

Meat Science and Muscle Biology: Lamb and Pork Quality and Muscle Biology and Meat Products

746 Carcass and meat attributes of Red Sokoto buck goats as influenced by post-slaughter processing methods. A. B. Omojola*¹, E. S. Apata¹, and O. O. Olusola¹, ¹University of Ibadan, Ibadan, Oyo State, Nigeria, ²Olabisi Onabanjo University, Ago Iwoye, Ogun State, Nigeria, ³University of Ibadan, Ibadan, Oyo State, Nigeria.

A total of 27 good grade Red Sokoto buck goats weighing between 18.25 and 19.50kg were purchased from a specialized goat market, quarantined and stabilized on a standard diet for 20 one days. The goats were sacrificed to evaluate the effects of scalding, singeing and skinning on their yield, carcass and meat attributes in a completely randomized design. The animals were well rested, starved of feed for 16 h, weighed, stunned mechanically and slaughtered in batches of 3 under commercial conditions. The samples for shear force, cooking loss and water holding capacity (WHC) were taken from the loin. The result showed that the dressing percentage was highest ($P < 0.05$) in scalded carcasses (58.29%) and least in skinned carcasses (46.27%). The carcass length was least ($P < 0.05$) in singed carcass (34.35cm) and highest (44.76cm) in skinned carcasses. Singeing imposed a higher degree ($P < 0.05$) of toughness (6.61 kg/cm³) on the meat as against 5.20 and 4.12 kg/cm for meat from scalded and skinned carcasses respectively, while the cooking loss was highest ($P < 0.05$) in singed carcasses. WHC was highest ($P < 0.05$) in meat from skinned carcasses (68.76%) followed by skinned (62.70%) and least in meat from singed carcasses (53.80%). The visual color score was highest ($P < 0.05$) for singed carcasses (7.45), followed by scalding (6.16) and least in skinned (5.30). The rib eye area and the depth of chest were not significantly ($P > 0.05$) affected by the post slaughter processing methods however, width and length of leg were highest ($P < 0.05$) in skinned carcasses and least in singed carcasses. Skinning elicited higher ($P < 0.05$) meat quality attributes and the leather industry will benefit immensely as the skin of Red Sokoto goats are highly priced. Post slaughter processing methods (dressing) were found to affect the quality of meat from Red Sokoto goats.

Key words: skinning, scalding, singeing

747 Yield of West African dwarf buck goats slaughtered at different weights. A. B. Omojola*¹, S. Attah², and O. O. Olusola¹, ¹University Of Ibadan, Ibadan, Nigeria, ²University of Agriculture, Markurdi, Nigeria, Markurdi, Nigeria, ³University of Ibadan, Ibadan, Nigeria.

Goat meat is highly relished and forms a major item of food in Nigeria and other developing African countries however there is no proper documentation on its yield as affected by different slaughter weights. A total of 36 male West Africa Dwarf goats with initial live weight between 5.47 and 8.82 kg were reared on a 16.8% crude protein concentrate diet until they reached the pre-determined slaughter weight (SW) of 10, 15 and 20 kg. Each carcass was split into two halves along the back bone. The right side of each carcass was separated into wholesale cuts and weighed while the left half was split into trunk, pelvic and pectoral limbs. Each part was subsequently dissected into lean, fat and bones. The result obtained showed that the hot carcass weight (HCW), chilled carcass weight (CCW) and the dressing percentage (DP) increased ($P < 0.05$) as the SW increased while there was an inverse relationship between the SW and the percent chilling loss. The percent external offal (head, skin and feet) reached maximum weight

at 15 kg SW. The liver and the empty stomach gave highest values for goats slaughter at 15 kg, while the relative weight of organs such as lung, heart, kidney, pancreas and spleen were not significantly ($P > 0.05$) affected by the SW. The leg cut gave the highest percentage (25.53-28.18%), followed by shoulder (21.43-23.24%), rack (11.11-12.34%) and loin (10.07-40.7%). The percentage weight of the leg and shoulder were highest ($P < 0.05$) at 15 kg SW while that of rack was highest ($P > 0.05$) at 10 kg SW. Goats slaughtered at 15 kg SW has the highest proportion of lean, external and internal offal.

Key words: slaughter weight, offal, carcass

748 Fatty acid composition of muscles from Sarda suckling lamb reared indoor and outdoor. A. Nudda*, M. G. Manca, G. Battaccone, R. Boe, M. Sini, N. Castanares, and G. Pulina, University of Sassari, Dipartimento di Scienze Zootecniche.

In dairy sheep farms the production of meat by milking lamb is an relevant source of income. The knowledge of the fatty acid composition of lamb meat is important for its economic value. The aim of this work was to study the effect of rearing system on the fatty acid composition of 2 muscles from suckling lambs of Sarda breed. Forty-eight suckling lambs were divided into 2 groups subjected to different rearing system: 24 lambs raised indoor (Group IN) and fed only dam's milk during the night when they were kept together; while 24 lambs followed their mothers also in outdoor pasture (Group OUT). Lambs were weighed weekly and finally slaughtered at 28 d of age. After 24 h of refrigeration, at 4°C, the tight muscles (TM) and longissimus dorsi (LD) were dissected from each right half-carcass. Intramuscular fatty acid composition (FA) of each sample was determined by gas-chromatography. Data were analyzed by 2 ways ANOVA with rearing system, muscle type and their interaction as fixed factors. The weight gains of lambs were not affected by rearing system. The intramuscular fat content was significantly higher in TM than in LD muscle, while this variable was not affected by rearing system. The type of muscle influenced significantly almost all FA concentration, except the C18:1 c9 content. The PUFA n3 were higher in LD, because of the highest content of C18:3 n3 and very long chain FA (EPA, DPA and DHA), compared to TM. The content of PUFA n6 was also higher in LD than in TM sample, due to the highest content of C18:2 c12,c15 and C20:4 n6. Concentrations of C16:0, C18:1 t11, and CLA c9,t11 were higher in TM than in LD samples. The rearing system of lambs does not seem to affect significantly the FA composition of intramuscular fat, except for C18:0 content. The comparison between two rearing system performed in this trial did not show effect on FA composition of intramuscular fat of suckling lambs. Moreover, results suggest that muscle type should be take in to account when examining FA profile in meat.

Key words: lamb muscles, fatty acid, rearing system

749 Nutritive and organoleptic characteristics of kilishi as affected by meat type and ingredient formulation. O. O. Olusola*, A. B. Omojola, and A. O. Okubanjo, University of Ibadan, Ibadan, Oyo, Nigeria.

Kilishi is a ready-to eat-intermediate moisture meat which is highly relished. The product is traditionally prepared from beef infused with spices and defatted groundnut paste. It contains about 46% meat and

54% non meat ingredients. This study tried to appraise the eating quality of kilishi as affected by meat types and ingredient formulation. Three different kilishi recipes viz fresh, frozen and oven dried groundnut paste representing recipes 1, 2 and 3 respectively were formulated and used for the preparation of pork and beef kilishi in a completely randomized design. The nutrient composition and eating qualities of each kilishi type were evaluated. The results obtained showed that kilishi from the recipes were similar in crude protein content with a value ranging from 55.47 – 62.33%. These differed significantly from the crude protein content of the dried raw pork (46.1%) and the dried raw beef (35.85%) which were not infused in the mixture of spices and groundnut paste. The ash content was highest ($P > 0.05$) in beef kilishi from recipe 1 with a value of 10.31 percent and least (6.96%) in pork kilishi from recipe 2. The color rating was highest in all pork kilishi irrespective of the recipe. The panelist also rated pork kilishi higher in juiciness with a value range of 3.50 – 4.30 as against values of 1.80 – 4.40 for beef kilishi. Beef kilishi from recipe 1 had the highest flavour rating while the overall acceptability was highest in both products from recipe 1 with values of 6.30 and 5.20 for beef and pork kilishi respectively. The plant ingredients in the recipes highly contributed to the crude fiber values of 2.96 – 4.42% obtained in products across the recipes. The results obtained in this study showed that the non meat ingredients contributed substantially to the nutritive value of kilishi produced from the three recipes, however the use of recipe 1 with fresh groundnut paste was better in product qualities than frozen or oven dried groundnut paste.

Key words: groundnut paste, kilishi, pork/beef

750 Over-nutrition during pregnancy increases collagen content in the skeletal muscle of mature male offspring. Y. Huang*, M. J. Zhu, R. J. McCormick, N. M. Nathan, S. P. Ford, and M. Du, *Department of Animal Science, University of Wyoming, Laramie.*

Collagen and its crosslinking in meat contribute to the background toughness. However, mechanisms regulating collagen accumulation has not been well studied. We hypothesized that the fetal stage of development would have dramatic effects on the muscle collagen content of offspring meat. To test, ewes were fed a control diet (CON, fed 100% of NRC, $n = 7$) or an over-nourished diet (OB, fed 150% of NRC, $n = 7$) from 60 d before conception to lambing. After weaning, male offspring were penned together and fed to requirements to 2 – 3 years old when the Longissimus dorsi (LD) muscle was sampled. An increase of $37.8 \pm 19.0\%$ ($P < 0.05$) was observed in collagen content in OB offspring LD muscle compared with Con offspring. The mRNA expression of Collagen I and Collagen III, the major types of fibrillar collagen in muscle, also tended to elevated ($P < 0.10$) in OB offspring (80.7 ± 49.8 and $42.2 \pm 21.6\%$, respectively) when compared with CON offspring. Matrix metalloproteinases (MMPs) and tissue inhibitors of metalloproteinases (TIMPs) are involved in collagen remodeling. There was an increase in MMP1 expression in OB offspring LD muscle compared with CON offspring ($52.6 \pm 25.0\%$, $P < 0.05$), but CON offspring expressed more MMP13 ($91.7 \pm 35.4\%$, $P < 0.05$) than OB offspring. The mRNA expression of TIMP1 and TIMP3 in LD muscle tended to increase ($P < 0.10$) in OB offspring compared with CON offspring (49.7 ± 21.1 and $94.6 \pm 45.8\%$, respectively). Lysyl oxidase is a key enzyme catalyzing collagen cross-linking; the expression of lysyl oxidase was higher in OB offspring compared with the CON offspring LD muscle ($74.0 \pm 32.3\%$, $P < 0.05$). In summary, our data demonstrate that over-nutrition during pregnancy increased collagen content in the muscle of mature male offspring. This increase is associated with both enhanced collagen synthesis and decreased con-

nective tissue remodeling (Supported by USDA-2008–35206–18826, NIH 1R01HD067449, and INBRE #P20RR016474).

Key words: collagen, offspring, muscle

751 Intrauterine crowding impairs formation as well as growth of secondary myofibers. C. E. Pardo^{1,2}, A. Koller-Bähler¹, M. Kreuzer², and G. Bee*¹, ¹*Agroscope Liebefeld Posieux, Posieux, Switzerland*, ²*Department of Agricultural and Food Science, Zurich, Switzerland.*

There is evidence that intrauterine crowding is linked to intrauterine growth retardation and impaired myofiber hyperplasia. The aim of the study was to determine the impact of differences in uterine space using unilateral hysterectomized-ovariectomized (UHO) and unilateral oviduct ligated (OL) sows on reproduction performance, organ and muscle development of selected progeny at birth. In the study 8 UHO and 10 OL Swiss Large White third parity sows were used. At farrowing litter size and litter birth weight (BtW) were determined. Subsequently, within each litter 2 male and 2 female progeny with the lowest (L) and highest (H) BtW were sacrificed and internal organs and the LM were collected and weighed. To determine the number and diameter of primary (Prim) and secondary (Sec) myofibers and to calculate the Sec:Prim ratio, histological analyses were performed on the LM using mATPase staining after pre-incubation at pH 4.3 and 10.2. The litter size was similar (8.0 vs. 7.6; $P > 0.75$) for the 2 sow groups. However, as expected progeny born from UHO sows were lighter (1.43 vs. 1.85 kg; $P \leq 0.01$) than those from OL sows. When expressed per 100 g BtW, the heart, liver, kidney and spleen of UHO and OL progeny were of similar ($P \geq 0.36$) weight whereas the brain was heavier (2.52 vs. 1.92%; $P < 0.01$) and the brain:liver ratio was greater (1.03 vs. 0.75; $P < 0.01$) in UHO than OL piglets. Due to a numerically higher ($P = 0.13$) number of Prim but not ($P = 0.92$) Sec myofibers, the Sec:Prim myofiber ratio was lower (27.1 vs. 29.6; $P = 0.05$) in the LM of UHO than OL progeny. The Sec but not the Prim myofibers were smaller (8.1 vs. 9.1 μm ; $P < 0.01$) in diameter in the LM of UHO than OL piglets. In L piglets a brain sparing effect was observed as their relative brain weight (2.4 vs. 2.0%) and brain:liver ratio (0.99 vs. 0.79) was higher ($P < 0.01$) than in H piglets. Only Prim myofiber number, which tended ($P = 0.06$) to be higher in L than H piglets, was affected by BtW. The current data suggest that regardless of BtW and gender, in individuals born from a crowded environment, formation as well as growth of Sec myofibers in the LM was impaired.

Key words: intrauterine crowding, muscle development, pig

752 Microarray analysis of the differentially expressed genes in adipose tissues between Jinhua pigs and Landrace pigs. T. Wu*, Z. Yuan, Y. Wang, and T. Shan, *Institute of Feed Science, Zhejiang University, Hangzhou, Zhejiang province, China.*

This study was conducted to detect the gene transcriptional expression profiles and further screen out the differentially expressed genes in subcutaneous fat between Jinhua pigs (at age of 90 d) and landrace (at age of 90 d) by Microarray. A total of 458 genes at least 2.0-fold significant difference were screened out including 223 higher expressed genes (77 genes with annotation available) and 235 lower expressed genes (58 genes with annotation available) in subcutaneous fat tissues of Jinhua pig compared with that of landrace. Furthermore, semi-quantitative PCR and real-time quantitative PCR were used to confirm the 9 differentially expressed genes (Leptin, salivary lipocalin, heat shock 27kDa protein 8, Cyclin B2, Carboxylesterase 1, phosphoglycerate

mutase 2, Short/branched chain specific acyl-CoA dehydrogenase, apolipoprotein D, Cellular retinoic acid binding protein 1). The PCR depicting results showed great consistency with the microarray. Six categories including fat metabolism, energy metabolism, transcription, splicing factor, protein synthesis, protein degradation were classified through bioinformatics analysis. Taken together, this research demonstrates previously unrecognized changes in gene transcription of subcutaneous fat between Jinhua pigs and landrace pigs, and some potential candidate cascades identified in the study merit further investigation.

Key words: adipose tissue, differential expressed gene, microarray

753 SIFT-MS identifies unique volatile masses in 24 h post-mortem loins from Berkshire- and Landrace-influenced swine. S. Taylor*, C. A. Wick, J. Harper, M. Wick, K. Shircliff, and S. J. Moeller, *The Ohio State University, Columbus.*

The objective of this preliminary study was to test the efficacy of using Selected Ion Flow-Tube Mass Spectrometry (SIFT-MS) as a novel device for the discrimination of swine of different maternal genetic composition that have previously been observed in our laboratory to differ in pork quality. Berkshire-sired market pigs, derived from matings to one purebred Berkshire (BB, n = 5), one purebred Landrace

(BL, n = 5), and one Berkshire-Saddleback crossbred (BS, n = 5) dam were raised on straw with access to outdoor concrete from 30 kg through harvest (~5 mo of age, ~100 kg). A 3 phase feeding program was followed, providing ad libitum access to feed and water. Pigs were harvested following a 15-h fast. Pork loin quality was assessed at 24 h postmortem and a 2.54 cm diameter core removed from carcass and placed in LN2 for subsequent analysis. Warner-Bratzler Shear Force (WBSF) was assessed on one chop after a 7 d aging period. Loin 24 h pH was greater (0.14 units, $P < 0.05$) in BB and BS pig when compared with BL pigs, and chops from BB (3.01 kg) and BS (2.84 kg) exhibited less WBSF when compared with chops from BL pigs (4.67 kg). Each sample was divided into 3 equal parts, pulverized in LN2 and analyzed by SIFT-MS analysis. Sixty-one masses were identified and the relationships of the masses to maternal background determined by SIMCA. The BB and BS were not different from each other ($P > 0.05$); however, the BL loins were different from both the BB and BS loins ($P < 0.05$). These data support our hypothesis that rapid analysis by SIFT-MS is able to discriminate Berkshire from Landrace genetic influences in the present study. Future analysis by SIFT-MS will allow for the identification of the primary components unique to the different genetic lines and assess implementation as a tool for product characterization.

Key words: swine, pork quality, SIFT-MS