Cl Source	Dose (lbs/acre)	1st cutting %Cl	4th cutting %Cl
Control	0	.25 .08	.30 .14
NH_4Cl	50	.60 .04	.60 .12
NH_4Cl	100	.69 .08	.71 .08
NH_4Cl	150	.73 .03	.66 .20
MIX	50	.60 .09	.58 .18
MIX	100	.72 .02	.68 .14
MIX	150	.75 .07	.70 .09
$CaCl_2$	50	.55 .12	.52 .10
$CaCl_2$	100	.72 .13	.66 .16
$CaCl_2$	150	.83 .08	.72 .15

Key Words: Chloride fertilization, Alfalfa, DCAD

436 Productive and rumen reponses of lactating cows to buffer supplementation. F. Meschy[1], D. Bravo[2], and D. Sauvant*[1], [1]*INRA-INAPG Physiologie de la Nutrition et Alimentation Paris France,* [2]*Ets UCAAB Chateau-Thierry France.*

Avoid the consequencies of (sub)acidosis is an important target in dairy cows nutrition especially in early lactation and when the animals are fed high-concentrate diets. Several studies have dealt with the effects of buffer supplementation on dry matter intake (DMI), milk fat content (MF)and rumen parameters in lactating cows. In order to obtain multiple marginal responses to buffer supplementation a meta-analysis was performed on a database extracted from literature. This database (30 publications, 51 experiments, 101 treatments) only gathered data from experiments where the buffer was well identified in the publication (33 experiments with sodium bicarbonate, 10 with sodium carbonate, 7 with magnesium oxide and only one with potassium bicarbonate). In the database the concentrate percentage was 52% ± 26 and ADF content was 18% ± 6. Statistical analysis was performed using a model of variance-covariance including dose of buffer as percentage of DMI (DOSE) as covariable and experiment as between-group factor. No significant difference was observed according to buffer source. Buffer supplementation significantly increased intake (DMI = 19.63 + 0.59 DOSE, n = 44 R2 = 0.94 rsd = 0.86), milk fat% (MF = 3.33 + 0.18 DOSE, n = 50 R2 = 0.92 rsd = 0.17) and fat corrected milk 4%(FCM = 24.95 + 0.92 DOSE, n = 50 R2 = 0.97 rsd = 1.4). No significant effect was detected on raw milk production. Buffer supplementation had no effect on total volatile fatty acid production, but increased acetate (C2% = 55.6 + 1.39 DOSE, n = 28 R2 = 0.85 rsd = 2.29), butyrate (C4% = 10.24 + 0.94 DOSE, n = 22 R2 = 0.94 rsd = 1.11) and decreased propionate (C3% = 28.51 - 2.95 DOSE, n = 28 R2 = 0.92 rsd = 2.30). Acetate: propionate ratio was increased by buffer supplementation (C2/C3 = 2.07 + 0.28 DOSE, n = 28 R2 = 0.88 rsd = 0.26). These analyses indicate that buffer supplementation could help the animals to maintain these rumen parameters in a range which is favorable for microbial activity and milk performances when dietary conditions may induce metabolic disorders such as acidosis.

Key Words: Buffer, Dairy Cows, Rumen

437 Effect of dietary cobalt supplementation on cobalt metabolism in dairy cows. R. L. Kincaid*[1], J. D. Cronrath[1], and Socha M. T.[2], [1]*Washington State University, Pullman, WA,* [2]*Zinpro Corporation, Edina Prairie, MN.*

To determine the effect of Co supplementation on Co metabolism in dairy cows, prepartum Holstein cows (n = 36) were assigned to dietary treatments of low, medium, and high Co. Dry cows were fed hay (0.16 ppm Co) and 1 of 3 supplements that contained 0.51, 3.74, or 6.71 ppm Co (Co added as Co glucoheptonate) from 21 d prepartum until parturition. Estimated Co intakes of the dry cows were 3, 14, and 24 mg/d. From parturition until 120 DIM, cows were fed their respective TMR that contained 0.36. 0.68, or 1.26 ppm Co. Supplemental Co did not affect ($P > 0.05$) concentrations of Co in either serum (95 ng/ml) or whole blood (98 ng/ml), however, serum Co was higher at 7 DIM (116 ng/ml) than at 120 DIM (75 ng/ml). Liver samples, taken via biopsy at 120 DIM, had Co concentrations of 2.2, 2.5, and 1.3 ppm, respectively. Compared to multiparous cows, primiparous cows had higher concentrations of Co in colostrum (93 vs 119 ng/ml) and milk (94 vs 99 ng/ml). Serum B12 concentrations, although not affected by diet, were higher ($P < 0.05$) in primiparous than multiparous cows (1.81 vs 0.96 ng/ml) and higher ($P < 0.05$) at 21 d preparum (2.36 ng/ml) than at 120 DIM (1.24 ng/ml). There were no treatment effects on BW, BCS, or concentrations of glucose, NEFA, Zn and Cu in serum. These results indicate that gestation and lactation reduce endogenous reserves of Co and B12 in dairy cows.

Key Words: Cobalt, Vitamin B12, Cows

438 The effect of barley varieties on phosphorus utilization and fecal excretion in lactating dairy cows. T. D. Nennich*[2], J. H. Harrison[2], R. L. Kincaid[1], L. Johnson[2], and D. Davidson[2], [1]*Washington State University, Pullman, WA,* [2]*Washington State University, Puyallup, WA.*

Four barley varieties common to the Pacific Northwest were evaluated to determine the effect of variety difference on P digestibility, absorption, and excretion. Eight lactating Holstein dairy cows were used in an unbalanced double 5 x 4 Latin square design with 14 d periods. Barley varieties replaced corn in the diets and were fed at 24.3% of the diet dry matter. The 5 dietary treatments consisted of a control corn diet (CORN), and 4 diets containing equal amounts of Steptoe (STEP), Idagold (IDGD), Harrington (HGTN), or Baroness (BRNS) varieties of barley. Total mixed rations, orts, urine, and feces were collected during the last 4 d of each period and analyzed for P content. Phosphorus intake, fecal excretion, absorption, and digestibility were determined. Data listed below show the results of P utilization and excretion when corn and different barley varieties were fed. Differences in P digestibility and fecal output between corn and different barley varieties indicate that it may be possible to select feedstuffs to reduce levels of phosphorus entering the environment from livestock manure.

Item	CORN	STEP	IDGD	HGTN	BRNS
P intake, g/d	118^a	114^{ab}	97^d	101^{cd}	107^{bc}
Fecal P, g/d	70^c	79^b	83^{ab}	77^{bc}	85^a
P digestibility, %	37.4^a	29.2^{ab}	11.7^d	22.1^{bc}	19.1^{cd}
P absorption, g/d	26^a	12^b	-7^c	1^c	0^c

^{abcd}Values with different superscripts vary (P<0.05).

Key Words: phosphorus, barley, dairy cows

Swine Species

439 Sow hulls for gestating sow diets. PJ McKinnon* and SX Shi, *American Soybean Association.*

Two feeding trials were conducted on commercial farms in two different years to study the effects of unheated soy hulls in gestation diets on reproductive performance of mature crossbred (YxL) gestating sows. Treatments consisted of standard corn-soy control diets and 20 or 18 % soy hulls in trials 1 and 2 respectively. Reproductive performance was studied for one parity in trial 1 and two consecutive parities in trial 2. Sows were individually fed 2-2.2 kg of the control diet (CP 14.9 %, lysine 0.65 %, ME 3000 kcal/kg-est), depending on body condition and 2.2-2.4 kg/day of the soy hulls diet (CP 13.8 %, lysine 0.83 %, ME 2850 kcal/kg-est). All sows were fed a common corn-soy diet ad libitum in lactation. Sows were weaned at 21 days in trial 1 and 28 days in trial 2. Statistical analyses of the two trials were performed separately but in trial 2, results for the first and second parities were combined, because there were no significant differences in traits measured. With the exception of gestation weight gain in trial 1, where the sows on the soy hulls diet gained 8.4 kg BW less than sows fed the control diet, no other significant differences were observed. Since it was not possible to collect gestation feed intakes, it is not known whether this is due to feed intake differences or other factors. In trial 2, gestation body weight gain was lower than expected, but is in line with NRC (1998) data for mature gestating sows of >2 litters. Lactation weight loss in trial 2 is considerably greater than in trial 1, but litter birth and weaning weights are considerably greater, even if allowance is made for longer lactation. The results indicate that 18-20 % unheated soy hulls can be fed to gestating sows without depression of reproductive performance.

	Trial 1		Trial 2	
	Corn	Soy hulls	Corn	Soy hulls
n (1st/2nd parity of trial)	96	89	(50/42)	(52/45)
Gestn wt gain, kg	48.2	39.8	23.7	24.0
Lactn wt loss, kg	9.6	8.1	22.2	22.8
Lactn ADFI, kg	5.3	5.3	6.1	6.5
Wean to estrus, d	6.5	5.5	6.3	6.2
Av no pigs born alive	8.9	9.4	11.2	11.5
Av birth wt, kg	1.51	1.45	1.51	1.54
Litter birth wt, kg	13.2	13.4	17.0	17.6
No pigs 21 d	8.7	8.5	10.4	10.9
Av wean wt kg (21 or 28 d)	5.7	5.7	7.5	7.6

Key Words: Soy hulls, Sows, Gestation

440 Reducing odor in swine production: effect of a natural carbon-mineral supplement on odor reduction.

S. W. Kim*, F. Ji, and J. J. McGlone, *Texas Tech University*.

A natural, carbon-mineral source (NCM) is a feed supplement that is mined and minimally processed (Promax®, HumaTech, Houston, TX). Carbon compounds include humic acid, fulvic acid, and other organic compounds and minerals include bioavailable iron and other trace minerals. Ninety-six pigs, weaned at d 21 of age, were used. Pigs were allotted to one of two treatments, control and NCM. Each treatment had 6 replicates and a group of 8 pigs was housed to each pen-replicate. The NCM was supplemented to the treatment diet at the level of 0.5%, but to the control diet. After weaning, pigs were fed based on a 3-phase feeding program. Phase 1 was 1-wk postweaning, phase 2 was 2-wk after phase 1, and phase 3 was 4-wk after phase 2. A group of 8 pigs from each pen-replicate was moved to a pen (1.2 x 2.4 m) in a ventilated environmental chamber (3.0 x 3.0 x 2.4 m) for 2-d during which aerial ammonia was measured. The temperature inside of the chamber was maintained at 24°C and the fan was working continuously during the experimental period. A gas monitor with the sensors for ammonia, and hydrogen sulfide was used to measure the changes of these compounds during the 2 d collection period with 5 min intervals. Feed intake of pigs during the 2-d collection period was measured. The initial and final body weights were measured before and after moving pigs to the chamber. Feed intake and initial body weight were used as covariates in analyzing the data. The first 24 hr period was considered an acclimation period and the last 24 hr period was considered the primary data collection period. Hydrogen sulfide was very low and generally not detectable in our model. The main effect of treatment was not significant (P>0.10). The treatment by time interaction, however, was highly significant (P<0.01). Pigs given dietary NCM produced 5 to 40% less air ammonia. The regression models showed a clear diurnal variation in air ammonia. The increase in ammonia was associated with pig activity. Pig activity probably increased air ammonia by both producing more ammonia through more excretions and by mixing the air more when pigs were active. Using our model system, this formulation of NCM may reduce air ammonia to different degrees depending upon the time of day and pig activity levels

Key Words: Pigs, Natural carbon mineral, Odor

441 Response of growing pigs to dietary threonine:lysine ratio and protein level.

P.B. Lynch*[1], P.G. Lawlor[1], and S. van Cauwenberghe[2], [1]*Teagasc, Moorepark Research Centre, Fermoy, Co. Cork, Ireland*, [2]*Ajinomoto-Eurolysine, Paris, France*.

The objective of this trial was to assess the response of pigs from 50 to 95kg to variation in threonine to lysine ratio in diets of high (16%) and low (14%) crude protein content. Fifty single sex (gilts and boars) groups of 14 crossbred pigs (mean = 50kg), blocked on sex and weight were assigned at random to the following diets - (A) Low protein with THR:LYS ratio of 50% (LP/0.5); (B) Low protein with THR:LYS ratio of 60% (LP/0.6); (C) Low protein with THR:LYS ratio of 70% (LP/0.7); (D) High protein with THR:LYS ratio of 60% (HP/0.6); (E) High protein with THR:LYS ratio of 70% (HP/0.7). Diets, based on wheat, barley, wheat middlings and soybeanmeal, contained 13.5 MJ/kg digestible energy, 9.0g/kg total lysine (set at a limiting level on purpose to assess ratio response), nutritionally adequate levels of other essential amino acids and were fed ad libitum as dry pellets. Daily feed intake, daily weight gain and feed conversion ratio (FCR) were 2338, 2377, 2389, 2310 and 2333g (s.e. 37, P>0.10); 708, 792, 806, 755 and 773g (s.e. 16, P<0.01); 3.32, 3.01, 2.97, 3.07 and 3.03 (s.e. 0.05; P<0.01) for treatments A to E respectively. Backfat depths and carcass lean meat percentages (measured by Hennessy Grading Probe) were 11.5, 11.0, 11.4, 11.0 and 10.5mm (s.e. 0.35; P>0.10); 58.1, 59.0, 58.4, 58.6 and 59.4% (s.e. 0.30, P>0.10) for treatments A to E respectively. On the LP diets (A, B and C), there was a significant linear response (P<0.01) in daily gain to increasing the THR:LYS ratio and a tendency towards a quadratic effect (P=0.09). In FCR both linear (P<0.01) and quadratic (P<0.05) effects were significant. Feeding a lower protein diet (treatments B and C v. D and E) resulted in improved growth rate (P<0.05) and a tendency towards increased feed intake (P=0.11) with no effect on FCR (P>0.10). The small numerical improvement in FCR at the lower dietary protein is consistent with the energy sparing effect of low protein diets combined with the higher digestibility of lysine, threonine and methionine in these diets.

Key Words: Threonine, Crude protein, Growing swine

442 Effects of feeding echinacea purpurea to nursery pigs on performance and viremia.

J.R. Hermann*[1], M.S. Honeyman[1], J.J. Zimmerman[1], and C.C. Chang[1,2], [1]*Iowa State University*, [2]*Pig Research Institute*.

Our objective was to determine the effectiveness of Echinacea purpurea on growth performance and viremia when challenged with porcine reproductive and respiratory syndrome (PRRS). Three replicate trials involving a total of 120 pigs were conducted at the Iowa State University Livestock Infectious Disease Isolation Facility. The pigs and feeders were initially weighed and at 7 d intervals until the completion of each 42 d trial. Average daily gain (ADG) and average daily feed intake (ADFI) were recorded for each pen. Blood was collected at 7 d intervals. A commercial ELISA kit was used to detect PRRS specific antibody titers in serum. Sample-to-positive (S/P) values of 0.4 or greater were considered positive. A decedent clone of North American prototype PRRS virus isolate ATCC VR-2332 that had been passaged in pigs for 67 days was used in the study. Four complete meal-form dietary treatments were fed, containing carbadox (.055 g/kg), control, Echinacea I (2%), and Echinacea II (4%). Echinacea purpurea was added to the diets at 2 and 4% levels by weight. Diets were isocaloric and isolysinic based on calculated analysis. Pigs were initially allotted by weight to one of eight treatments. There were five pigs in a pen per treatment for each of three replications. In the PRRS positive pigs there was no difference in ADG for the dietary treatments (P > .10). There was a trend toward lower titer values for the Echinacea fed pigs from day 21 to day 35. Echinacea I (2%) compared to the control had a slightly lower titer (P < .10). Echinacea II (4%) compared to the control also had a lower PRRS specific antibody titer (P < .06). Overall in the PRRS negative pigs there were no differences in ADG for the dietary treatments. The PRRS negative group of pigs showed no positive titers. In the PRRS virus challenged pigs, the antibody titers trended lower for the Echinacea fed pigs compared to the control. More work is needed to clarify the possible mechanism of dietary Echinacea in viral infections.

Key Words: Echinacea, PRRS, pig

443 Growth rate and age at first estrus in relation to efficient gilt pool management.

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Identifying "select"(cyclic) gilts below market weight and avoiding excessive weights at breeding are two essential features of efficient gilt management systems. Prepubertal Camborough 22 gilts (PIC Canada Ltd; n=148) were used to examine relationships between growth rate and age puberty. Gilts were allocated to the study at 103.7 d of age and 62.2 kg weight, had ad libitum access to feed and water, were housed in groups of twenty and received approximately 20 min direct exposure to a vasectomized boar daily as a pen group for pubertal stimulation starting at 141.1±4.7 d (mean±SD) of age. Puberty was determined as the first day gilts exhibited the standing reflex in response to contact with a boar; gilts not exhibiting estrus by 180 d of age were considered non pubertal. There was no relationship between growth rate at 100d of age and age at puberty (P=.67, r=.04). As a consequence, inherent differences in age at puberty (lsmean±sem) (Early, 150.4±1.0 d; n=28: Intermediate, 158.4±.6 d; n=74: Late, 174.2±.9 d; n=33: or non pubertal, n=13) affected (P≤.05) weight (109.7±2.3, 115.7±1.4, 126.9±2.1 and 134.0±3.5 kg, respectively) and backfat depth (12.0±.8, 14.1±.5, 15.2±.7 and 15.2±1.0 mm, respectively) but not growth rate (P≥.05) (.72±.01, .72±.01, .73±.01 and .76±.02 kg/d, respectively) at puberty. Additionally, the Late puberty group averaged 33.1±.9 d from stimulation to first estrus. Litter of origin affected age at puberty (P≤.04) and is clearly an important contributing factor to inherent differences in the rate of sexual maturity. These results indicate that: 1) with average growth rates exceeding .7kg/d to puberty, gilts would need to cycle by 171 days (31 days after start of stimulation at 140d) to be "selected" below market weight; 22% of gilts failed to meet this target. 2) Later maturing (≥175d) and faster growing (≥.8 kg/d) gilts weighed ≥140 kg at first estrus and constitute potentially overweight gilts at breeding and farrowing.

Key Words: Gilts, Puberty, Growth rate

444 The effects of including a blend of incapsulated organic and inorganic acids in diets for weanling pigs. H. H. Stein*[1], D. Peters[1], B. T. Christopherson[1], and E. Cerchiari[2], [1]*South Dakota State University,* [2]*SODA Feed Ingredients, Monaco.*

One hundred and twenty weanling pigs were used in a five-week nursery experiment to evaluate the effect of including the acidifier Aciprol® in the phase 1 and the phase 2 diets for nursery pigs. Aciprol® consists of a blend of organic and inorganic acids that have been incapsulated during the manufacturing process. Four experimental groups were included in the experiment. Treatment group 1 was the negative control group # pigs in this group were fed unsupplemented phase 1 and phase 2 diets. Treatment group 2 was the Aciprol® supplemented group (0.5 and 0.3% in the phase 1 and the phase 2 diet, respectively) while pigs on treatment groups 3 and 4 were fed diets supplemented with 3000 ppm of zinc oxide and 50 ppm carbadox, respectively. Pigs were weaned at an age of 20 d, and they were placed in groups of five pigs per pen. There were six pen replicates per treatment group. The phase 1 diet was offered on an ad libitum basis during the initial two weeks post-weaning, while in the next three weeks, the phase 2 diet was provided. During the initial two weeks post-weaning, pigs fed the diet containing zinc oxide grew faster (PP < 0.05) and had a higher (P P< 0.05) daily feed intake than had pigs fed any of the other diets. However, during the following 3 weeks and overall for the entire experimental period, no differences (PP > 0.05) between the four groups were observed for daily gain or for average daily feed intake. Pigs fed the Aciprol® supplemented diets had a greater (P P < 0.1) gain to feed ratio during the second phase of the experiment and overall for the entire experimental period than had pigs fed diets 1 and 3. The results for the Aciprol® supplemented diet were not different (PP > 0.1) from those obtained for the carbadox-supplemented diet. From the present investigation, it is concluded that the dietary supplementation with Aciprol® during the nursery phase may be as beneficial as the supplementation with carbadox. ®

Key Words: Protected acids, Weanling pigs

Alpharma Beef Cattle Nutrition
Factors Affecting Feed Intake in Beef Cattle

445 The multifactorial nature of food intake control. J.M. Forbes*, *Centre for Animal Sciences, University of Leeds, England.*

In some situations it is apparent that intake of forage by ruminant animals is limited by the capacity of the digestive tract while in others it seems that metabolic factors control intake. It has sometimes been argued that physical limitation on intake is more apparent than real because positive relationships between rate of digestion and intake can be ascribed to causes other than gut capacity. However, there are receptors in the rumen wall sensitive to stretch and their afferent pathways converge with those from other classes of receptor thereby providing the means for several types of stimulus to be combined before reaching the controlling circuits of the brain. In addition there is experimental evidence of additivity of intake-limiting factors in sheep and dairy cows. The fact that various signals affecting intake (physical, metabolic, behavioral, environmental) are in different currencies has proved a barrier to the development of models; it is proposed that abdominal stimuli resulting from the ingestion of food, as well as climatic and social factors, generate discomforts which animals prefer to avoid and learn to minimize. There is considerable evidence that ruminants can learn to avoid toxic or imbalanced foods and to choose between two foods of different nutritional value in order to avoid either an excess or a deficiency of the nutrient in which the two foods differ. From this it can be deduced that the intake of a single food may be eaten in quantities that minimize the total discomfort whereas when two or more foods are available both the mixture of foods and their total intake are varied to achieve this state. Animals fed ad libitum have naturally fluctuating daily intakes which allows their daily intake to settle in the region of their most comfortable state. While these theories have not yet been properly quantified they provide a framework for integrating the various factors known to affect intake and should lead the way to better understanding and, possibly, prediction of voluntary feed intake and diet selection by beef cattle.

Key Words: Ruminants, Feed intake, Minimal Total Discomfort

446 Effects of roughage source and level on intake by feedlot cattle. M. L. Galyean*[1] and P. J. Defoor[2], [1]*Texas Tech Univeristy,* [2]*Nutrition Service Associates, Pratt, KS.*

Intake by beef cattle fed high-concentrate, grain-based diets is likely controlled by metabolic factors and not limited by bulk fill. Small changes (e.g., 5% of DM or less) in the level of bulky roughage and changing from less fibrous to more fibrous sources of roughage typically increase DMI by feedlot cattle. Reasons for increased DMI with changes in roughage level and source are not fully understood. Energy dilution effects caused by added dietary fiber might be responsible for altered DMI, but the quantity of dietary NEg provided by roughage shows little relationship to changes in DMI with roughage source and level. Altered rate of ruminal fermentation and(or) acid production as a result of roughage source and level might affect DMI via various mechanisms, including: 1) increased chewing and(or) rumination, with increased saliva flow; 2) inherent buffering properties of roughages; and 3) altered ruminal and(or) intestinal digesta kinetics. We hypothesized that much of the effect of roughage source and level on DMI by feedlot cattle could be accounted for by changes in dietary NDF. Data from 11 trials in the published literature involving roughage source and level effects on intake by feedlot cattle were compiled. The dataset included 48 treatment means with roughage sources including hays, straws, byproducts, and silages. Roughage level ranged from 0 to 30% of DM. Effects of dietary roughage level (% of DM), NDF (% of dietary NDF from roughage), or effective NDF (eNDF, % of dietary eNDF from roughage) and the random effects of trial on DMI (% of BW) were evaluated using the MIXED procedure of SAS (SAS Inst., Inc., Cary, NC). Tabular values were used to obtain estimates of NDF and eNDF. Using trial-adjusted means, dietary roughage level accounted for 69.9% of the variation in DMI, whereas the percentage of dietary NDF and eNDF supplied by roughage accounted for 92.0 and 93.1%, respectively, of the variation in DMI. The relationship between dietary NDF (% supplied by roughage) and DMI (% of BW) for trial-adjusted data was given by: DMI = 1.8562 - 0.02751 x NDF ($P < 0.01$; RMSE = 0.0447). Based on these results, percentage of dietary NDF supplied by roughage seems useful for predicting effects of roughage source and level on DMI by feedlot cattle.

Key Words: Feedlot cattle, Feed intake, Neutral detergent fiber

447 Metabolic consequences of feeding behavior and intake in feedlot cattle. T.A. McAllister*[1], K.S. SchwartzkopfGenswein[2], K.A. Beauchemin[1], D.J. Gibb[1], M.N. Streeter[3], D.D. Hickman[1], and D.H. Crews, Jr.[1], [1]*Agriculture and Agri-Food Canada, Lethbridge, AB,* [2]*Alberta Agriculture, Food and Rural Development, Lethbridge, AB,* [3]*Alpharma Inc., Fort Lee, NJ.*

Nutritionists and feedlot managers commonly attribute metabolic digestive disturbances such as subclinical acidosis to abnormal feeding