proportion of concentrate or NDF (NDF = 39.5 ±13.7 % DM) and provide data on ruminal pH (pH = 6.21 ± 0.34), liquid outflow rate (LOR = 12.1 ± 4.0 L/kg DM), and ruminally digested OM (rdOM = 39.5 ± 10.3 % DM). The LOR is an index of buffer recycling/kg DMI and rdOM is an index of VFA production/kg DMI. The compliled data also included dry matter intake (DMI = 2.81 ± .87 % LW) and Acetate/Propionate ratio (A/P = 3.18 ± 0.89). Data were analyzed using GLM procedure to separate variances among and within experiment. On 52 experiments and 132 treatments when ruminal pH was compared to rdOM, there was no significant relationship among or within the diets. In contrast, the small regression standard deviation (rsd) indicated that ruminal pH was fairly accurately explained within diets by LOR: pH = 4.90 + 0.15(LOR) - 0.003(LOR2); n = 86, nexp = 35, rsd = 0.09. With the A/P ratio, another index of ruminal perturbation, there was a curvilinear relationship with rdOM: A/P = -0.59 + 0.50(rdDOM) - 0.011(rdOM2); n = 79, nexp = 32, rsd = 0.46. However, the corresponding relationship was more accurate with LOR: A/P = - 0.57 + 0.52(LOR) - 0.014(LOR2); (n = 75, nexp = 30, rsd = 0.30). In conclusion, this summary of published research indicates that perturbations in ruminal pH and A/P are related more to LOR, which is linked to diet fibrosity indexes and chewing activity, than to differences in dietary variation linked to rdOM.

Key Words: Acidosis, Ruminal Digestibility, Ruminal pH Turnover

482 Design of a bovine metabolism gene array. B. E. Etchebarne*, W. Nobis, M. S. Allen, and M. J. VandeHaar, *Michigan State University, East Lansing*.

First generation microarrays employing extensive cDNA libraries have allowed high numbers of both known and unidentified genes to be surveyed. Many of these arrays have only one spot per gene, leaving no margin for measurement error and giving no information on variance of replication. The Human Genome Project has provided extensively annotated databases, such as Locuslink, the Kyoto Encyclopedia of Genes and Genomes (KEGG), The Institute for Genomics Research (TIGR), and BioCarta. These publicly available resources, paired with recent price reductions in oligonucleotide synthesis, allow researchers to feasibly design and produce microarrays with gene sets tailored to specific research areas. Using these databases, we identified approximately 2000 bovine genes representing enzymes of metabolic pathways, metabolic regulators and receptors, transport and binding proteins, intracellular signaling cascades, and cell cycle and apoptotic pathways. Three individual 70mer oligonucleotide probes per gene were designed for triplicate spotting onto glass slides, giving nine spots per gene. Each oligonucleotide was designed within specific parameters to standardize hybridization behavior. Use of multiple oligonucleotides per gene improves representation of the expressed fraction of each gene, including splice variants. High spot replication improves within-array quality control and increases the statistical power of detecting small changes in expression at a lower cost than slide replication. Statistical power is especially important for metabolic research, in which changes in gene expression are often subtle. In addition, our focus on only those genes that are relevant to metabolism improves downstream bioinformatics and data analysis for integration of metabolic gene networks. Because all genes included in this design are annotated with corresponding human homologs, the design can be applied to other species to promote our understanding of comparative metabolism. In conclusion, our design of a focused oligonucleotide microarray with multiple spots per gene will facilitate research in the metabolic genomics of cattle and can be easily applied to other species and disciplines.

Key Words: Microarray, Metabolism, Statistical Power

483 Effect of increasing ruminal valerate, caproate, and heptanoate on splanchnic metabolism of VFA absorbed from the washed reticulorumen of steers. N. B. Kristensen*[1] and D. L. Harmon[2], [1] *Danish Institute of Agricultural Sciences, Tjele, Denmark,* [2] *University of Kentucky, Lexington*.

Four steers fitted with a ruminal cannula and chronic indwelling catheters in the mesenteric artery, mesenteric vein, hepatic portal vein, hepatic vein, as well as in the right ruminal vein were used to study the absorption and metabolism of VFA from bicarbonate buffers incubated in the temporarily emptied and washed reticulorumen. Each treatment was incubation of a bicarbonate buffer in the rumen for 90 min and continuous infusion of ruminal infusate to maintain a constant rate of VFA disappearance. Treatments were control (VFA mixture) or added valerate (VAL), caproate (CAP) or heptanoate (HEP). With the control the ruminal disappearance rates were 585 ± 24, 257 ± 10, 12 ± 0.4, 118 ± 3, and 17 ± 1 mmol/h of acetate, propionate, isobutyrate, butyrate, and valerate, respectively. With VAL, the valerate disappearance increased to 99 ± 1 mmol/h. Ruminal disappearance of caproate and heptanoate were 57 ± 1 and 60 ± 0.4 mmol/h with CAP and HEP, respectively. Net portal flux (68 vs. 39 ± 2 mmol/h) and splanchnic flux (22 vs. 10 ± 1 mmol/h) of butyrate increased (P = 0.01) with VAL compared with control. The concentration difference of butyrate between artery and ruminal vein increased (P = 0.01; 0.242 vs. 0.120 ± 0.007 mmol/kg blood) with VAL compared with control indicating that butyrate metabolism by the ruminal epithelium was inhibited by the increased valerate. Net portal flux of caproate and heptanoate accounted for 54 and 43% of the ruminal disappearance, respectively. The splanchnic flux of caproate and heptanoate accounted for less than 2% of the ruminal disappearance rate indicating complete metabolism by the splanchnic-drained viscera. Caproate and heptanoate affected rumen epithelial butyrate metabolism less than the increased valerate.

Key Words: Cattle, Energy Metabolism, Volatile Fatty Acids

ALPHARMA Beef Cattle Symposium: Factors Affecting Feedlot Profitability

484 Assessing the cost of beef quality. J. D. Lawrence*, C. Forristall, and G. May, *Iowa State University, Ames*.

The number of U.S. fed cattle marketed through a value-based or grid marketing system is increasing dramatically. Most grids reward Choice or better quality grades and some pay premiums for yield grades. The Choice-Select (C-S) price spread increased 55 percent, over $3/cwt during the 1990s. However, there is a cost associated with pursuing these carcass premiums both in the feedlot and the cowherd. Correlations between carcass and performance traits resulted in economic tradeoffs that change across input costs and quality grade premiums and discounts. Feedlot profitability was largely determined by marbling, carcass weight, and feed efficiency. Carcass weight was most important at a low C-S spread but give way to marbling at average and higher quality premiums. Data suggests that cow size and marling score are negatively correlated. The current trend toward wider C-S spreads places greater emphasis on marbling ability of calves. These correlations and results suggest that higher marbling is associated with lower cost cows to maintain.

Key Words: Beef, Feedlot Profits, Grid Marketing

485 The effect of cattle health on performance, production costs, and carcass value. R. L. Larson*, *College of Veterinary Medicine, Commecial Agriculture Program, University of Missouri, Columbia*.

Bovine respiratory disease (BRD) and possibly other diseases may detrimentally affect weight gain, carcass weight, rib eye area, marbling, and meat tenderness of feedlot cattle. Gardner et al. (1999) found steers with lung lesions had lighter hot carcass weights, lower dressing percentage, less internal fat, and lower marbling scores than steers without lesions. Steers with lung lesions also tended to have less external fat and smaller longissimus muscle area than healthy counterparts.

A clear mechanistic pathway linking disease to changes in growth and carcass traits has not been described. In their review of feedlot cattle growth, Owens et al. (1995) summarized that rate and composition of tissue accretion may be controlled by chronological age, physiological age, energy intake, hormonal status, relative turnover of tissues, cell number, and cell activity. Disease could conceivably impact all of these control processes except chronological age. There are three possible mechanisms by which disease may impact growth and carcass traits. First, metabolic signals such as cytokines and cortisol could have an effect on carcass composition through modification of hypothalamic secretions of thyrotropin-releasing hormone, by inhibition of IGF-I and insulin actions on muscle and fat tissues, and by direct protein catabolism

and lipolysis. Second, disease-induced anorexia could decrease serum IGF-I and increase serum GH which causes irreversible change in the partitioning of nutrients for tissue deposition. Ward et al. (1992) found that fasted cattle have higher serum cortisol concentrations than do fed cattle. Cortisol may be involved in anorexia-associated decreases in carcass weight and fatness through decreased thyroid hormone activity and increased protein catabolism. Third, cytokines and endotoxin induce various behavioral symptoms of sickness including lethargy, adipsia, and reduced social interactions. The result may be an indirect effect of anorexia on growth and carcass traits in that sick cattle are effectively on feed for fewer days than healthy penmates.

Key Words: Respiratory Disease, Cattle, Carcass Value

486 Effects of nutrition and management on carcass value and profitability. L. L. Berger* and N. A. Pyatt, *University of Illinois, Urbana*.

As increasing numbers of cattle are being marketed on a grid basis, carcass value rather than live weight is becoming the primary determinant of profitability. Carcass value is determined by weight, quality grade, yield grade, choice-select spread, and premiums and discounts. Early-weaned steers (n = 192, Simmental or greater) of known genetics were individually fed in a four-year study to determine performance and carcass factors explaining variation in carcass value and profitability. Steers were weaned at 88.0 ± 1.1 d and fed a high concentrate diet ($108.99/T) for 84.5 ± 0.4 d prior to allotment. Steers consumed a 90% concentrate diet ($98.93/T), consisting primarily of whole shelled corn and corn silage, for 249.7 ± 0.7 d and harvested at 423.3 ± 1.4 d of age. Five-year price data were collected for feedstuffs, dressed beef, and grid premiums and discounts. Average dressed beef price was $110.67/45.4 kg. Premiums ($/45.4 kg) were given for Prime ($5.62), premium Choice ($1.50), yield grades (YG) 1 ($2.46), 2A ($1.31) and 2B ($1.11). Discounts ($/45.4 kg) were given for Standard (-$17.72), Select (-$8.90), YG 3A (-$0.12), 3B (-$0.19), 4 (-$14.16) and 5 (-$19.56), and hot carcass weight (HCW) extremes (409-431 kg, -$0.64; 432-454 kg -$11.39; > 454 kg, -$19.71). Input costs included annual cow costs ($327.77), veterinary/medical and labor ($35/hd), feed markup ($22/T), yardage ($0.25/hd/d) and interest (10%). Dependant variables were carcass value and profit per steer. Independent variables were yearling weight EPD, marbling EPD, daily DMI, ADG, feed efficiency, HCW, 12th rib fat, calculated YG and marbling score (MS). Carcass value was correlated ($P < 0.05$) with yearling weight and marbling EPD, DMI, ADG, feed efficiency, HCW and MS. Carcass weight, MS and YG accounted for over 79% of the variation in carcass value among steers; explaining 57, 12 and 10%, respectively. Profit was correlated ($P < 0.05$) with DMI, ADG, feed efficiency, HCW and MS. Marbling score, DMI, ADG, YG and HCW accounted for over 77% of the variation in profit among steers; explaining 30, 14, 12, 12 and 9%, respectively

Key Words: Carcass Value, Quality Grade, Yield Grade

Companion Animal Symposium

487 Nutritional management of obese animals. G. D. Sunvold*, *The Iams Company Research and Development, Lewisburg, OH*.

Being overweight or obese is the single most common nutritional disease in companion animals. Traditional weight management technology involves diluting dietary calories with fiber. The potential side effects of high fiber diets will be noted in the presentation. An alternative weight management strategy, managing the underlying physiological changes that occur in overweight animals or put these animals at risk for obesity, will be discussed. The close relationship between obesity and glycemia makes it important to study glucose and insulin metabolism in order to effectively treat obesity. This metabolic association will be discussed. The role of several nutrients for use in weight management has been examined and will be an important aspect of this presentation.

Key Words: Dogs, Cats, Obesity

488 Humans and companion animals: hand-in-paw towards aging and obesity. B. T. Larson*, D. F. Lawler, Y. Pan, and J. R. Jackson, *Nestle Purina PetCare Co*.

The effects of aging are relentless. In response to aging, living organisms make functional, physiological and zoometric adaptations. Beyond these seemingly pre-ordained genetic and physiological adaptations, there are increasing adverse effects upon aging mediated through obesity. The relative abundance of inexpensive, entertaining, and delectable food energy sources combined with a lack of immediacy or initiative to use calories through physical activity has caused an epidemic of obesity. Statistics regarding obesity in humans and companion animals compels science to explore available options. Scientific knowledge surrounding obesity and aging is growing at a remarkable rate. New revelations have been made of adipose tissue's regulatory effects on whole-body physiology (insulin resistance, ex.). In addition, obesity is related to chronic disease development (osteoarthritis, organ function, cancers, ex.) through insulin sensitivity. These new developments have opened new venues in the science of aging and obesity. Additionally, the aging-related loss of lean tissue mass physiologically intersects with age-associated fat tissue deposition to multiply downstream physiological effects. Unfortunately, this exponential knowledge growth exceeds population implementation rate. How companion animal science approaches these issues is critical to implementation. What is the science component in the aging and obesity implementation equation? Given, that science agrees to disagree about mechanistic theories, how is interim credibility preserved with partners outside science? Who are sciences potential partners in the aging and obesity implementation equation? What might this partnership look like in order to curb the acceleration of obesity in aging companion animals?

Key Words: Companion Animals, Aging, Obesity

Dairy Foods and Human Nutrition

489 Fortification in dairy products. C. Boeneke*, *Louisiana State University Agricultural Center, Baton Rouge*.

Webster's dictionary defines fortification as the act or process of adding materials to for strengthening or enriching. Fortification of dairy products is not a new idea. The process of fortification of milk with vitamin D dates back to the 1930's. The acceptance of this practice led to additions of vitamin A and minerals in the 1940's. No vitamin content levels were specified by the Milk Ordinance and Code until 1953 when a level of at least 400 International units (IU) per quart was established for vitamin D. In 1965, the Milk Ordinance and Code became the Grade A Pasteurized Milk Ordinance or PMO. This PMO defined low fat milk but gave no provisions for its fortification. An increase in consumption of the lower fat products led to nutritional concerns over vitamin A. The content of vitamin A, a fat-soluble vitamin, is smaller in the lower fat product. The 1978 PMO required fortification of these lower fat products at levels of not less than 2000 IU per quart for vitamin A. Vitamin D fortification was still optional and could be added at 400 IU per quart. Consumers are demanding products that taste good and have health benefits. Dairy products are already rich in nutrients like potassium, riboflavin, calcium and vitamins A, D, and B-12. Fortification has the potential to improve them further. Dairy products fortified with added calcium, whey proteins, beneficial bacteria, and isoflavonoids are already on the shelves. Other ingredient additions such as vitamin C and E, lactoferrin, lutein, and others are available. Fortification poses unique problems to scientists and manufacturers involved with dairy products. Interactions with the ingredients used in fortification can cause product improvement or product detriment. More research must be conducted to examine the results of fortification in dairy products.

Key Words: Fortification, Dairy