

Nonruminant Nutrition: Energy and fiber

W225 Fitting and validating prediction equations of metabolizable energy of meat and bone meal for pigs. R. A. Castilho¹, P. C. Pozza², N. T. E. Oliveira³, C. P. Sangali², C. N. Langer⁴, and R. V. Nunes³, ¹*Safeeds Nutrição Animal, Cascavel, Paraná, Brazil*, ²*Universidade Estadual de Maringá, Maringá, Paraná, Brazil*, ³*Universidade Estadual do Oeste do Paraná, Mchal Candido Rondon, Paraná, Brazil*, ⁴*Swine Production System, Quatro Pontes, Paraná, Brazil*.

The aim of this study was to fit and validate models to predict the metabolizable energy (ME) of meat and bone meal (MBM) for pigs. Thirty-two barrows (26.75 ± 1.45 kg) were allotted in a randomized blocks design with 8 treatments (7 MBM that replaced 20% the basal diet) and 4 replicates, to determine the ME. All MBM samples were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), gross energy (GE), crude fiber (CF), mineral matter (MM), calcium (Ca) and phosphorus (P). The multiple linear regression models were adjusted using GE, CP, EE, MM, Ca and P as regressors (DM basis) using the ordinary least square method. To validate prediction equations, a database was compiled containing 48 pairs of observed and predicted ME. The 48 observed ME values were compiled from the literature and classified according to the scientific origin, resulting in 15 Brazilian data and 33 from international literature. The validity was initially assessed by adjusting the linear regression of 1st degree of the observed ME in function of the estimated ME, using the ordinary least squares. This procedure was adopted for the databases from the Brazilian, international and mixed literature. The validation of the estimated equations, as predictors of the linear ratio of ME, was checked by fitting a linear model of 1st degree of the predicted values ($y = b_0 + b_1x_i$) of ME by the equations initially estimated in function of the observed values. The ME values of MBM ranged from 1645 to 2645 kcal/kg. The prediction equations $ME_1 = -4233.58 + 0.4134GE + 72P + 89.62MM - 159.06Ca$ ($R^2 = 0.90$); $ME_2 = 2087.49 + 0.3446GE + 31.82MM - 189.18Ca$ ($R^2 = 0.87$); $ME_3 = 2140.13 + 0.3845GE - 112.33Ca$ ($R^2 = 0.86$); $ME_4 = -346.58 + 0.656GE$ ($R^2 = 0.80$); and $ME_5 = 3221.27 + 178.96EE - 76.55MM$ ($R^2 = 0.82$) were effective in predicting the ME of Brazilian MBM. However, there was no validation when using data obtained from international researches. In conclusion, the equations that efficiently estimates the ME of MBM for pigs in Brazilian conditions are $ME_1 = -4233.58 + 0.4134GE + 72CP + 89.62MM - 159.06Ca$ and $ME_2 = 2087.49 + 0.3446GE + 31.82EE - 189.18Ca$.

Key Words: chemical composition, feedstuff, model

W226 Effects of different net energy concentrations of diets on the growth performance of growing or finishing pigs housed individually. Gang Il Lee¹, Kwang-sik Kim², Jun Cheol Park², and Dong Yong Kil¹, ¹*Chung-Ang University, Anseong-si, Gyeonggi-do, Republic of Korea*, ²*Rural Development Administration, Cheonan-si, Chungnam, Republic of Korea*.

This experiment was conducted to investigate the effects of different net energy (NE) concentrations of diets on the growth performance of growing or finishing pigs housed individually. In experiment 1 (growing pigs), a total of 60 growing pigs (Landrace × Yorkshire × Duroc; initial BW = 34.3 ± 3.7 kg) were allotted to 5 dietary treatments with 12 replicate pens and 1 pig per pen in a 35-d feeding trial. In experiment 2 (finishing pigs), a total of 60 finishing pigs (Landrace × Yorkshire × Duroc; initial BW = 73.7 ± 5.6 kg) were allotted to 5 dietary treatments

with 12 replicate pens and 1 pig per pen in a 28-d feeding trial. Within each experiment, a corn-soybean meal-based basal diet (91.75%) was prepared to meet all nutrient requirements for growing or finishing pigs (NRC, 2012). The remaining portion (8.25%) was added to the basal diet by different inclusion ratio of soybean oil and starch to create 5 NE concentrations (2,318, 2,390, 2,462, 2,533, or 2,605 kcal NE/kg) of diets for growing or finishing pigs. The NE and amino acids concentrations in diets were calculated based on the values from NRC (2012). Pigs were allowed ad libitum access to feed and water in both experiments. Statistical model included dietary treatment as a fixed effect. Orthogonal polynomial contrast test was performed to determine linear and quadratic effects of NE concentrations of diets. Results indicated that the final BW, ADG, ADFI, and feed efficiency (G:F) of growing pigs were not affected by dietary treatments. Similarly, final BW, ADG, and ADFI of finishing pigs were not affected by dietary treatments. However, the G:F of finishing pigs was improved (linear, $P < 0.01$) with increasing NE concentrations in diets (0.326, 0.331, 0.323, 0.352, and 0.349 for 2,318, 2,390, 2,462, 2,533, or 2,605 kcal NE/kg, respectively). In conclusion, increasing NE concentrations in diets from 2,318 to 2,605 kcal/kg have no beneficial effects on the growth performance of growing pigs, but improve feed efficiency of finishing pigs.

Key Words: growth performance, net energy, pig

W227 Effects of dietary metabolizable energy levels on performance and energetic metabolism of broiler chickens. M. P. F. Teixeira, N. C. Baiao, L. J. C. Lara, M. A. Pompeu*, L. F. P. Pereira, C. W. R. Gondim, K. R. Soares, and W. L. S. Climaco, *Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil*.

Recent research has demonstrated a reduction in dietary heat increment and improvements in production performance from supplementing lipids as an energy source. This performance improvement can be attributed to increased availability of nutrients from feed ingredients, in addition to improved energy efficiency by increasing net energy (NE) of diet. The present study was conducted to evaluate the effects of increasing metabolizable energy (ME) levels in the diet on performance parameters, nutrient digestibility and energy balance of 19 to 41 d of age broilers kept in thermoneutral conditions. A total of 336 male broiler chickens were evaluated in this study, distributed in a completely randomized design with 4 treatments and 6 replicates with 14 broilers each. The treatments consisted of 4 diets containing 19% CP and increasing ME levels (2,980, 3,080, 3,180 and 3,280 kcal/kg), which were obtained by addition of soybean oil. The data were submitted to ANOVA and the means were compared by the Tukey test ($\alpha = 0.05$). Feed intake was not affected by ME levels; although the best results for weight gain (2.3 kg) and feed conversion ratio (1.53 kg/kg) were obtained in broilers fed with diets containing 3,280 kcal/kg ($P < 0.01$). The viability rate and feed cost per kg of live weight did not differ between treatments, but production efficiency ratio increased linearly as ME was increased ($P < 0.01$). The ME levels affected the EE digestibility, broilers fed with more energetic diets (3,180 and 3,280 kcal/kg) achieved better EE digestibility (79.8% and 81.4%, respectively; $P < 0.01$). Heat production and increment was not affected by ME levels. The dietary ME levels had a linear effect over NE ($P < 0.03$), but ME conversion into NE remained constant between diets. In conclusion, ME levels has influence on performance and energetic metabolism of broiler chickens under thermoneutral condition.

Key Words: heat increment, net energy, thermal comfort

W228 Effects of dietary metabolizable energy levels on performance and energetic metabolism of broiler chickens under cyclic heat stress condition. M. P. F. Teixeira, N. C. Baiao, L. J. C. Lara, M. A. Pompeu*, L. F. P. Pereira, K. R. Soares, A. F. Silva, J. F. V. Braga, and A. R. C. Abreu, *Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.*

Improving broiler performance during heat stress has been the aim of many researches, and one of most common approach is to increase dietary metabolizable energy (ME), which may increase nutrients availability and improve energy efficiency by both reducing heat increment (HI) and increasing ME conversion into net energy (k). This study aimed to evaluate the effects of increasing ME levels on performance, nutrient digestibility and energy balance of 19 to 41 d old broilers kept under cyclic heat stress (16 h of $23 \pm 2^\circ\text{C}$ and 8 h of $32 \pm 2^\circ\text{C}$; $60 \pm 2\%$ RH). A total of 336 male broilers were used, distributed in a completely randomized design with 4 treatments and 6 replicates of 14 birds each. Treatments consisted of 4 diets containing 19% CP and 4 ME levels (2,980, 3,080, 3,180 and 3,280 kcal/kg), which were obtained by the addition of soybean oil. Data were submitted to ANOVA and the means were compared by Tukey and SNK test for performance and energetic metabolism, respectively ($\alpha = 0.05$). Weight gain, feed intake, viability and productive efficiency ratio were not influenced by ME levels ($P > 0.05$). However, broilers presented a better feed conversion ratio when fed with 3,280 kcal/kg, followed by 3,180 kcal/kg ($P = 0.003$). Moreover, the lowest feed cost per kg of live weight was observed with 2,980 kcal/kg, followed by broilers that consumed 3,080 kcal/kg of feed ($P = 0.028$). The digestibility of CP and EE increased linearly with ME increase in diet ($P < 0.001$). The consumption of ME adjusted to zero nitrogen balance was not affected by diet treatment ($P > 0.05$), but a higher heat production was observed in broilers that received diets with the lowest ME level ($P = 0.012$). HI was higher in broilers fed with 2,980 kcal/kg diet ($93.9 \text{ kcal/kg}^{0.75}/\text{day}$) ($P = 0.016$). The dietary ME levels had a linear effect over net energy ($P < 0.021$), but k remained constant between diets ($P > 0.05$). We conclude that ME level influences on performance and energetic metabolism.

Key Words: cyclic heat stress, heat production, net energy

W229 Determination of apparent digestibility of fibrous sources for finishing pigs. Bernardo Berenchein*¹, Evelyn Brito¹, Adibe Abdalla², Helder Louvandini², Dineshkumar Danashekar², Adibe Abdalla Filho², Paulo Lima², and Patrícia Righetto², ¹*Laboratory of Studies and Researches of Production and Nutrition of Poultry and Swine; Federal University of Amazonas, Parintins, AM, Brazil,* ²*Center of Nuclear Energy in Agriculture, Piracicaba, SP, Brazil.*

Many studies evidenced that the possibility of using forages and other grasses as feedstuffs in swine production. However, there is a need to study the potential fibrous feedstuffs in swine production in terms of identification, quantification and evaluation of interactions between physiological and associative effects on digestibility and animal performance. Hence, the objective of the present study was to evaluate the apparent digestibility of Tifton-hay, Citric Pulp and Soybean hulls in finishing pig diets. Twenty crossbred barrows ($70 \pm 1.95 \text{ kg}$) were distributed in a randomized block design with 4 treatments ($n = 5$) fed 20% replacement of fibrous diets on basal diet, Group I- 100% basal diet; Group II- 80% basal diet +20% Tifton hay; Group III- 80% basal diet +20% Citric pulp and Group IV- 80% basal diet +20% Soybean hulls, in individual metabolism cages. Apparent digestibility of Dry Matter and nutrients was performed by total feces and urine collection method for pigs, which animals were housed in metabolism cages for 12 d (7 d for acclimation and 5 d for collection). Feeds and feces were

analyzed for dry matter (DM), crude energy (CE), crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF). Our result shows that Tifton hay had 2.425 kcal/kg of apparent digestible energy and 3.36% of apparent digestible protein. In addition, apparent digestibility of NDF and ADF of Tifton hay were 28.47 and 22.63% respectively. However, the results for Citric pulp were 2.850 kcal/kg of apparent digestible energy, 1.47% of apparent digestible protein and also apparent digestibility of NDF and ADF, were 8.14 and 7.85%. Soybeans hulls showed 2.250 kcal/kg of apparent digestible energy, 7.85% of apparent digestible protein and apparent digestibility of NDF and ADF were 21.7 and 26.39%, respectively. Therefore, our present study concluded that fibrous sources were used like feedstuffs in finishing pig diets. Moreover, it confirms that fibrous feeds will be both nutritionally and economically beneficial to swine production. The authors thank for the support of CNPq and FAPEAM.

Key Words: citric pulp, soybean hulls, Tifton hay

W230 Feeding diets containing low-protein or rapidly fermentable carbohydrate to weanling pigs does not affect growth performance. Vivian V. Almeida*¹, Amoracyr J. C. Nuñez¹, Patrícia V. A. Alvarenga², Fabrício R. Castelin², Ysenia V. Silva-Guillen², and Maria Cristina Thomaz², ¹*Department of Animal Sciences, Purdue University, West Lafayette, Indiana,* ²*Department of Animal Science, São Paulo State University, Jaboticabal, São Paulo, Brazil.*

The objective in this study was to evaluate the effects of dietary CP and dried citrus pulp (DCP, rapidly fermentable carbohydrate source) contents on growth performance of weanling pigs. A total of 108 barrows weaned at 21 d of age were blocked by initial BW ($5.82 \pm 0.96 \text{ kg}$) and randomly assigned to 4 treatments with 9 replicate pens per treatment and 3 pigs per pen. Treatments were arranged in a 2×2 factorial, with 2 CP contents (HCP and LCP; high- and low-CP diets, respectively) and 2 DCP contents (0 and 7.5%, as-fed basis). The HCP treatments consisted of feeding 20 and 21% CP diets (as-fed basis) throughout the pre-starter I (1 to 14 d) and pre-starter II (15 to 28 d) phases, respectively. For the LCP treatments, CP contents were 16 and 17% for the pre-starter I and II diets, respectively. The AA contents in the diets were balanced by supplementation with crystalline AA, such as L-Lys, DL-Met, L-Thr, L-Trp, L-Val, and L-Ile to maintain an ideal AA pattern. Ideal AA ratios (standardized ileal digestible basis) were: 100% Lys; 28% Met; 63% Thr; 18% Trp; 69% Val; and 55% Ile. Individual pig BW and pen feed disappearance were recorded weekly to determine ADG, ADFI, and G:F. Data were analyzed as repeated measures using the MIXED procedure of SAS, with pen and block as the random effects and CP, DCP, day, and 2-way and 3-way interactions as the fixed effects. There were no CP x DCP interactions for BW, ADG, ADFI, and G:F; thus, the main effects are discussed. Growth performance was not affected by the dietary DCP contents. Even though BW and ADFI did not differ between dietary CP contents during the 28-d feeding period, pigs fed the LCP-diet showed decreased ADG ($P = 0.03$) and G:F ($P = 0.02$) from d 21 to 28 post-weaning compared with those fed the HCP-diet. However, overall ADG and G:F were not affected by reducing the dietary CP content. In conclusion, feeding diets containing 7.5% DCP to weanling pigs does not affect growth performance. Moreover, dietary CP content in pig pre-starter diets may be reduced by 4 percentage units when combined with AA supplementation without depressing overall growth performance.

Key Words: amino acid, fiber, pig

W231 Effects of dietary protein and rapidly fermentable carbohydrate contents on cecal microbial fermentation profile of weanling pigs. Vivian V. Almeida*¹, Amoracyr J. C. Nuñez¹, Patrícia V. A. Alvarenga², Fabrício R. Castellini², Ysenia V. Silva-Guillen², and Maria Cristina Thomaz², ¹Department of Animal Sciences, Purdue University, West Lafayette, Indiana, ²Department of Animal Science, São Paulo State University, Jaboticabal, São Paulo, Brazil.

A total of 108 barrows weaned at 21 d (5.82 ± 0.96 kg initial BW) were used to determine the effects of dietary CP and dried citrus pulp (DCP; rapidly fermentable carbohydrate source) contents on VFA and ammonia concentrations in the cecal digesta of weanling pigs. Pigs were blocked by initial BW and randomly assigned to 1 of 4 treatments with 9 replicate pens per treatment and 3 pigs per pen in a randomized complete block design. Treatments were arranged in a 2×2 factorial, with 2 CP contents (HCP and LCP; high- and low-CP diets, respectively) and 2 DCP contents (0 and 7.5%, as-fed basis). The HCP treatments consisted of feeding 20 and 21% CP diets (as-fed basis) throughout the pre-starter I (1 to 14 d) and pre-starter II (15 to 28 d) phases, respectively. For the LCP treatments, CP contents were 16 and 17% for the pre-starter I and II diets, respectively. Crystalline AA were added to the HCP and LCP diets to maintain an ideal AA pattern. Cecal digesta samples were collected from 1 pig per pen on d 7 and 28 postweaning for determinations of VFA profile by gas chromatography and ammonia concentration by colorimetry. Data were analyzed as repeated measures using the MIXED procedure of SAS, with pen and block as the random effects and CP, DCP, day, and 2-way and 3-way interactions as the fixed effects. Pigs fed diets containing 7.5% DCP tended ($P = 0.06$) to have increased acetate concentration and decreased ($P < 0.01$) propionate, isovalerate, and valerate concentrations in the cecum. Cecal butyrate, isobutyrate, and total VFA concentrations were not affected by the treatments. There was a DCP \times day interaction ($P < 0.05$) for isovalerate concentration, in which dietary inclusion of 7.5% DCP decreased ($P < 0.01$) isovalerate concentration only at 28 d postweaning. There was a CP \times DCP interaction for ammonia concentration ($P < 0.01$), in which adding 7.5% DCP to the diet tended ($P = 0.06$) to decrease cecal ammonia concentration only for pigs fed the LCP diet. In conclusion, low-protein AA-supplemented diets with 7.5% DCP inclusion may reduce proteolytic fermentation in the cecum of weanling pigs.

Key Words: microbial metabolite, protein, piglet

W232 Effect of feeding wheat- or barley-based diets with high- or low- nutrient density on diet nutrient digestibility and growth performance in weaned pigs. X. Zhou*¹, M. G. Young², M. L. Swift^{1,3}, E. Beltranena^{1,4}, and R. T. Zijlstra¹, ¹University of Alberta, Edmonton, AB, Canada, ²Gowans Feed Consulting, Wainwright, AB, Canada, ³Alberta Agriculture and Rural Development, Lethbridge, AB, Canada, ⁴Alberta Agriculture and Rural Development, Edmonton, AB, Canada.

Barley grain is a commonly fed energy feedstuff for grower-finisher pigs in western Canada. However, its feeding value for weaned pigs is poorly characterized, especially by modern feed formulation method using NE values and standardized ileal digestible (SID) AA coefficients for feedstuffs. Formulating lower nutrient dense diets may reduce feed cost, provided weaned pigs can maintain growth performance by increasing ADFI to meet requirements. To compare the feeding value of wheat- and barley-based diets with high- or low- nutrient density, 4 diets based on 64% wheat or 68% barley grain providing either 2.4 or 2.3 Mcal NE/kg were fed in a 2×2 factorial arrangement to 208 weaned pigs (9.0 kg) housed in 13 pens per diet. Diets were formulated to 4.5

g SID Lys/Mcal NE and were fed for 21 d. Feed added, remaining, and pig BW were measured weekly to calculate pen ADFI, ADG, and G:F. Freshly-voided feces were collected on d 19 and 20 to measure diet apparent total-tract digestibility (ATTD) of DM, GE, and CP and diet DE values. No interactions between cereal source and nutrient density were observed. Compared with wheat-based diets, feeding barley-based diets reduced ($P < 0.01$) the ATTD of DM, GE, and CP by 2.7, 3.0, and 4.4%, respectively, and reduced ($P < 0.01$) measured diet DE value by 0.05 Mcal/kg. Compared with high-nutrient density diets, feeding low-nutrient density diets reduced ($P < 0.01$) ATTD of DM, GE, and CP by 2.6, 1.8, and 2.3%, respectively, while measured diet DE value was not affected. Overall, feeding barley-based diets increased ($P < 0.01$) ADG by 41 g and G:F by 0.04 g:g compared with feeding wheat-based diets, but ADFI was not affected. Diet nutrient density did not affect ADFI, ADG, or G:F. In conclusion, feeding barley grain instead of wheat as cereal energy source for weaned pigs may increase growth performance. Growth performance of weaned pigs was not affected by reducing dietary NE by 0.1 Mcal/kg when SID Lys/NE was maintained. Feeding barley- instead of wheat-based diets provided advantages for the feeding of weaned pigs.

Key Words: barley, energy, weaned pig

W233 Graded concentrations of dietary wheat bran reduce ileal and total tract digestibility of nutrients but increase hindgut digestibility of dry matter and organic matter in pigs. A. R. Son*, W. B. Kwon, and B. G. Kim, Konkuk University, Seoul, Republic of Korea.

The objective was to determine the effects of graded concentrations of wheat bran (WB) on apparent ileal (AID), apparent total-tract (ATTD), and hind gut digestibility of nutrients and to test the effects of time for collecting fecal grab samples on nutrient digestibility in pigs. Six barrows (initial mean BW of 70.7 ± 5.7 kg) surgically fitted with a T-cannula in the distal ileum were used. A replicated 3×3 Latin square design was used with 3 diets, 3 periods, and 6 pigs. A basal diet was prepared to mainly contain wheat, soybean meal, and cornstarch. Two additional diets were formulated to contain 20 or 40% of WB at the expense of cornstarch. Each experimental period consisted of a 7-d adaptation period and a 4-d collection period. After the adaptation period, fecal samples were collected on d 8 and 11 using a grab sampling method, and ileal digesta samples were collected on d 9 and 10. To compare differences between nutrient digestibility calculated based on time points for fecal grab sampling, before or after the collection period for ileal digesta, a paired *t*-test was used. The AID of DM (81.8, 71.4, and 58.4%), OM (84.9, 75.0, and 62.4%), CP (78.2, 77.5, and 68.9%), and ADF (49.7, 45.4, and 36.1%) linearly decreased ($P < 0.05$) with increasing inclusion rate of WB from 0 to 40%. The ATTD of DM (91.8, 84.7, and 76.0%), OM (93.9, 87.2, and 78.8%), CP (89.7, 88.5, and 84.1%), and ADF (68.6, 53.4, and 39.1%) linearly decreased ($P < 0.01$) as the inclusion rate of WB increased. Hindgut digestibility of DM (9.6, 13.4, and 17.6%) and OM (8.7, 12.2, and 16.4%) linearly increased ($P < 0.05$), and that of NDF (30.5, 15.2, and 10.3%) and Ca (19.9, 18.2, and 10.1%) linearly decreased ($P < 0.05$) with increasing inclusion rate of WB. However, there were no differences in ATTD of nutrients between time points for feces grab sampling. In conclusion, the inclusion of WB reduced AID and ATTD of nutrients but increased hindgut digestibility of DM and OM, and there were no difference in the ATTD between the fecal collection time points of before and after ileal digesta collection in pigs.

Key Words: digestibility, swine, wheat bran

W234 Up to 30% insoluble dietary fiber reduces carcass fat content of heavy pigs. Daniela Junqueira Rodrigues¹, Maria Cristina Thomaz¹, Urbano dos Santos Ruiz², Maryane Sespere Oliveira*¹, Everton Daniel¹, Fabrício Rogério Castelini¹, Ysenia Victoria da Silva Guillen¹, Vivian Vezzoni Almeida¹, and Sarah Sgavioli¹, ¹Universidade Estadual Paulista, Jaboticabal, Sao Paulo, Brazil, ²Universidade de São Paulo, Piracicaba, Sao Paulo Brazil.

The slaughter of heavy pigs (120 to 130kg BW) provides relatively bigger carcasses and a higher amount of meat, but has the disadvantage of a higher fat deposition, given that animals have higher food intake while protein deposition remains the same. Qualitative feed restriction is a technique that provides caloric intake control, diluting the diet energy with a fibrous ingredient. Our aim was to test the effects of diets containing increasing concentrations of insoluble fiber as part of a qualitative feed restriction program on carcass traits. Thirty 2 barrows (commercial crossbred; initial BW 78.53 ± 11.02kg), were assigned to 4 dietary treatments (ad libitum) with 8 replicate pens per treatments and one animal per pen in a randomized block design: control (corn and soybean meal based; 3230 kcal/kg calculated ME, 13.9% CP, 15.5% insoluble fiber) and 3 diets with increasing concentrations of insoluble fibers (20, 25 and 30%; from purified cellulose), and consequently decreased concentrations of calculated ME. The slaughtered happened when BW means were 133.30 ± 11.59kg. The yields were calculated based on the final BW, the backfat thickness, loin eye and fat area were measured at last ribs, in the insertion of the last thoracic vertebra to the first lumbar. Data were analyzed by ANOVA using GLM procedure of SAS, polynomial regression were used to determine the effect of insoluble fiber. We observed linear reduction ($P < 0.05$) to backfat thickness and fat area, moreover, linear increase to meat:fat ratio. There were no differences in final BW, yield, lean meat, loin eye area and ham yield. In conclusion, using up to 30% of insoluble fiber in diets of heavy pigs as part of a qualitative feed restriction program reduces carcass fat without altering other carcass traits.

Table 1 (Abstr. W234). Carcass traits from swine fed different levels of insoluble fiber

| Item | Experimental diets (% IF) | | | | SEM | Effect of IF |
|--------------------------------|---------------------------|--------|--------|--------|------|--------------|
| | 15.5 | 20 | 25 | 30 | | |
| Final BW, kg | 136.18 | 132.38 | 131.83 | 130.97 | 2.23 | — |
| Yield, % | 80.83 | 80.54 | 79.72 | 79.14 | 0.76 | — |
| Lean meat, % | 55.53 | 54.53 | 56.11 | 57.39 | 0.75 | — |
| Backfat thickness, mm | 33.97 | 31.62 | 32.16 | 26.78 | 0.90 | Linear |
| Loin eye area, cm ² | 44.14 | 39.14 | 43.14 | 45.43 | 1.36 | — |
| Fat area, cm ² | 28.86 | 33.86 | 23.29 | 23.14 | 1.48 | Linear |
| Meat:Fat | 1.63 | 1.16 | 1.97 | 2.14 | 0.12 | Linear |
| Ham yield, % | 29.22 | 27.93 | 30.75 | 29.04 | 0.55 | — |

Key Words: backfat thickness, cellulose, feed restriction

W235 Effect of dietary inclusion of insoluble fiber from sugar cane on meat quality of finishing swine. Maryane Sespere Oliveira*, Maria Cristina Thomaz, Marco Monteiro Lima, Fabrício Faleiros Castro, Patricia Versuti Arantes Alvarenga, Manuela Vantini Marujo, and Daniela Junqueira Rodrigues, *Universidade Estadual Paulista, Jaboticabal, Sao Paulo, Brazil.*

The objective of this study was to evaluate the effects of insoluble fiber, extracted from sugar cane, in finishing swine diets on meat quality. Fifty barrows were blocked by initial BW (79.33 ± 2.20 kg) and randomly assigned to one of 5 treatments with 10 replicate pens per treatment and

one animal per pen. Treatments consisted of corn/soybean meal-based diets formulated to contain 0, 5, 10, 15 to 20% insoluble fiber and the levels of calculated ME (3230, 3069, 2905, 2745 and 2586 kcal/kg) were decreased according to increased dietary fiber. Pigs were slaughtered when BW means were around 130 kg. Initial pH (pH45) in *longissimus dorsi* (LD) was measured at the last rib position 45 min after slaughter and final pH (pHu) was measured 24 h after slaughter. The left LD muscle was removed, and sections of about 10 cm thickness were cut from the anterior end for meat quality analysis, such as, color, drip loss, oxidative stability, shear force, the concentration of cholesterol and lipids. The color of LD was measured with a Minolta Chromameter. The oxidative stability was assessed by TBARS. The shear force required to shear each block of muscle was determined by means of a Stable Micro systems texture analyzer fitted with Volodkevitch jaws. Data were analyzed by ANOVA using the MIXED procedure of SAS, diet was the fixed effect and replicate was the random effect. Polynomial contrasts were used to determine the effect of insoluble fiber inclusion. The drip loss, color parameters *L* (lightness), *a* (redness), *b* (yellowness) of LD and muscle pH were unaffected by dietary fiber treatments. But linear responses in Shear force (2.00, 1.74, 1.75, 2.00 and 1.87 ± 0.12, $P < 0.05$) and quadratic responses in Cholesterol (27.35, 25.24, 28.59, 27.00 and 24.51 ± 2.12, $P = 0.02$) were observed as amount of insoluble fiber increased in the diet. Insoluble fiber level had no effect on oxidative stability and lipids of LD. In conclusion, increasing insoluble fiber in the diet may soften meat and reduce cholesterol in the swine meat, without altering other meat qualities.

Key Words: insoluble fiber, meat quality, pig

W236 Mannans and glucans in diets for weanling pigs and their effects on the diarrhea incidence and pH of the digestive tract. Patricia V. A. Alvarenga, Maria C. Thomaz, Marco M. Lima*, Daniela J. Rodrigues, Manuela V. Marujo, Fabrício F. Castro, and Maryane S. F. Oliveira, *Univesidade Estadual Paulista, Jaboticabal, Sao Paulo, Brazil.*

An experiment was conducted to evaluate the effects of diets containing mannans and glucans on diarrhea incidence and pH of the digestive tract organs of weanling pigs. Ninety-six piglets weaned at 24 d (7.7 ± 1.76 kg initial BW) were blocked by initial BW and randomly assigned to 4 treatments with 8 replicate pens per treatment and 3 pigs per pen in a randomized complete block design. Pigs had ad libitum access to feed and water over a 42 d study. The treatments were: PC (positive control diet: 40ppm of colistine sulfate); NC (negative control diet: free of antimicrobial); NC+CA (NC + Compound A: 10% MOS and 18% β-glucan); NC+CB (NC + Compound B: 18% MOS and 20% β-glucan). The inclusion of Compound A was 10 kg/ton and of Compound B was 2 kg/ton. The diarrhea incidence was measured 2 times a day, every day until the 21 d of experiment, using subjective scores according to the consistency and appearance of feces (1 = well-formed, 2 = soft, and 3 = diarrhea). One animal per pen was slaughtered on d 14 of experiment. The pH of the organs contents were measured using a pH meter. Data were analyzed by ANOVA and Tukey's test (5%), using the GLM procedure of SAS. Higher incidence of diarrhea and also less incidence of well-formed and soft feces were observed for NC ($P < 0.01$). The pH of the stomach content was lower for NC+CB and PC ($P < 0.05$), and the pH of the small intestine was lower for NC+CA compared with PC ($P < 0.05$), but did not differed from NC and NC+CB. In conclusion, feeding diet with no additives results in higher incidence of diarrhea, also treatments NC+CB and PC are able to reduce the pH of the stomach.

Table 1 (Abstr. W236). Diarrhea incidence and pH of the digestive tract organs

| Item | Treatments | | | | SEM | P-value |
|--------------------|---------------------|---------------------|---------------------|---------------------|--------|---------|
| | NC | NC+CA | NC+CB | PC | | |
| pH | | | | | | |
| Stomach | 3.309 ^b | 3.278 ^b | 2.615 ^a | 2.591 ^a | 0.1994 | <0.05 |
| Small intestine | 5.366 ^{ab} | 4.900 ^a | 5.310 ^{ab} | 5.763 ^b | 0.1988 | <0.05 |
| Cecum | 5.504 | 5.230 | 4.931 | 5.023 | 0.1867 | >0.05 |
| Diarrhea incidence | | | | | | |
| Well-formed | 6.870 ^b | 17.375 ^a | 15.000 ^a | 15.250 ^a | 1.9483 | <0.01 |
| Soft | 6.000 ^b | 10.750 ^a | 11.500 ^a | 15.000 ^a | 1.5889 | <0.01 |
| Diarrhea | 25.000 ^b | 9.250 ^a | 11.375 ^a | 7.625 ^a | 1.6219 | <0.01 |

Key Words: glucan, mannan, diarrhea

W237 Influence of hydrolysable tannin extract supplementation on performance of growing-finishing pig. Rubén Aguirre¹, Javier A. Romo¹, Rubén Barajas*¹, Juan M. Romo¹, and Héctor R. Güémez^{1,2}, ¹FMVZ-Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México, ²Granja Porcina La Huerta, Culiacán, Sinaloa, México.

Seventy-two pigs (36 males and 36 females) with 26.98 ± 4.26 kg of initial weight and 70 d old were used in a 90 d experiment to evaluate the influence of hydrolysable tannin extract supplementation on performance of growing-finishing pig. Animals were weighed, allotted by initial

weight, and in groups of 6 (3 males and 3 females) they were placed in 12 paved floor pens (7×1.5 m). Pen constituted the experimental unit. In a randomized complete block design, pens were assigned to treatments as follows: 1) Growing and finishing diets formulated with corn and soybean meal (Control); or 2) Control plus addition of 0.2% of hydrolysable tannin extract (HT). The hydrolysable tannin extract was provided as SilvaFeed NutriP (Pronutrient Developer, Mexico). Results were analyzed by ANOVA for a randomized complete block design. During the first 49 d that constituted the growing phase (d 1–49), HT supplementation augmented ($P = 0.04$) body weight (66.11 vs. 60.18 kg) and improved average daily gain ($P = 0.04$) by 18% (0.802 vs. 0.680 kg). Addition of HT increased ($P < 0.01$) average daily feed intake (0.805 vs. 1.675 kg), but the feed intake as proportion of mean body weight was similar between treatments (3.84 vs. 3.89%). The feed efficiency (Gain/feed ratio) was not affected by treatments (0.410 vs. 0.447). During the finishing phase (d 50 to d 90), HT supplementation increased ($P = 0.02$) feed intake (2.44 vs. 2.08 kg) without effect on ADG and feed efficiency. In complete 90 d experiment (joint growing and finishing phases), HT supplementation tended ($P = 0.06$) to improve final weight (97.17 vs. 88.17 kg) and average daily gain (0.782 vs. 0.681 kg); increased ($P < 0.01$) feed intake (2.093 vs. 1.858 kg), without effect on feed efficiency. It is concluded that 0.2% hydrolysable tannin supplementation during the growing phase improves performance of pig, but its addition during the finishing phase does not represent any advantage.

Key Words: growth performance, hydrolyzable tannin, pig