

Meat Science and Muscle Biology II

T143 Pearson correlation coefficients of multiple methods for measuring water-holding capacity in two pork muscles. J. W. Rickard¹, Z. D. Callahan*¹, T. A. Wilmoth², C. S. Perkins¹, M. E. Wilson², and B. R. Wiegand¹, ¹University of Missouri, Columbia, ²West Virginia University, Morgantown.

Water holding capacity is an economically important aspect of fresh and further processed pork. The ability to retain or take up added water contributes to consumer acceptance and the overall eating experience of pork products. The objective of this experiment was to estimate the relationship, via Pearson correlation coefficients, of multiple accepted methods of water holding capacity determination currently employed in academic and industry laboratories. Longissimus dorsi (LD) and lumbar lean (LL) were sampled using a 2.54 cm coring device on 24 h chilled carcasses from 40 individually fed market barrows of the same genetic line. Samples were subject to duplicate determination of water holding capacity using 24 h drip loss (DL), Carver Press method (CPM), vacuum package purge (VPP), and centrifugation (CENT) (1000 x g for 10 min). Additionally, we evaluated the relationship between LD muscle fiber type and diameter, pH 24hr, and various measures of water holding capacity of fresh muscle. Within LD muscle samples, a significant correlation existed for DL and CENT ($P = 0.003$, $r = 0.454$). Within LL muscle samples, a significant correlation existed for CENT and VPP ($P = 0.003$, $r = 0.451$). LD VPP was positively correlated to LD primary fiber number ($P = 0.008$, $r = 0.523$), but negatively correlated to LD secondary fiber number ($P = 0.014$, $r = -0.387$). For LD and LL samples subject to CENT, there was a significant and negative correlation to pH 24hr ($P = 0.035$, $r = -0.337$ and $P = 0.05$, $r = -0.312$, respectively). Finally, in the current study, CPM measures of water holding capacity did not have a significant relationship to any other variable of interest ($P > 0.55$). These results indicate that muscle morphology is related to downstream water holding characteristics of fresh pork muscles. Additionally, the less invasive and less time consuming method of centrifugation (which requires approximately 15 min from sampling to result) might have merit in predicting water holding characteristics of LD and LL from pork carcasses.

Key Words: pork, water-holding capacity, Pearson correlations

T144 Carcass and muscle fiber characteristics of ractopamine fed market pigs with a genetic propensity to deposit significant subcutaneous carcass fat. C. S. Perkins*¹, T. A. Wilmoth², Z. E. Kerley¹, Z. D. Callahan¹, M. E. Wilson², and B. R. Wiegand¹, ¹University of Missouri, Columbia, ²West Virginia University, Morgantown.

Ractopamine hydrochloride (Paylean) functions as a potent repartitioning agent in growing-finishing pigs with respect to muscle and fat deposition. The objective of this experiment was to assess the extent of fat and lean partitioning in pigs with a propensity to deposit high levels of subcutaneous carcass fat. Additionally, we investigated the change in primary and secondary muscle fiber size and number in this pig model when Paylean was fed at 7.4 ppm for the final 30 d of finishing. Following an approved animal care and use protocol, individually penned, growing (42 kg) barrows ($n = 40$) were fed a commercial corn-soy diet until they reached 91 kg body weight. Then, barrows were equally and randomly assigned to a diet containing 0 (CON) or 7.4 ppm Paylean (PAY) until they reached 121 kg final wt. Carcass measurements of hot carcass weight (HCW), loin muscle area (LMA), tenth rib fat (TRF),

and last rib fat (LRF) were made. Longissimus dorsi (LD) and semi-tendonosus samples were removed after a 24hr carcass chill. Samples were fixed and used to determine diameter and number of primary and secondary fibers. As expected, PAY diets increased ($P < 0.005$) HCW (86.8 kg vs 94.5 kg) and increased ($P < 0.0001$) LMA (38.45 cm² vs. 47.22 cm²). However, TRF and LRF were not changed with PAY inclusion ($P = 0.17$ and $P = 0.96$, respectively). Primary muscle fiber diameter was lower ($P = 0.03$) in the LD and tended to be lower ($P = 0.06$) in secondary muscle fibers of the LD for PAY fed pigs. Additionally, primary muscle cell number tended to be lower ($P = 0.63$), but did not differ ($P = 0.42$) for secondary muscle fiber number of the LD for PAY fed pigs. Measures of 24hr drip loss and pH in the LD did not differ ($P > 0.05$), because of treatment. These data indicate that a typical PAY feeding program (7.4 ppm for 30 d) increased muscle mass, but did not decrease subcutaneous fat depth at the tenth and last rib for a genetic line of pigs with a propensity to deposit greater than average subcutaneous carcass fat. Dietary PAY appears to alter some morphological aspects of muscle fiber types in the longissimus muscle.

Key Words: subcutaneous fat, ractopamine, muscle fiber

T145 Shelf stability and quality of fresh ground pork and pork sausage from pigs fed a combination of dried distillers grains with solubles, ractopamine hydrochloride, and conjugated linoleic acid. B. R. Wiegand,* H. L. Evans, Z. D. Callahan, and C. S. Perkins, University of Missouri, Columbia.

This experiment evaluated the effects of ractopamine (RAC), conjugated linoleic acid (CLA) and distillers dried grains with solubles (DDGS) on fatty quality and shelf stability of ground pork. Picnic shoulders ($n = 72$) were selected from pigs fed one of 8 dietary treatments, consisting of 2 levels of DDGS inclusion (0 or 20% DDGS), 2 levels of RAC (0 and 7.4 mg/kg), and 2 levels of CLA (0 and 0.6%). Picnic shoulder trim from each animal was divided into 3 sections and each was assigned to 1 of 3 processing treatments: A) ground pork, B) fresh pork sausage, or C) fresh pork sausage + rosemary extract. Samples were analyzed for fatty acid profiles, TBARS, and color during retail display. Higher IV were seen with DDGS ($P < 0.0001$) and RAC ($P = 0.004$) inclusion and lower IV with CLA ($P < 0.0001$). A significant interaction between RAC and CLA was observed for TBARS (mg malonaldehyde / kg sample) values ($P = 0.03$). In non-RAC fed pigs, CLA decreased TBARS when compared with non CLA fed pigs (0.654 vs. 0.831). Moreover, in non-CLA fed pigs, RAC decreased TBARS from 0.831 to 0.559, indicating that RAC was more effective at lowering TBARS than CLA, but no additive effect was seen on TBARS when both RAC and CLA were fed ($P > 0.05$). Within each processing treatment, RAC inclusion led to decreased ($P < 0.05$) TBARS. In non-RAC fed pigs, processing treatment B resulted in lower TBAR than A; however, processing treatment C had lower TBARS than both A and B. In RAC-fed pigs, no difference existed between process A and B or process B and C ($P > 0.05$); however, TBARS for ground pork (process A) were significantly higher than for pork sausage (process B). Dietary DDGS inclusion did not affect TBARS values ($P = 0.78$). Minolta L* (lightness) reflectance values were lower for DDGS-fed pigs over the entire display period (52.97 vs. 53.87; $P = 0.02$). Additionally, an interaction was observed between RAC and processing treatment for L* values ($P = 0.01$). Within processing treatments B and C, RAC inclusion led to lower L* reflectance values when

compared with non-RAC fed pigs. Dietary fat source influences pork meat fatty acid profile and shelf-life can be extended with addition of rosemary as an antioxidant in pork sausage.

Key Words: pork, fat quality, shelf life

T146 Effects of genotype and dietary oil supplementation in pigs. 2. Pork quality and fatty acid composition. T. M. Bertol¹*, R. M. L. de Campos², J. V. Ludke¹, N. N. Terra³, E. A. P. de Figueiredo¹, V. L. Kawski¹, A. Coldebella¹, and N. M. Lehr¹, ¹Embrapa Suínos e Aves, Concórdia, SC, Brazil, ²Fundação Universidade Federal do Vale do São Francisco, Petrolina, PE, Brazil, ³Universidade Federal de Santa Maria, Santa Maria, RS, Brazil.

A 42 d study was carried out to evaluate the effect of genotype (GEN): terminal sire line Duroc × F1 (DC×F1); terminal sire line Embrapa MS115 × F1 (MS115×F1); and MS115 × Moura (MS115×MO) and 3 dietary oils (DIET): 3% soybean oil (SBO); 3% canola oil (CAN); and 1.5% canola oil + 1.5% flax oil (CAN+FLX), on pork quality and fatty acid composition. Ninety animals (45 barrows and 45 gilts) averaging 130.7 ± 3 d of age were utilized, 15 barrows and 15 gilts of each GEN per diet. The progeny of MS-115 sire line showed higher ($P < 0.05$) pH values at 45 min and 24 h post slaughter than DC×F1 pigs. The DC×F1 pigs had lower ($P < 0.05$) a* values and higher ($P < 0.05$) L* values than the other GEN. The highest ($P < 0.05$) content of intramuscular fat (IMF) was observed in DC×F1 pigs, followed by MS115×MO and MS115×F1 with the lowest values. Shear force was higher ($P < 0.01$) in MS115×F1 pigs, followed by DC×F1 and the lowest values observed in the MS115×MO. DIET did not affect meat quality, except marbling, which was higher ($P < 0.05$) in pigs fed CAN compared with CAN+FLX. DC×F1 pigs showed the highest values ($P < 0.01$) of C14:0, C16:0, C18:0, C16:1, and C18:1 fatty acids (FA), while MS115×F1 pigs had the highest ($P < 0.01$) content of C18:2, C18:3, C20:2, and C20:4 and the lowest ($P < 0.001$) content of C14:0, C16:0, and C18:1 in the loin. CAN or CAN+FLX oils provided higher ($P < 0.01$) content of C18:1 and lower ($P < 0.01$) content of C18:2 and C20:2. C18:3 was higher ($P < 0.01$) in the loin of pigs fed CAN+FLX and in the backfat of pigs fed CAN or CAN+FLX. The n-6/n-3 ratio was 14.61, 11.30, and 6.46 in the loin and 8.89, 6.68 and 3.77 in the backfat, for SBO, CAN and CAN+FLX oils, respectively. In conclusion, MS-115 sire line positively influenced meat color, but when crossed with F1 females reduced tenderness and IMF. Duroc sire line positively influenced the IMF. Moura breed positively influenced meat tenderness and IMF. Supplementing the diet with CAN or CAN+FLX oils provided higher monounsaturated and C18:3 and lower C18:2 FA, reducing the n-6/n-3 ratio, than supplementing SBO oil. CAN+FLX DIET provided the best n-6/n-3 ratio.

Key Words: canola oil, flax oil, soybean oil

T147 Effects of antibiotics on growth performance, plasma biochemical index and meat quality of growing-finishing pigs. X. Wu, Y. Zhang, X. Liu, H. Yang, and Y. Yin,* *Key Laboratory of Agro-Ecological Processes in Subtropical Region, Institute of Subtropical Agriculture, Chinese Academy of Sciences, Changsha, China.*

To investigate the effects of antibiotics on growth performance, plasma biochemical index and meat quality of growing-finishing pigs, 1010 weaned piglets (average weight of 6.5 ± 1.5 kg) were chosen and grouped into 2 groups: control group (antibiotic-free group, 350 piglets) and antibiotics group (660 piglets), and fed with the same base diet. The

diet in the antibiotics group supplemented with antibiotics (aureomycin 800 ppm, olaquinox 100 ppm and colistin 800 ppm) from d 28 to 120 (first stage), while the control group didn't use any antibiotics. On d 120 and 180, 6 piglets from each treatment were selected randomly and slaughtered for tissue sampling, respectively. The results showed that mortality of pigs in the first stage was lower in the antibiotics group ($P < 0.05$), and the ADG and AIDF tended to be higher; however, ADFI and ADG tended to be lower in the second stage. Compared with the antibiotic-free diet, antibiotics tended to increase plasma IgG and IgM in the first stage, while decrease in the second stage; blood glucose had a similar change. Antibiotics decreased plasma urea in the first stage ($P < 0.05$), however, plasma urea tended to be higher in the second stage. Plasma cholesterol was lower in the control group in the second stage ($P < 0.05$). It is interesting that antibiotics resulted in a significant decrease in plasma Fe in the first stage ($P < 0.05$), and plasma Total Iron Binding in the antibiotic-free group was higher ($P < 0.05$). The result from the evaluation of meat quality showed that brightness of the meat from the antibiotic-free group had a decreasing trend, and red scale had an increasing trend. These data suggest that the use of antibiotics postweaning decreased feed efficiency in a extended period, and also decreased meat quality.

Key Words: antibiotics, meat quality, pig

T148 Effects of level of feeding and breed on fatty acid profile of meat from Brazilian native goats. L. S. Lopes¹, M. L. Chizzotti²*, M. M. Ladeira², K. C. Busato², J. R. R. Carvalho², R. T. S. Rodrigues², and D. P. D. Lana³, ¹State University of Santa Catarina, Chapecó, SC, Brazil, ²Federal University of Lavras, Lavras, MG, Brazil, ³University of São Paulo, Piracicaba, SP, Brazil.

Goat meat is an important protein source for Brazilian semi-arid's population. The meat composition can be affected by breed, age, gender and nutrition. The aim of this study was to evaluate the effects of 3 breed groups (Caniné, Moxotó and F1 Boer × nondescript breed) and 3 feeding levels on fatty acid profile of goat meat, using a 3 × 3 factorial design. Forty-five goats (15 of each breed group), with average initial body weight of 15 kg were used. Five goats of each breed group were randomly allocated to one of the following treatments: ad libitum intake, restricted fed at 75% of the ad libitum intake and restricted fed at 50% of the ad libitum intake. The diet consisted of 40% of Elephant grass and 60% of concentrate. Animals were kept in individual stalls, partially shaded, in the middle of a native Caatinga area, to simulate the semi-arid environment. After 90 d on feed, all animal were slaughtered and the carcasses were dissected into meat and bone. The meat was then ground and sampled. The fatty acid profile was accessed by gas chromatography. There was no interaction between level of feeding and breed group ($P > 0.10$). The polyunsaturated fatty acid concentration was higher ($P < 0.05$) in Moxotó than in F1 Boer group. The n-3 content in F1 Boer was greater ($P < 0.05$) than in Moxotó. There were no differences ($P > 0.05$) among breeds for the other fatty acids. For the levels of consumption, the ad libitum treatment had higher ($P < 0.05$) concentration of oleic (C18:1 c9), conjugated linoleic acids (C18:2 c9t11), unsaturated and monounsaturated fatty acids and lower ($P < 0.05$) levels of saturated fatty acids than the restricted fed treatments. The n-3 concentration was higher ($P < 0.05$) in the treatment with 50% restriction. As a conclusion, breed has a small effect on meat fatty acid profile, but the level of consumption affects the fatty acid profile of goat meat. Funded by FAPEMIG and CNPq.

Key Words: CLA, fat, intake

T149 Effect of dietary organic chromium on meat quality of Mahabadi goat kids. A. Emami, M. Ganjkanlou,* A. Zali, A. Hojabri, and A. Akbari-Afjani, *University of Tehran, Tehran, Iran.*

The objective of this study was to evaluate the possible effect of different levels of dietary chromium from chromium-methionine (Cr-Met) on meat quality of Mahabadi goat kids. Thirty-two male kids (BW = 22 ± 2 kg, 4 Mo) were used in a completely randomized design with 4 treatments: 1) control (without Cr), 2) 0.5, 3) 1.0 and 4) 1.5 mg Cr as Cr-Met/animal/d. Diets were formulated for NRC requirements with forage (alfalfa and corn silage): concentrate ratio of 30:70 in TMR form. Diets were the same, except for top-dress addition of Cr-Met fed in 2 equal meals (0800 and 1600 h). Experimental period was 90 d. At the end of the trial, kids were weighed and slaughtered following 16-h fasting. Meat samples were taken from the longissimus dorsi muscle (LDM). Color (lightness (L*), redness (a*) and yellowness (b*)), and pH of LDM were measured at 24 h after slaughter. Some of the LDM were immediately stored at -20°C for assessing moisture, intramuscular fat and crude protein content. Cooking loss (CL) was determined by weighing the samples before and directly after cooking in a water bath at 70°C for 1 h. Percentage of CL was calculated. Data were analyzed by the GLM procedure of SAS 9.1 and Tukey test ($P \leq 0.05$). PH, lightness, moisture (%), intramuscular fat (%), crude protein content (%) and CL percentage were not affected by Cr supplementation ($P > 0.05$). However, chromium supplementation decreased redness ($P = 0.02$) and yellowness ($P = 0.01$) of LDM. These results suggest that supplementing diet with Cr-Met did not influence the meat quality but decreased redness and yellowness of LDM in Iranian Mahabadi goat kids.

Table 1. Meat quality of kids fed different levels of Cr-Met

Trait	Treatment (mg of CR)				SEM
	Control	0.5	1.0	1.5	
pH	5.74	5.83	5.74	5.84	0.06
L*	49.15	44.91	48.95	48.56	1.57
A*	14.52 ^a	14.27 ^a	13.97 ^{ab}	13.15 ^b	0.32
b*	10.55 ^a	10.01 ^a	10.65 ^a	8.92 ^b	0.30
CK%	22.93	23.49	26.22	21.68	2.04
Fat%	1.91	1.96	2.42	2.15	0.69
Moisture%	71.32	68.89	72.99	75.11	2.73

^{a,b}Means in each row with different superscripts were statistically different ($P > 0.05$).

Key Words: meat quality, intramuscular fat, cooking loss

T150 Influence of dietary zilpaterol hydrochloride on finishing performance, carcass characteristics and meat quality of castrated male goats. A. Hatefi*¹, A. Towhidi¹, A. Zail¹, M. Ganjkanlou¹, and A. Plascencia², ¹*Department of Animal Science, University of Tehran, Karaj, Alborz, Iran,* ²*Instituto de Investigaciones en Ciencias Veterinarias, Universidad Autónoma de Baja California, Baja California, México.*

The effects of β -2 agonist zilpaterol hydrochloride (ZH) supplementing on growth performance, carcass characteristics, longissimus muscle (LM) composition and meat quality characteristics (cooking loss and Warner-Bratzler shear force (WBSF)) in male goats were investigated. Sixteen Mahabadi castrated male goats (6 mo old and 23 ± 4.4 kg live body weight) were fed with the finishing diet based on 2.35 Mcal ME and 15.23%CP for 93 d (feedlot period). The goats were assigned to 2 treatment (ZH and control) arrangements in a completely randomized design. After 60 d of feedlot period, 8 castrated goats were treated to

0.2 mg/kg live body weight ZH for 30 d with 3 d as the withdrawn period. Then, all the goats (n = 16) were harvested and, their carcasses were stored at 0–2°C for 48h. The meat composition and quality were determined by standard procedures of the AOAC (1990) and AMSA (1995), respectively. The data collected from dry matter intake, total live body weight, postmortem aging for WBSF and cooking loss were analyzed by MIXED procedure, and the data obtained from other studied parameters were analyzed by GLM procedure of SAS software. Results showed that ZH decreased ($P < 0.01$) dry matter intake and increased total live body weight in the end of feedlot period ($P = 0.02$). These parameters improved feed efficiency ($P < 0.01$) and average daily gain ($P = 0.02$). After slaughter, it was clearly observed that ZH increased ($P < 0.01$) hot carcass weight and LM area and decreased back fat thickness and improved carcass dressing yield ($P < 0.01$). ZH led to increased WBSF values, cooking loss percentage, protein and moisture contents ($P < 0.01$), whereas it decreased fat content in LM ($P = 0.02$). Likewise, the postmortem aging decreased WBSF value in the LM muscle of ZH and control ($P < 0.01$). These results indicate that ZH has positive effects on enhancing feedlot performance and carcass efficiency, and improves some chemical compounds in castrated male goat meat. However, supplementation of this β -2 agonist can adversely affect meat quality characteristics.

Key Words: zilpaterol hydrochloride, meat quality, carcass characteristics

T151 Effect of diet linseed supplementation in ewes during gestation and lactation on fatty acid profile of suckling lamb meat. A. Nudda,* G. Battacone, M. Lovicu, N. Castanares, R. Boe, A. Fenu, and G. Pulina, *Dipartimento di Agraria, Sezione di Scienze Zootecniche, Università di Sassari, Sassari, Italy.*

The polyunsaturated n-3 fatty acids (PUFA n3) contained in the human diet are essential for regular growth and development. Thus the increase of PUFA n3 content in meat represents a primary task in applied animal science. In this work, the effect of α -linolenic acid (ALA) diet supplementation of dairy ewes during pregnancy and early lactation on ALA conversion into longer-chain PUFA (C20:5, EPA; C22:5, DPA; C22:6, DHA) in muscle of 28 suckling lambs was investigated. Twenty-eight Sarda dairy ewes were divided in 4 groups and fed one of the dietary treatment from approximately the last 8 weeks of gestation to the first 4 weeks of lactation. A control diet (CONT) and an ALA enriched diet by adding linseed (LIN) were used. The 4 dietary treatments consisted of gestation/lactation feeding of ewes to give CONT/CONT, CONT/LIN, LIN/LIN or LIN/CONT lambs. Lambs were slaughtered at 4 weeks of age. After 24 h at 4°C, the longissimus dorsi muscle was dissected from each right half-carcass. Fatty acid composition of intramuscular fat was determined by gas-chromatography. The effect of ALA supplementation during gestation, lactation or both on PUFA n3 was tested by one way ANOVA using dietary treatment as the main effect. The LIN/LIN treatment resulted in a significantly higher content of ALA (almost 3-fold; $P < 0.01$) and EPA (2-fold; $P < 0.01$) compared with the CONT/CONT. The LIN supplementation only during gestation (LIN/CON) decrease the ALA and EPA concentration compared with LIN/LIN group. Feeding the LIN only during lactation determined lower values for EPA (-50%; $P < 0.01$) and ALA (-24%; $P = 0.07$) compared with LIN/LIN group. These results evidenced that a continuous linseed supplementation during gestation and lactation resulted in an increase in muscle ALA concentration and in a conversion to its longer-chain metabolite EPA but not in DHA. From a nutritional point of view, the linseed supplementation during all experimental periods resulted in

a increase of PUFA n3 in lamb meat of 74%. Research supported by Cargill - Animal Nutrition Division, Milan, Italy.

Key Words: lamb meat, PUFA n-3, maternal linseed diet

T152 The influences of intermittent feeding zilpaterol hydrochloride during two last week finishing period on growth performance in Japanese quails. A. Towhidi,* M. Mohammadi Arekhlo, H. Moravej, and A. Zare Shahneh, *Department of Animal Science, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran.*

Zilpaterol hydrochloride is a β -adrenergic agonist which has been shown to increase lean muscle and decrease fat deposition. The objective of this study was to determine the effect of intermittent feeding of zilpaterol hydrochloride (ZH) on growth performance of Japanese quails. 128 male quails at 33 d of age were divided into 4 treatments. Each

treatment consisted of 4 replicates of 8 birds. Diets were based on corn and soybean meal during the finisher period (24% CP and 2.9 Mcal/kg of ME). The birds intermittently (2 d on, 2 d off) received different levels of ZH including 0, 0.2, 0.225, or 0.25 mg/kg of live weight. The treatment diets were fed until 47 d of age and then ZH was withdrawn 3 d before slaughter at d 50. Data were analyzed using the GLM procedure in SAS. Results showed that ZH supplementation improved weight gain ($P < 0.05$), and feed efficiency ($P < 0.01$) in treated groups compared with control diet, but did not affect feed intake. The highest feed efficiency belonged to the 0.225 mg/kg live weight treatment. Quails fed zilpaterol hydrochloride had lower abdominal and subcutaneous fat ($P < 0.05$) compared with the control. Dietary zilpaterol hydrochloride did not affect carcass, thigh, breast and liver weight. It was concluded that intermittent feeding of zilpaterol hydrochloride improved growth performance in Japanese quail.

Key Words: β 2-agonist, body weight, Japanese quail