from weaning (3 wk of age) to market weight (112.6±2.1 kg) to test the supplemental effects of DPX4600 and DPX5600 compared with the control group. Each treatment had 8 replicate pens with 8 pigs per pen. Other design and methods were identical to those of Exp 1. There were no differences in ADG and gain/feed between control and DPX 4600 treatment. However, pigs fed DPX5600 had lower ($P < 0.05$) ADG and gain/feed than pigs fed the control diet or DPX4600. Loins from pigs fed diets with DPX4600 or DPX5600 had higher pass rates based on meat color preference for the Japanese market than loins from pigs fed the control diet. Loin pH was higher ($P < 0.05$) for pigs fed diets with DPX4600 and DPX5600 than pigs fed the control diet. These results suggest that supplementing selected FeNCM (except for DPX5600) in swine diets may improve growth performance as well as carcass characteristics.

Key Words: Pigs, Natural Carbon Mineral, Growth

230 Effects of vitamin C supplementation on plasma ascorbic acid and oxalate concentrations and meat quality in swine. S. J. Pion*, E. van Heugten, and M. T. See, *North Carolina State University, Raleigh*.

Two experiments were conducted to determine the effects of vitamin C supplementation on plasma ascorbic acid and oxalate concentrations and its effect on pork quality. In Exp. 1, 16 pigs (81.6 kg BW) were blocked by sex and weight and randomly assigned within block to one of three treatments: 1) control; 2) 1,000 mg/L vitamin C; or 3) 2,000 mg/L vitamin C supplemented in the drinking water for a 48 h period. Supplementing vitamin C increased plasma ascorbic acid (AA) levels (23.4, 19.5 and 11.6 μg/mL; $P \leq 0.05$) within 6 h of supplementation. Plasma AA levels from treated pigs declined and did not differ from the levels of the control pigs (18.6, 18.2 and 13.7 μg/mL; $P \geq 0.05$) within 2 h of ending supplementation. No differences in plasma AA levels ($P \geq 0.05$) were found between the two levels of supplementation. Vitamin C intake resulted in no differences ($P \geq 0.05$) in plasma oxalate and cortisol levels. In Exp. 2, 30 pigs (118.2 kg BW) were blocked by sex and weight and randomly assigned within block to one of three treatments: 1) control; 2) 500 mg/L vitamin C; or 3) 1000 mg/L vitamin C supplemented in the drinking water 48 h pre-slaughter. Pigs were slaughtered 4 h after vitamin C supplementation ended. Loin samples were collected for measurement of pH, color, fluid loss and oxidative stability (TBARS). Loin chops were stored at refrigerated temperatures, similar to retail display, for 4 and 8 d for analysis of color, fluid loss and oxidative stability (TBARS). At time of slaughter no differences in plasma AA, oxalate and cortisol or muscle AA and lactic acid ($P \geq 0.05$) were observed between treatments. No differences ($P \geq 0.05$) were observed in pH values between carcasses from treated or control pigs. Vitamin C supplementation failed to improve color, decrease fluid loss or improve oxidative stability. The lack of elevated plasma AA and oxalate levels at slaughter implies that timing of slaughter relative to vitamin C supplementation may be critical in order to observe potential improvements in pork quality.

Key Words: Swine, Pork Quality, Vitamin C

Abstract 366 can be found on page 91.

Odor and Nutrient Management

231 Physiological and biological limitations for nutrient utilization in farm animals. B. J. Kerr*[1], [1]*USDA-ARS-MWA-SOMMRU*.

Optimizing nutrient utilization by farm animals is vital in maintaining economical animal production in light of environmental concerns associated with agriculture. In an effort to optimize nutrient utilization, however, there are numerous physiological and biological factors preventing complete nutrient use. Except for gut fill, it was not long ago that the gastrointestinal tract was hardly considered as an organ of metabolic concern. Glutamine, a dispensable amino acid, has long been known to be a key energy substrate for the gastrointestinal tract. Only recently has Thr, an indispensable amino acid, been shown to be highly metabolized by gastrointestinal tissue. The metabolic fate of Thr is further complicated by the fact that crystalline Thr, which is a readily available feed ingredient, is more rapidly absorbed than protein-bound Thr. Consequently, these two metabolic conditions prevent complete utilization of dietary amino acids to be deposited into edible animal product. Another factor that impacts nutrient utilization is the relationship between diet and gastrointestinal physiology and microbial ecology. It is well known that changing dietary forage has a tremendous impact on rumen microbial ecology. The understanding of this relationship in monogastrics is lacking and complicated by sizeable microbial population that inhabit the lower gastrointestinal tract of pigs. Past research in monogastrics dealt mainly with the impact of fiber addition on animal performance with little data describing physiological or microbiological changes. In addition, characterization of the fiber type was lacking such that the changes in dietary fiber(s) consumed could not be calculated. With the current emphasis on supplementing feed ingredients or neutraceuticals targeted for selective hind gut microbial fermentation, more information is needed on the metabolic and physiological changes in the animal due to fiber supplementation. An additional area of nutrient utilization interest is the low retention of various minerals commonly supplemented in livestock feed, either due to their inability to be adequate digested or their controlled metabolic regulation. Improved utilization of nutrients will lead to a more sustainable livestock production.

Key Words: Nutrient Utilization, Amino Acids, Microbiology

232 Enhancing nutrient efficiency through genetic selection: Opportunities and challenges. M.T. See*, *North Carolina State University, Raleigh NC*.

Intensive animal agriculture has led to public and legislative concern about environmental and health risks from manure. Genetic selection for increased efficiency of production is one of many tools that can be used to decrease the amount of nutrients excreted in urine and feces. Genetic reduction of nutrient excretion from animal production systems has occurred from improved feed conversion and increased nutrient utilization. In addition, genetic improvement of reproduction optimizes the production system and leads to decreased nutrient excretion when we assume that a fixed number of animals units are produced in a location annually. Tremendous genetic progress has been observed historically for growth rate and lean composition in swine and poultry resulting in indirect improvement for feed conversion. In both industries there has been a significant reduction in days to market and increased lean yield. The annual genetic trend for milk yield has also accelerated with time producing a more efficient industry. However, intense selection for increased efficiencies has not been without challenges. Selection for efficiency has resulted in negative complications, such as reduced product quality, reduced reproductive performance, reduced appetite, and skeletal abnormalities. Genetic improvement of milk yield has likely resulted in negative effects on cow reproduction and intense selection has led to an accumulation of genetic relationships within the Holstein breed. In addition to negative genetic correlations associated with selection, production environments and production systems do not always allow animals to express their genotypes. For example, chronic heat stress, disease and other factors will result in poorer efficiency regardless of genetic merit. There is additional opportunity to enhance nutrient efficiency by directly selecting on lean tissue feed efficiency and taking into consideration not only feed costs but manure costs in developing breeding objectives. Additional genetic progress can also be made in the reproductive rates and health of all species. Improved understanding of how to profitably maximize the expression of genetic potential in commercial production situations can also enhance nutrient efficiency.

Key Words: Genetics, Efficiency, Manure

233 Reducing nutrient excretion and odor: a production system approach. G. G. Gourley*, *Swine Graphics Enterprises, Webster City, IA*..

Although extensive research has been conducted on reducing nutrient excretion and odor, the implementation and economic considerations of applying the research and technologies are unique to every production system. Some of the various products, programs, techniques, designs and technologies for dealing with nutrient excretion and odor will be reviewed. Two examples of the economic considerations and the steps in the decision process will be presented for the extensively researched feed

microbial enzyme phytase, low phytic acid corn, and crystalline amino acid fortified diets. Environmental factors will be discussed including: geography, soil type, agronomic rotations of grain and/or forage, nutrient handling, storage and application considerations, as well as local, state and national regulatory factors. The impact of newer technologies on public perception and relations will also be discussed. Odor reduction strategies have been the focus of vast research efforts. Feed additives, enzymes, microbials, and amino acids have been studied extensively from the feed production perspective. Manure mangement strategies including aeration, bio- and synthetic manure covers, biofilters, and manure injection techniques have shown promise in some regions of the country. Social and good neighbor policies that go above and beyond regulations have and are quickly becoming economically important decisions not only from a production perspective, but also with respect to capital acquisition and the potential for future litigation. This presentation will provide examples of odor reduction strategies and address the economic considerations within the context of a modern swine production system.

Key Words: Nutrient Excretion, Odor, Phytase

235 Effect of organic vs. inorganic sources of zinc supplementation on the whole body mineral composition (Cu, Zn, Fe, Mn, P, and N) of nursery pigs. M.J. Rincker*, G.M. Hill, J.E. Link, J.E. Rowntree, J.G. Green, and D.M. Dvoracek-Driksna, *Michigan State University, East Lansing, MI.*

The use of pharmacological levels of Zn as a growth promoter in nursery pigs raises concern relating to nutrient management. A difference in metabolic management may exist between Zn Oxide (ZnO) and Zn Methionine (ZnM) to achieve Zn homeostasis. To examine this further, thirty crossbred barrows (18 2 d; 6.4 kg) were used to compare ZnO with ZnM supplementation on whole body mineral concentration in nursery pigs. Initially, six barrows were euthanized for computation of baseline (BL) mineral concentrations. The remaining twenty-four barrows were randomly allotted by body weight, within litter, to one of three dietary treatments and fed in two dietary phases (P1: d 1-7; P2: d 8-14). Dietary treatments were formulated to meet NRC recommendations (1998), excluding Zn, and consisted of: 1) negative control (NC), no supplemental Zn source; (2) NC + 2,000 ppm Zn from ZnO; and (3) NC + 2,000 ppm Zn from ZnM. Pigs were individually fed and euthanized after 14-d. All pigs (n = 30) were ground and subsamples of whole body were collected, freeze-dried, and analyzed for P (colorimetrically), N (combustion/Leco), and Cu, Fe, Zn, and Mn (atomic absorption spectrometry). Results (DM basis) indicate that Zn supplementation increased ($P < 0.0001$) whole body Zn concentration (BL = 62.4 vs. Zn0 = 346.5 and ZnM = 358.3 mg/kg) and whole body N concentration (BL = 7.3 vs. Zn0 = 8.6 and ZnM = 8.4 mg/kg). Also, pigs fed ZnM (4.1 mg/kg) had increased ($P < 0.05$) Mn concentration in the body compared with BL (1.2 mg/kg). A similar trend ($P < 0.05$) was noted in Fe concentration (BL = 178.2 vs. ZnM = 238.2 mg/kg). Whole body concentration of Cu and P were not affected by supplemental Zn. These data suggest that feeding pharmacological levels of Zn either as an organic or an inorganic source increases the whole body Zn concentration of nursery pigs and may also have an affect on the accretion of other minerals.

Key Words: Whole Body Mineral Concentration, Nursery Pig, Zinc

236 Growth performance, carcass characteristics and nitrogen emission of grower-finisher pigs fed reduced crude protein, amino-acid supplemented, wheat-soybean diets. A.B.G. Leek*[1], W. Henry[2], and J.V. O'Doherty[1], [1]*University College Dublin, Ireland,* [2]*Devenish Nutrition Ltd., Belfast, Northern Ireland.*

Two experiments were conducted to determine the production and environmental effects of reduced crude protein (CP) wheat-soybean diets in growing-finishing swine. Dietary CP content was adjusted to 13, 16, 19 and 22 % by changing wheat and soybean meal inclusion. Levels of digestible energy and lysine were maintained at 14 MJ/kg and 11 g/kg respectively. Dietary essential amino acid content was maintained by inclusion of synthetic lysine, methionine, threonine and tryptophan. In experiment 1, designed to examine the dietary effect on growth performance and carcass characteristics, 60 individually fed pigs (9 boars and 6 gilts) were randomly assigned to each dietary treatment. Average daily feed intake (ADI), gain (ADG), feed conversion ratio (FCR) and plasma urea nitrogen (PUN) levels were measured from 40 kg to slaughter. Dietary CP level had no effect on ADG, ADI, FCR or kill out proportion ($P>.05$). Pigs fed 13 % CP had a higher P2 backfat and a lower lean meat yield than pigs fed 22 % CP ($P<.05$). PUN increased with CP level ($P<.001$). In experiment 2, using identical dietary formulations, the nitrogen (N) balance of 4 boars per treatment was investigated and replicated at 60, 70, 80 and 90 kg live weight. An *in-vitro* measurement of NH_3-N emitted over 10 days and recovered from the headspace-air drawn over the surface of a fresh slurry sample collected during the N balance experiment, was performed. N excretion was 19.3, 34.1, 37.1 and 50.6 g/d (sed=1.815; $P<.05$) in diet 13, 16, 19 and 22 % respectively. The volume of slurry produced was 3.09, 4.46, 4.12 and 6.80 kg/d (sed=0.451; $P<.001$) in diet 13, 16, 19 and 22 % respectively. NH_3-N emission was 2.53, 5.46, 5.74 and 9.71 g/d (sed=0.758; $P<.05$) per pig in diet 13, 16, 19 and 22 % CP respectively. In conclusion, reducing the crude protein content greatly reduced N excretion and N emission without affecting growth performance. However, carcass lean yield may be reduced at 13 % CP.

Key Words: Pigs, Crude Protein, Ammonia

237 Effectiveness of geotextile covers to reduce emissions from manure storage structures. J. R. Bicudo[1], C. J. Clanton[2], D. R. Schmidt[2], L. D. Jacobson[2], W. Powers[3], C. L. Tengman[4], and M. C. Bradshaw*[4], [1]*University of Kentucky,* [2]*University of Minnesota,* [3]*Iowa State University,* [4]*National Pork Board.*

Odor, hydrogen sulfide (H_2S), ammonia (NH_3) and volatile organic compounds (VOC) were measured between May and October 2000, and between April and October 2001 at three sites in Southwest Minnesota. Each site consisted of a pair of farms (nursery N1A, N1B; 2,000-head finishing F2A, F2B; 3,000-head finishing F3A, F3B). A manure storage from each pair was selected as treatment, where a geotextile cover (BioCap^{TM}) was installed. The experimental design was a completely randomized block design consisting of three different swine production types with either covered or non-covered manure storages. Data was logarithmic transformed for statistical analysis. Calculations were done using a regression approach with production type, geotextile cover, and collection year as main effects. A wind tunnel was used for collecting samples from the covered and uncovered surfaces. Flux rates for the specific gases are determined by multiplying the concentration of gas in the exhaust air by the flow rate through the tunnel. Hydrogen sulfide was measured by a Jerome meter, ammonia by boric acid collection, and volatile organic compounds solid phase micro extraction. Results showed that there was a significant deterioration of the performance of geotextile covers in reducing odor and gas emissions from manure storages on the second year of the study. Odor emissions were, in average, reduced by 48% over the two-year period. Emission rate were reduced by 90% in terms of H_2S in the first year, but no significant differences were found between covered and non-covered manure storages in 2001. NH_3 emissions were, in average, reduced by 44% in 2001. No significant differences in total-VOC emissions from covered and non-covered manure storages were observed during the two-year study. Analysis of the ambient H_2S data suggested that the covers were effective in reducing ambient H_2S concentrations near manure storages located at the two finishing sites. Odor and gaseous emission rates from all sites were poorly correlated with most manure characteristic parameters (nutrients, solids, organic matter, VOCs).

Key Words: Swine Manure, Hydrogen Sulfide, Ammonia

238 Effect of using a manure pit additive (Barrier^{TM}) on growth performance of grow-finish pigs and volatile organic compounds, ammonia, hydrogen sulfide, and odor emissions in an anaerobic deep pit swine confinement finishing facility. M. H. Whitney*, J. S. Knott, M. J. Spiehs, and G. C. Shurson, *University of Minnesota, St. Paul, MN.*

A study was conducted to determine the effect of using a commercial manure pit additive (Barrier^{TM}) on gas and odor emissions and growth performance of grow-finish pigs raised in a confinement building using an anaerobic deep pit for manure storage. The 40 pen building was mechanically ventilated with partially slotted concrete floors, and was divided into 2 rooms, each with a separate 2.45 m anaerobic deep pit. A total of 1240 pigs with average initial BW of 23 kg were allotted to rooms to provide approximately 8 pigs/pen (0.87 m^2/pig) during each of

four trials. Pigs remained in their assigned pens until reaching market weight at approximately 114 kg. Barrier^{TM} was added to the assigned treatment pit on a monthly basis (0.05% vol/vol) for each trial. A 5-phase, separate sex feeding program was used. Corn-soybean meal based diets were formulated to meet or exceed NRC (1998) nutrient requirements. Pig weights and feed disappearance were determined every two wks. Air samples were collected monthly at pit (30 cm above manure surface) and pig level, and from pit fans to measure concentrations of hydrogen sulfide (H_2S), ammonia (NH_3), and volatile organic compounds (VOC). Air samples were also collected at pig level and from pit fans at the beginning, middle, and end of each trial and evaluated for odor utilizing an olfactometer and trained human odor panel. Analysis of variance with repeated measures in time (within each trial) was used to analyze all data. Addition of Barrier^{TM} to manure pits had no effect on ADG, ADFI, G/F, or days on test ($P > 0.10$). No differences in odor detection threshold, intensity, or persistence between treatments were observed ($P > 0.10$). H_2S and NH_3 concentrations were numerically reduced in pits treated with Barrier^{TM}, but due to high variability in these measurements and minimal replication, differences were not significant ($P > 0.10$). Some VOC may have been affected by pit application of this product, but further refinements in procedures for collecting and analyzing these compounds is necessary. These results suggest that the addition of Barrier^{TM} to anaerobic deep pits has no effect on odor or growth performance, but may provide some benefit for reducing H_2S and NH_3 emissions.

Key Words: Swine, Pit Additive, Odor

239 Mathematical evaluation of excess non-essential amino acid nitrogen and sulfur in feed ingredients used in swine diets.

J.S. Knott* and G.C. Shurson, *University of Minnesota*.

Minimizing excess dietary nitrogen (N) and sulfer (S) is essential when formulating "environmentally friendly" swine diets. By calculating the amount of non-essential amino acid N and S in feed ingredients, it may be possible to select ingredients to minimize N and S excretion. The objective of this study was to develop a feed ingredient indexing system to rank ingredients based upon the amount of excess non-essential amino acid N and S. Chemical composition of essential amino acids (EAA) and cystine were used to calculate the contribution of N and S to the total molecular weight of each amino acid. Concentrations of EAA and cystine, crude protein, and total S for each ingredient ($n = 79$) were obtained from NRC (1998). Total N was calculated by dividing crude protein values by 6.25. The sum of N and S contained in EAA and cystine was compared to the sum of the total N and S in each ingredient. Ingredients were ranked on the basis of the amount excess non-essential N and S. The percentage of total N contributed from the EAA and cystine ranged from 26.11% (whey permeate) to 58.07% (blood meal). Based upon our calculations, 41 to 74% of N contained in feed ingredients is in the form of non-essential N and other N compounds. Corn ranked 47th of 79 ingredients and contained 39.82% of the total N in EAA and cystine. Solvent extracted soybean meal ranked 15th and contained 47.59% of N in EAA and cystine. The percentage of total S contributed from methionine and cystine ranged from 554% in bakery waste to 5% in cassava meal. Theoretically, the methonine and cystine cannot contribute more than 100% of the total S in an ingredient. Calculated contributions of S from methionine and cystine exceeded 100% in 22 of the 79 ingredients. Total S values, and perhaps, methionine and cystine values of feed ingredients listed in NRC (1998) need to be re-evaluated and better defined. This information will become increasingly important to nutritionists when selecting ingredients to reduce gaseous emissions and nutrient excretion from swine facilities.

Key Words: Nutrients, Nitrogen, Sulfur

240 Effects of grazing management on sediment and phosphorus in pasture runoff.

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Three replications of five 0.4 ha smooth bromegrass paddocks with slopes up to 15° were utilized to determine the effects of grazing management on phosphorus (P) and sediment loss from pastures. Pasture management treatments included an ungrazed control (UG), summer hay harvest with winter stockpiled grazing (HS), continuous stocking to a residual sward height of 5 cm (CS5), and rotational stocking to a residual sward height of 5 cm (RS5) and 10 cm (RS10). Cattle in paddocks with the RS5 and RS10 treatments were removed to allow a 35-d rest period once desired sward heights were reached. Cattle in paddocks with the CS5 treatment were managed with a put and take method to maintain the desired sward height. Grazed paddocks were initially stocked with three mature Angus cows in May 2001. In June, August, and October of 2001 and April 2002, rainfall simulations were conducted at 6 sites within each paddock and 6 sites in a buffer zone down slope from each paddock. Rainfall simulators dripped at 7 cm/h over a 0.5 m^2 area for 1.5 h. Runoff was collected and analyzed for sediment and total and dissolved P. Simultaneous to each rainfall simulation, slope, ground cover, sward height and mass; and soil penetration resistance, surface roughness, and P and moisture concentrations were measured. Annual carrying capacities for paddocks with the UG, HS, CS5, RS5, and RS10 treatments were 0, 8, 81, 62, and 47 cow-days/ha ($P < 0.01$). Slope and pasture treatment in paddocks did not significantly affect the concentration of sediment in runoff. However, concentrations and amounts of total P in runoff from grazed paddocks were greater ($P < 0.05$) than UG and HS paddocks. Concentrations and amounts of total P in runoff from paddocks with the RS10 treatment were lower ($P < 0.05$) than paddocks with the RS5 treatment. The amounts of sediment and total P in runoff from paddocks that were grazed were greater ($P < 0.05$) than their respective buffers. Increasing the amounts of residual forage in pastures will reduce total P loss from pastures.

Key Words: Grazing, Water Quality, Phosphorus

Physiology

241 The use of haplotype information in the genetic dissection of genes affecting important traits.

D. C. Ciobanu*, *Sygen International*.

Modern molecular biology and the science of genomics have opened up new and exciting possibilities to dissect complex phenotypic traits. With the human genome now nearly fully sequenced, there is an intense effort to increase the number of markers, in particular SNPs (Single Nucleotide Polymorphisms) to cover most of the genome. Using this genetic variation will substantially improve our ability to find genes/loci associated with specific diseases or quantitative traits. Multiple SNPs can be organized together in haplotypes. Haplotypes can cover a full gene, a set of genes or a part of a chromosome and carry more information than individual SNPs. In humans, haplotype variants have been shown to be associated with several diseases such as, Crohn disease, Saguenay-Lac-Saint-Jean cytochrome oxidase deficiency or type I diabetes. The construction of a comprehensive haplotype map for the human genome will greatly assist in the dissection of such complex genetic traits. SNP discovery programs are also building momentum in economically important livestock species. SNPs within coding sequences can be used to help map the transcriptome of each species and are particularly useful in identifying the genes responsible for phenotypic variation in traits with important economic impact. Recently, new economically important alleles were found in the porcine PRKAG3 (protein kinase, AMP-activated, gamma 3 subunit) gene that affect glycogen content in the muscle and the resulting pork quality. In this study, haplotype analysis revealed the effects of PRKAG3 substitutions much more clearly than the analysis of individual SNPs. While single SNPs and haplotypes are both useful in the analysis of complex traits and the identification of associated genetic variation, the use of haplotypes is found to be more powerful.

Key Words: Genome, Haplotype, SNP

242 Protein identification using mass spectrometry.

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Protein identification is a key component in the rapidly expanding area of proteomics. The mass spectrometry facility at the University of Nebraska has been involved with the identification of proteins for the past three years. Proteins isolated using both one and two dimensional gel