebs cycle. BCAA degradation was markedly inhibited by L-cycloserine ($P < 0.01$). Rates of enterocyte BCAA catabolism did not differ ($P > 0.05$) between barrows and gilts. Oxidation of all other EAA was negligible in the cells from barrows or gilts. The lack of degradation of His, Met, Phe, Lys, Thr, and Trp was confirmed by HPLC analysis of amino acids in medium plus incubated cells. Collectively, our results demonstrate that BCAA are degraded substantially in pig enterocytes and that these cells are not the site for the extensive catabolism of His, Lys, Met, Phe, Thr, and Trp in the pig small intestine. Supported by funds from the Chinese Academy of Sciences, China NSF, and TAES.

Key Words: Amino acids, Catabolism, Small intestine

Physiology and Endocrinology: Metabolic Regulation of Food Intake

105 Hepatic energy status as a stimulus for hunger and satiety. M. Friedman*, *Monell Chemical Senses Center*, *Philadelphia, PA*.

Eating requires at least two basic decisions: what to eat, which is a decision about food choice, and how much to eat, which is a decision about food intake. Feeding behavior is controlled by a variety of signals, including those generated by the supply and utilization of metabolic fuels, which influence food intake in the short and long-term. Traditionally, it has been thought that separate metabolic signals associated with glucose and fat metabolism control food intake. More recently, evidence is accumulating that metabolic processes and events common to the metabolism of both glucose and fat, at the level of ATP production, are involved. Many studies point to a role of the liver in controlling feeding behavior, and a variety of evidence indicates an inverse relationship between hepatocyte ATP concentration and food intake. Experiments using metabolic inhibitors have shown that a reduction in hepatic energy status can trigger feeding behavior and have also elucidated how changes in fatty acid oxidation influence food intake by affecting energy metabolism in the liver. Other studies have demonstrated a relationship between food intake and liver energy in experimental diabetes and under fasting/refeeding conditions. Currently, we are studying the role of hepatic metabolism in obesity and have found that hyperphagia in several animal models of obesity is associated with reduced liver energy status. Very little is known about how changes in hepatocyte energy metabolism are transduced into a signal the nervous system can interpret. To date, evidence suggests that transduction could be mediate via changes in intracellular calcium concentrations and by alterations in hepatocyte sodium pump activity. Theoretically, changes in hepatic energy status could be transmitted to the brain via a neural or humoral route; at present, however, there is evidence only for a neural connection, specifically via vagal afferent neurons. Recent electrophysiological experiments suggest that a relatively small population of afferents in the hepatic branch of the vagus carry metabolic signals from the liver to the brain.

Key Words: Liver, Appetite, ATP

106 The role of ghrelin in the regulation of energy balance in the sheep. I. Clarke*, *Monash University*, *Melbourne, Australia*.

Ghrelin mainly secreted by the stomach is an endogenous ligand for the growth hormone secretagogue receptor/s (GHS-R) and stimulates growth hormone (GH) secretion in a variety of species including sheep. In monogastric species examined, ghrelin also stimulates food intake. The ruminant presents an interesting model to study in this regard, since the gastrointestinal tract is never completely emptied. The ghrelin producing cells are found in the abomasum of this species. Ghrelin levels transiently increase pre-prandially and fall post-prandially, indicating a conditioned response to feeding. The preprandial rise occurs in animals of all body weights and this stimulates a post-prandial rise in plasma GH levels. Such a relationship is maintained with increasing adiposity, but is lost in diet-induced reduction in body weight. Since GH is an important metabolic regulator, the pre-prandial rise in ghrelin secretion is probably important in relation to partitioning of energy. In sheep, either central or peripheral administration of ghrelin fails to stimulate food intake, in spite of changes in plasma GH levels. Since the central administration of ghrelin stimulates GH secretion, this demonstrates action via growth hormone releasing hormone and somatostatin neurons that is relayed to the pituitary somatotropes. Whereas ghrelin does not affect food intake in this species, it remains possible that central action affects energy expenditure, as in other species. Ghrelin receptor levels are higher in the arcuate nucleus of lean ewes, but the functional significance of this is unknown; if ghrelin reduces energy expenditure in this species, this may be one salient mechanism. The ghrelin system may present a means of regulating GH without affecting food intake in ruminants. Supported by NH&MRC, Australia.

Key Words: Ghrelin, GH, Appetite

107 Metabolic regulation of food intake in ruminants. M. S. Allen* and B. J. Bradford, *Michigan State University*, *East Lansing*.

Food and energy intake of ruminant animals can change dramatically in response to changes in diet composition or metabolic state, and such changes are poorly predicted by traditional models of food intake regulation. Recent work suggests that temporal patterns of fuel absorption, mobilization, and metabolism affect food intake in ruminants by altering meal size and frequency. Research with non-ruminants suggests that meals can be terminated by a signal carried from the liver to the brain via afferents in the vagus nerve that are affected by hepatic oxidation of fuels and generation of ATP. Of fuels metabolized by the ruminant liver, propionate is likely a primary satiety signal because its flux to the liver increases greatly during meals. Propionate is utilized for gluconeogenesis or oxidized in the liver and stimulates oxidation of acetyl CoA. While propionate is extensively metabolized by the ruminant liver, there is little net metabolism of acetate or glucose, which may explain why these fuels do not consistently induce hypophagia in ruminants. Lactate is metabolized in the liver but has less effect on satiety probably because hepatic uptake during meals is low. Hypophagic effects of fatty acid oxidation in the liver are likely from delaying hunger rather than promoting satiety because beta-oxidation is inhibited during meals by rapid uptake of propionate. A shortage of glucose precursors and increased fatty acid oxidation in the liver for early lactation cows leads to an abundance of NADH and a lack of TCA cycle intermediates, resulting in a buildup of the intracellular acetyl-CoA pool and export of ketone bodies. In this situation, hypophagic effects of propionate may be enhanced, because propionate entry into the liver provides TCA cycle intermediates that allow oxidation of acetyl-CoA. Oxidizing the pool of acetyl-CoA rather than exporting it dramatically increases ATP production and causes satiety, despite the use of propionate for glucose synthesis. A better understanding of metabolic regulation of food intake will allow diets to be formulated to increase the health and productivity of ruminants.

Key Words: Hepatic oxidation, Satiety, ATP

108 Effect of body composition on feed intake and macronutrient selection in growing pigs. M. J. Azain*, *University of Georgia*, *Athens*.

Numerous factors are involved in the regulation of feed intake in growing animals. The focus of this presentation is on the roles that body composition or composition of gain play in energy and amino acid requirements in nonruminants. When fed a single diet, energy is the primary determinant of intake. However, when animals are allowed to select between diets that vary in macronutrient nutrient content, they are able to self-select a diet that optimizes growth. This has been observed with diets that vary not only in crude protein, but in individual essential amino acids. Examples of this ability include studies that examine differences in selection patterns in response to 1) age-associated, 2) repartitioning agent induced or 3) genetic changes in composition of gain. In the case of repartitioning agents, growing pigs treated with somatotropin have changes in the rates of protein and lipid accretion that alter the energy and protein (amino acid) requirements and ultimately affect selection patterns and total feed intake. Similarly, the selection pattern between high and low protein diets differs in pigs with different levels of fatness. The mechanisms involved in the ability to monitor lipid and protein accretion rates in the periphery and to distinguish subtle differences between diets are not clear, particularly in livestock. Research in rodent models suggests that protein accretion likely affects circulating amino acid levels which in turn alter neurotransmitters that are monitored centrally. Leptin or other factors from adipose tissue may be the signal used to monitor rates of lipid accretion. The ability to distinguish differences in incoming nutrients, particularly amino acids is likely through the liver. A better understanding of the mechanisms that tie composition of gain to diet selection would contribute to design of feeding systems that meet the nutrient requirements of individual animals under group housing conditions.

Key Words: Feed intake regulation, Composition of gain, Macronutrients

Ruminant Nutrition: Growing/Finishing Nutrition – Beef

109 Performance evaluation of calf- and yearling-finishing. W. A. Griffin*, T. J. Klopfenstein, G. E. Erickson, D. M. Feuz, and J. C. MacDonald, *University of Nebraska*, *Lincoln*.

The objective of this study was to compare performance of calf (calf-fed) and yearling finishing systems conducted in Nebraska from 1995-2003. Calves were born in April and weaned in October. During the receiving procedure cattle were sorted by weight into two groups. Heavy calves were placed directly into the feedlot and fed an average of 168 d, while lighter calves were placed into a long yearling system. The yearling system consisted of a corn residue grazing period (supplemented wet corn gluten feed (WCGF) at 2.27 kg/hd/d) followed by a summer grazing period. Following summer grazing, yearlings were placed in the feedlot and fed an average of 90 d. Trials included in the data set were selected based on finishing diet composition. Calf-feds were fed a basal diet of either dry-rolled (DRC) or high-moisture corn (HMC) with WCGF (targeted inclusion of 25-40% of the diet). The yearling finishing diet consisted of either DRC or HMC fed with WCGF at an inclusion level of 35-45%. At receiving, calf-feds were heavier than cattle entering the yearling system (292 kg vs. 239 kg; $P < 0.01$) by design. However, when comparing BW at the beginning of the finishing period, yearling cattle were 143 kg heavier than calf-feds ($P < 0.01$). Yearlings had greater ($P < 0.01$) DMI than calf-feds (13.89 kg/d vs. 9.71 kg/d); however, due to the difference in days fed, yearling cattle consumed less DM over the entire finishing period (1252 kg vs. 1633 kg; $P < 0.01$). Daily gain was 0.33 kg higher during the finishing period for yearling cattle ($P < 0.01$); however, calf-feds were 16.7% more efficient ($P < 0.01$) than yearlings (5.63 vs. 6.76). Final BW was 37.7 kg heavier ($P < 0.01$) for yearlings relative to calf-feds, due to a 23.6 kg ($P < 0.01$) heavier HCW. Marbling score was not affected by production system ($P > 0.10$); however, calf-feds had 0.15 cm greater fat thickness. Overall, yearling cattle had fewer days on feed, gained more rapidly, consumed less total DM, and were heavier at slaughter than calf-feds, while calf-feds were more efficient relative to yearling cattle.

Key Words: Calf, System, Yearling

110 Effect of phase feeding protein on cattle performance and nitrogen mass balance in the summer. S. Quinn*, G. Erickson, T. Klopfenstein, R. Stowell, and K. Vander-Pol, *University of Nebraska*, *Lincoln*.

A summer feedlot trial was conducted using 96 yearling steers (374 ± 0.12 kg) to compare conventional CP levels to phase-fed diets balanced for degradable intake protein (DIP) and undegradable intake protein (UIP) on performance and N volatilization. Steers were stratified by BW and assigned randomly to 12 pens and one of two treatments. Treatments were 1) control diet formulated for 14% CP (CON) or 2) a phase-fed diet using the NRC model to balance DIP and UIP requirements over the finishing period and encourage N recycling over the feeding period (PHASE; CP = 14 to 11%). Diets consisted of 83% dry rolled corn, 7% alfalfa hay, 5% molasses and 5% supplement. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Total N lost was calculated by subtracting manure and runoff N from excreted N. Ammonia emissions were measured weekly during the last six weeks of the feeding period using forced air wind tunnels and a sulfuric acid trap for 30 minutes in each pen. DMI for PHASE was greater ($P = 0.08$) than CON with 10.5 and 10 kg/hd for CON and PHASE, respectively. There was no difference ($P = 0.38$) in ADG between CON and PHASE (1.71