
Avoid the consequences 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 = 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, J. D. Cronrath, and Socha M. T., 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 prepartum (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


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 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.

<table>
<thead>
<tr>
<th>Item</th>
<th>CORN</th>
<th>STEP</th>
<th>IDGD</th>
<th>HGTN</th>
<th>BRNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>P intake, g/d</td>
<td>118a</td>
<td>114a</td>
<td>97c</td>
<td>101cd</td>
<td>106bc</td>
</tr>
<tr>
<td>Fecal P, g/d</td>
<td>70b</td>
<td>79b</td>
<td>83b</td>
<td>77bc</td>
<td>85a</td>
</tr>
<tr>
<td>P digestibility, %</td>
<td>37.4a</td>
<td>29.2b</td>
<td>11.7a</td>
<td>22.1bc</td>
<td>19.1cd</td>
</tr>
<tr>
<td>P absorption, g/d</td>
<td>26b</td>
<td>12b</td>
<td>.7c</td>
<td>1c</td>
<td>0c</td>
</tr>
</tbody>
</table>

abcdValues 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 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

The objective of this trial was to assess the response of pigs from 50 to 95 kg 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 = 50 kg), 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 soybean meal, contained 13.5 MJ/kg digestible energy, 9.0 g/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 2333 kg (s.e. 37, P<0.01; 708, 792, 806, 755 and 773 kg (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 10.5 mm (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. A 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
with a boar; gilts not exhibiting estrus by 180 d of age were considered non-pubertal. There was no relationship between growth rate at 100 d of age and age at puberty (P=.67, r=.04). As a consequence, inherent differences in age at puberty (lmean±s;em) (Early, 150.4±1.0 d; n=28: Intermediate, 158.4±1.0 d; n=74: Late, 174.2±9.9 d; n=33: or non-puberal, n=13) affected (P<.05) weight (106.7±2.3, 115.7±1.4, 126.9±2.1 and 134.0±3.5 kg, respectively) and backfat depth (12.8±.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±9.9 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

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**444** The effects of including a blend of incapsulated organic and inorganic acids in diets for weanling pigs. H. H. Stein*, D. Peters², B. T. Christopherson³, and E. Cerco², ¹South Dakota State University, ²SODA 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 carboxad, 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 (PP < 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 < 0.01) 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 > 0.01) from those obtained for the carboxad-supplemented diet.

From the present investigation, it is concluded that the dietary supplemen- tation with Aciprol® during the nursery phase may be as beneficial as the supplementation with carboxad. ¹ ²

**Key Words:** Protected acids, Weanling pigs

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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 receptor s 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

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**446** Effects of roughage source and level on intake by feedlot cattle. M. L. Galvean* and P. J. Depoer*, ¹Texas Tech University, ²Nutrition 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 hay, straw, 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; RMSSE = 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, Feed intake, Neutral digestible fiber

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**447** Metabolic consequences of feeding behavior and intake in feedlot cattle. T.A. McAllister*, K.S. SchwartzkopfGenswein², K.A. Beauchemin³, D.J. Gibb³, M.N. Streeter³, D.D. Hickman¹, and D.H. crews, Jr.¹, ¹Agriculture and Agri-Food Canada, Lethbridge, AB, ²Alberta Agriculture, Food and Rural Development, Lethbridge, AB, ³Alpharma Inc., Fort Lee, NJ.

Nutritionists and feedlot managers commonly attribute metabolic di-gestive disturbances such as subclinical acidosis to abnormal feeding