for percent empty body water and ether extract using the percentage water in the 9-10-11th rib cut are presented on table 1.

Table 1: Regression equations using %water of 9-10-11th rib cut as independent variable to predict empty body composition.

Genetic group	Dependent variable (% EBW)	Regression equation	R^2
AN	EE	y = -1.2124x + 111.1	0.8051
AN	Water	y = 0.5294x + 31.96	0.8950
CN	EE	y = -1.2744x + 114.22	0.8196
CN	Water	y = 0.581x + 28.61	0.8870
NE	EE	y = -1.1648x + 107.09	0.8716
NE	Water	y = 0.5348x + 31.70	0.8986
SN	EE	y = -1.4296x + 124.54	0.9151
SN	Water	y = 0.6447x + 23.63	0.9129

Key Words: Empty body composition, Nellore crossbred, 9-10-11th rib cuts

M81 Phenotypical characterization of genetically different cattle in segregating family structures, growth and carcass characteristics. R. Pfuhl*, O. Bellmann, J. Wegner, K. Ender, and C. Kühn, *Research Institute for the Biology of Farm Animals*, *Dummerstorf, Germany*.

The physiological mechanisms which affect the transformation of nutrients into body fat in bulls of secretion type or into muscle tissue in bulls of accretion type is still not fully revealed. Hence, we designed a study of segregating family structures using Charolais (Ch) cattle as a representative for the accretion type and German Holstein (GH) cattle as a representative for the secretion type of cattle. In further experiments, the P_0 generation was characterized phenotypically. This study compares selected phenotypical results of the F_2 bull generation (n= 65) with the P_0 data to get first insights in potential segregating of growth and carcass traits. The F_2 bulls of five segregating families showed an average final weight at 18 mo between 676.69 kg and 739.18 kg. These data were intermediate between the P_0 Charolais bulls, which gained a final weight of 750.6 kg and were 84.7 kg heavier than the GH bulls with 665.9 kg ($P<0.001$). The Charolais bulls exhibit a hot carcass weight (HCW) of 450.26 kg, the GH bulls 356.74 kg ($P<0.001$). The average HCW of the F_2 bull families extends from 387.85 kg to 414.46 kg and is within the P_0 data ($P<0.001$). The Rib eye area of the F_2 bulls (103.18 cm^2 – 108.17 cm^2) varies ($P<0.001$) within the P_0 bulls (Ch = 125.82 cm^2 and GH = 82.14 cm^2). The average dressing percent in the F_2 bull families (56.46 %– 58.01 %), was between the P_0

bulls (Ch = 60.31, GH = 53.96) with ($P<0.001$). The inner fat content of the F_2 bulls varies from 39.6 kg to 43.3 kg and is within the P_0 range (Ch = 35.4 kg, GH = 51.06 kg) with ($P<0.001$). In conclusion, the F_2 animals showed intermediate data with high variation between the values of the P_0 animals in the observed traits, which confirms the expected results for the F_2 generation. No atypical effects of these traits were recorded. Further experimentation will be conducted on the F_2 bulls.

Key Words: Cattle, Carcass, Growth

M82 Residual feed intake (RFI), behavioral, and physiological measures in Angus Bulls. J. P. Cassady*, C. S. Whisnant, M. H. Poore, and G. B. Huntington, *North Carolina State University*, *Raleigh*.

The objective was to measure RFI in 56 registered Angus bulls (285 ± 34 kg BW, 275 ± 21 d old) from one herd and to relate RFI to physiological and economically important traits. After completing a post-weaning vaccination and parasite elimination program, bulls were adapted to a corn silage-based diet (140 g CP, 1.73 Mcal NEm and 1.22 Mcal NEg per kg DM), and trained to use individual feeding gates. They were blocked based on BW and sire into groups of 12 and fed the same diet for 84 d. They were weighed every 14 d, and measures of temperament, chute escape velocity, hip height, scrotal circumference, blood samples, for determination of circulating concentrations of testosterone, triiodothyronine (T3) and thyroxine (T4), and ultrasound measures of body composition were collected at d 8, d 58, and d 84. At the end of the study rate of eating was measured on the eight bulls with the highest and lowest RFI (n = 16). Mean ± SD RFI (predicted minus measured) was 0.12 ± 0.73 kg DM/d. Mean ± SD ADG and DMI were 1.42 ± 0.20 and 7.3 ± 1.7 kg. Residual feed intake was positively correlated with eating rate, BW, BW gain, hip height, scrotal circumference, and testosterone on d 8 ($P < 0.05$) and negatively correlated with T3 on d 8 ($P < 0.08$). Increased ribeye area ($P < 0.07$) and calmer temperament ($P < 0.13$) tended to correlate with RFI. For 6 bulls greater than 1 SD from the mean, RFI was 1.40 ± 0.37, and for 7 bulls less than 1 SD from the mean RFI was -1.10 ± 0.56. Compared to the 8 bulls with lowest RFI (-1.03 kg/d), the 8 bulls with the highest RFI (1.24 kg/d) ate faster, were taller and heavier, gained weight faster ($P < 0.05$), and tended ($0.05 < P < 0.20$) to be calmer in the weigh box, slower to leave the chute, had larger ribeye area, greater increases in subcutaneous fat over the rib and rump, and less increase in hip height from d 58 to d 84. We conclude that differences in physiological and behavioral traits of bulls likely explain important components of RFI.

Key Words: Beef cattle, Residual feed intake, Efficiency

Meat Science and Muscle Biology

M83 Fatty acid profile in selected rodent and fish species from Colombia. L. L. Betancourt*[1] and G. J. Díaz[2], [1]*Universidad de La Salle, Facultad de Zootecnia*, *Bogotá, Distrito Capital, Colombia*, [2]*Universidad Nacional de Colombia, Facultad de Medicina Veterinaria y Zootecnia*, *Bogotá, Distrito Capital, Colombia*.

The fatty acid profile of muscle tissue of three rodent species and nine fish species was investigated. Rodent species included capybara (Hydrochaeris hydrochaeris), guinea pig (Cavia porcellus), and agouti (Agouti sp.), which are commonly eaten by native Colombian people. The fish species investigated were: trout (Oncorhynchus mykiss), tilapia (Oreochromis sp.), common two-banded seabream (Diplodus

vulgaris), black capu (Colossoma macropomum), tiger shovelnose catfish (Pseudoplatystoma fasciatum), jau catfish (Paulicea luetkeni), matrincha (Brycon sp.), pictus catfish (Pimelodus grosskopfii) and capitán (Eremophilus mutisii). A total of 500 gr of muscle tissue was lyophilized, and its fat content was extracted with organic solvents. Fatty acids extracted from the fat were analyzed as methyl-esthers using gas chromatography with flame-ionization detection. Individual fatty acids were reported as percent of total fatty acids. The capybara, agouti, and guinea pig omega-3 (n-3) fatty acid content in muscle tissue was 21.3, 13.0, and 9.3%, respectively. These levels of n-3 fatty acids are higher that those observed in beef, pork or poultry. Among

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fish the highest content of n-3 fatty acids was observed in jau catfish and tilapia (both from warm waters) followed by trout, and capitán (from cold waters). The n-3 fatty acid content in these four fish species was 20.7, 15.6, 14.3 y 10.3%, respectively. Most of the n-3 fatty acid content in fish samples corresponded to eicosapentaenoic (C20:5, n-3), docosapentaenoic (C22:5, n-3), and docosahecaenoic (C22:6, n-3) acids, whereas the main n-3 fatty acid found in rodent samples was alfa-linolenic (C18:3, n-3) acid. The results of the present study indicate non-conventional indigenous foods such as rodents can be a good and healthy source of n-3 fatty acids for humans. This observation is also valid for a number of fresh-water edible fish species, which accumulate high levels of n-3 fatty acids, independently of the water temperature where they live.

Key Words: Omega-3 fatty acids, Meat, Indigenous foods

M84 Fatty acid composition in bovine and buffalo beef. L. Betancourt*[1], C. Bustamante[1], and G. Díaz[2], [1]*La Salle University, Bogotá Distrito Capital, Colombia*, [2]*National of Colombia University, Bogotá, Distrito capital, Colombia*.

The present study investigated the fatty acid composition of liver, and longissimus dorsi and semitendinosus muscles of bovine and buffalo fed on grazing pastures. The tissue simples were lyophilized and their fat content extracted with organic solvents. Fatty acids extracted from the fat were analyzed as methyl-esters using gas chromatography with flame-ionization detection. Individual fatty acids were reported as percent of total fatty acids. Buffalo liver had a greater content ($P<0.05$) of linoleic (C18:2, n-6), alfa-linolenic (C18:3, n-3), and eicosapentaenoic (C20:5, n-3) acids, while the content of docosahexaenoic (C22:6, n-3) and saturated fatty acids was greater ($P<0.05$) in bovine liver. Both buffalo and bovine liver had a relatively large content of omega-3 fatty acids with 13 and 11%, respectively. These high levels are comparable to those found in aquatic species such as trout and tilapia. The bovine longissimus dorsi muscle had a greater percentage ($P<0.05$) of palmitic (C16:0), linoleic (C16:2, n-6), monounsaturated and polyunsaturated fatty acids, and omega-6 and omega-3 fatty acids compared with buffalo. However the buffalo semitendinosus muscle had a greater content ($P<0.05$) of omega-6 and omega-3 fatty acids. It is important to note that both bovine and buffalo tissues had a low omega-6 to omega-3 ratio (0.8 to 2.2), which can be consider adequate for a proper fatty acid balance of a human diet.

Key Words: Buffalo beef, Bovine beef, Omega-3 fatty acids

M85 Prediction of melting point of intramuscular fat of Japanese Black cattle by image analysis method using high resolution digital image. M. Oishi*[1], S. Fukushima[1], S. Hidaka[1], H. Tsukuda[2], and K. Kuchida[1], [1]*Obihiro Univ. of AVM, Obihiro-shi, Japan*, [2]*Livestock Implov. Assoc., Makubetsu-cho,Japan*.

Meat flavor might be related to the melting point of its fat in marbling. The lower this point drops, the more mellow and richer of the meat. Generally, melting points of marbling are measured by a chemical method; however this method requires the samples to be cut off, as well as time and high cost to obtain the values. Therefore, a nondestructive, simple and prompt method with low cost is desirable. The objective of this study was to predict the melting point of marbling in Japanese Black cattle with the image analysis method using high-resolution digital images. Data were collected from 204 Japanese Black steers slaughtered at 21 month for 8 investigation days. Samples were collected from M. trapezius, and the melting point was measured with the rise melting point method. Characteristics of marbling shape (73 traits), rib eye shape (4 traits), rib eye color (46 traits), the length of muscle and fat measured for the cross sections (68 traits), and subcutaneous and intermuscular fat area and its proportion to the cross section area (25 traits) were calculated by image analysis. Using these 216 traits, the melting point was predicted by multiple regression analysis using the stepwise method. The selected traits were limited to 5 variables. The average melting point with the chemical method was 28.22±3.24 °C (9.40-34.95). Correlation coefficients of melting points with carcass weight and marbling score were 0.15 and 0.05, respectively. There was no trait that highly correlated with melting points. For all 204 samples, R2 of the multiple regression equation was 0.13. When the eight investigation days were included in the multiple regression analysis, the R2 was high (0.60-0.82), indicating that the prediction of melting points is possible. Traits concerning rib eye color and length of muscle or fat in cross sectional images were chosen in the regression equation on seven investigation days.

Key Words: Beef, Melting point, Image analysis

M86 Comparison of belly and loin volumes between cattle breeds by image analysis using mirror-type photographic equipment. Y. Hamasaki*[1], T. Osawa[1], S. Hidaka[1], T. Hori[2], H. Kodaka[3], Y. Sasaki[4], and K. Kuchida[1], [1]*Obihiro University of A&VM, Obihiro, Hokkaido, Japan*, [2]*Hokkaido Indust. Res. Inst., Sapporo, Hokkaido, Japan*, [3]*HAYASAKA Sci. and Engin. Corp., Sapporo, Hokkaido, Japan*, [4]*SASAKI Livestock Corp., Obihiro, Hokkaido, Japan*.

We have developed a mirror-type photographing equipment to use on beef carcass. The most important feature of this equipment is its ability to photograph between the narrow clearance of carcass cross section. The view angle of the mirror type (30×40cm) equipment was almost doubled in comparison with the former equipment. Photographs with clear and detailed images of *M. latissimus dorsi* and *M. serratus ventralis*, as well as *M. longissimus thoracis*(ribeye), have been possible using this equipment. The aim of this study was to compare in four breeds the characteristics of major muscles in the carcass cross section at the 6-7th rib using computer image analysis. Digital images of the 6-7th rib cross section from 20 Japanese Black (JB), 20 Japanese Brown (JBR), 23 Holstein (HOL) and 24 Angus (ANG) were used in this study. The area, length, maximum width and the ratio of marbling to each muscle area (ribeye, *M. trapezius*, *M. semispinalis capitis*, *M. semispinalis dorsi*, *M. atissimus dorsi* and *M. serratus ventralis*) were calculated with image analysis. Analysis of variance on their image analysis traits was performed, in which breed and sex were treated as crossclassified fixed effects. The results showed that the total area of the cross section (617.6, 682.8, 545.6, and 561.9 cm^2 for JB, JBR, HOL, and ANG, respectively), area of *M. latissimus dorsi* (57.3, 67.9, 42.2, and 47.8 cm^2) and area of ribeye (50.7, 58.8, 43.6, and 48.1 ^{2}) were significantly larger for JBR ($P<0.05$). The ratio of the total area of the 6 muscles to the total area of the carcass section (36.7, 37.5, 33.7, and 35.5%) was significantly smaller for HOL ($P<0.05$). The ratio of marbling to (ribeye) area (43.3, 34.6, 22.9, and 23.8%) was significantly higher for JB (P<0.05), but there were no significant differences between JB and JBR for the ratios of marbling to *M. latissimus dorsi* area (31.3, 26.2, 10.1, and 17.4%) and to *M. serratus ventralis* area (48.5, 46.7, 30.9, and 37.3%). Correlation coefficients between marbling percentages in ribeye and *M. serratus ventralis* were 0.32, 0.70, 0.45, and 0.54 for JB, JBR, HOL, and ANG, respectively.

Key Words: Beef cattle, Image analysis, Belly

M87 Effect of suckling regimen on intramuscular collagen properties of *Comisana* lambs. G. Maiorano*[1], A. Ciarlariello[1], C. Cavone[1], R. J. McCormick[2], and A. Manchisi[1], [1]*University of Molise, Campobasso, Italy*, [2]*University of Wyoming, Laramie.*

The effect of restricted suckling on intramuscular collagen (IMC) properties (collagen and crosslink concentrations) of different lamb muscles was determined. Twenty-one naturally suckled male *Comisana* lambs were divided into three equal weight groups with differing suckling management systems: 1) only maternal milk (C); 2) only maternal milk until 14d of age and, from 15d of age to slaughter, maternal milk, concentrate and Lucerne hay *ad libitum* (T1); 3) only maternal milk until 14d of age and, from 15d to 30d of age, maternal milk, concentrate and Lucerne hay *ad libitum*, and from 30d of age to slaughter only concentrate and Lucerne hay *ad libitum* (T2). At slaughter (63d) *semitendinosus* (ST), *semimembranosus* (SM) and *gluteus biceps* (GB) muscles were removed from chilled carcasses. Muscles were trimmed of fat and *epimysium*, lyophilized, and hydrolyzed in 6N HCl for determination of hydroxyproline and hydroxylysylpiridinoline (HLP) crosslinks, both of which are regarded as main connective tissue components influencing meat tenderness. ANOVA with GLM was performed using a 3x3 factorial design. Suckling system affected IMC ($P<0.01$) and HLP ($P<0.05$) amounts, and HLP/IMC ratio ($P<0.05$). T2 compared to T1 and C groups had higher amounts of IMC (33.19b, 27.29a, 26.80a µg/mg, respectively) and HLP (5.34b, 4.16a, 5.11ab µg/mg, respectively). IMC was more mature in C than in T1 and T2 groups, as indicated by the HLP/IMC ratio (0.13b, 0.11a, 0.12ab mol/mol, respectively). Muscle type influenced HLP/IMC ratio which was higher ($P<0.05$) in ST than in GB and SM (0.14b, 0.11a, 0.10a mol/mol, respectively). No differences ($P>0.05$) were found between SM, GB and ST in IMC (29.65, 29.10 and 27.44 µg/mg, respectively) and HLP (4.50, 4.58 and 5.50 µg/mg, respectively) concentrations. Suckling management systems can alter IMC amount and maturation, leading to variability in lamb tenderness.

Key Words: Lamb, Suckling regimen, Intramuscular collagen

M88 Image analysis of marbling in pork rib eye and prediction of crude fat contents. K. Kuchida*[1], M. Oishi[1], Y. Kuwabara[2], M. Hanada[1], and S. Hidaka[1], [1]*Obihiro University of A&VM, Obihiro, Hokkaido, Japan*, [2]*Fuji Nojo Service, Fujinomiya, Shizuoka, Japan.*

Palatability can be expected from pig breeds that produce highly marbled pork. Computer image analysis (CIA) used for beef may objectively be used to evaluate marbling for pork as well. In comparison with beef which offers a better color contrast, marbling assessment in pork is more challenging. The aims of this study were to evaluate pork marbling by CIA with high accuracy using high resolution digital image, and to investigate the relationship between crude fat contents measured by a chemical method and by CIA. The rib loin between the 5th and 12th ribs (approx. length 20 to 25cm) of eight Landrace × (Large White × Duroc) was cut in 2.5 cm intervals. Images of eight slices from 1 pig were taken by photography equipment with a high resolution digital camera (13.5 M pixels), which was originally developed for beef carcass cross section by the authors. The tone of the image was adjusted using commercial image-processing software in order to easily distinguish between fat and muscle. The marbling particles were semi-automatically extracted by the borderline comparison method using a special software programmed by the authors, and the ratio of the marbling area to the ribeye was calculated. Crude fat contents of the front part of the rib loin (around the 5th rib) were determined by ether extraction, and the chemical values were compared with the CIA values. The average marbling percentage for each pork, which is the average of the values for the 8 slices by CIA, was ranged from 0.95 to 4.03%. The marbling percentage in the 8 slices varied largely even in the same pork; the largest range was 2.93% (2.17 to 5.11%). The least square mean of the marbling percentage at the front part (around the 5th rib) of the rib loin was significantly ($P<0.05$) higher at 3.14% than that at the rear (around the 12th rib) at 2.18%. The correlation coefficient between the average marbling percentage of the 3 slices near the 5th rib loin and the crude fat contents was extremely high (0.96). These results indicated that the marbling degree can be evaluated and crude fat contents can be predicted with high accuracy using CIA method in pork, just as in beef.

Key Words: Image analysis, Pork marbling, Crude fat contents

M89 Effect of type of pasture and time of supplementation on fatty acid composition of grazing beef heifers. G. J. Depetris*[1], E. Pavan[1], F. J. Santini[1], E. L. Villarreal[1], and T. P. Garcia[2], [1]*EEA INTA Balcarce- Fac Cs. Agrarias. UNMdP, Balcarce, Buenos Aires, Argentina*, [2]*Inst. de Tecnología de Alimentos. INTA Castelar, Moron. Buenos Aires, Argentina.*

The objective of the trial was to assess the impact of the pasture type and time supplementation before slaughter on meat fatty acid profile. Forty heifers (264±5.16 Kg) were allotted to one of five dietary treatments (n=8). Heifer grazed a ryegrass red pasture with no supplementation (**RG**) or a red clover pasture for 42 d; heifer grazing red clover were supplemented with 1.3% BW of cracked corn grain for 0, 14, 28, or 42 d before slaughter (**RC**, **RC14**, **RC28** or **RC42** respectively). Heifers were slaughtered the same day in commercial abattoir and the carcasses were cooled for 24 h at 3°C. Samples of *longissimus dorsi* at 10-12 ribs were obtained and frozen at -18°C for fatty acid (FA) analysis. Preplanned contrasts were used to test: effects of pasture type (RG vs RC), and linear and quadratic effects of supplementation time. Beef of RC had higher percentage of conjugated linoleic acid (CLA), linoleic acid and n-6/n-3 ratio than RG pasture. CLA decreased linearly and linoleic acid, polyunsaturated fatty acids (PUFA), n-6 and PUFA/SFA ratio increased linearly as time of supplementation increased. Quadratic effect of time on supplementation was observed (P=0.08) for n-6/n-3 ratio only. Neither type of pasture nor time of supplementation affected the ether extract percentage (2.12±0.24), monounsaturated fatty acids (MUFA) and saturated fatty acids (SFA). These results show that short time of supplementation before slaughter affect meat fatty acid composition.

Table 1.

Item	RG	RC	RC14	RC28	RC42	SEM	Linear[1]	RG vs RC[1]
Linoleic	3.03	3.72	3.44	3.95	4.26	0.220	0.04	0.04
Linolenic	1.49	1.65	1.49	1.51	1.52	0.076	0.30	0.15
SFA	39.21	39.45	38.97	37.82	37.5	0.085	0.18	0.84
MUFA	38.66	37.09	37.70	38.02	38.66	0.788	0.20	0.17
PUFA	8.67	8.31	8.90	10.16	10.35	0.601	0.01	0.68
n-3	3.87	3.04	3.46	3.89	3.69	0.353	0.11	0.07
n-6	4.80	5.26	5.44	6.26	6.66	0.296	0.01	0.37
n-6/n-3	1.25	1.86	1.62	1.62	1.82	0.111	0.84	0.001
CLA	0.53	0.70	0.56	0.57	0.48	0.044	0.01	0.02
PUFA/SFA	0.22	0.21	0.23	0.27	0.28	0.019	0.03	0.81

[1] Probability, *P=*

Key Words: Meat fatty acid, Time of supplementation, Red clover and ryegrass pastures

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M90 Effect of type of pasture and time of supplementation on meat quality traits of grazing beef heifers. G. J. Depetris*[1], E. Pavan[1], F. J. Santini[1], E. L. Villarreal[1], G. Grigioni[2], M. Irurueta[2], and F. Carduza[2], [1]*EEA INTA Balcarce- Fac Cs. Agrarias, UNMdP, Balcarce, Buenos Aires, Argentina*, [2]*Inst. de Tecnolog&iactue;a de alimentos, INTA Castelar, Morón, Buenos Aires, Argentina*.

The objective of the trial was to evaluate the meat quality of heifers grazing different pasture type and time supplementation before slaughter. Forty heifers of 264±4.10 Kg were allotted to one of five dietary treatments (n=8). Heifer grazed a ryegrass red pasture with no supplementation (**RG**) or a red clover pasture for 42 d; heifer grazing red clover were supplemented with 1.3%BW of cracked corn grain for 0, 14, 28, or 42 d before slaughter (**RC**, **RC14**, **RC28** or **RC42** respectively).Heifers were slaughtered the same day in commercial abattoir and the carcasses were cooled for 24 h at 3°C. Ultimate pH was measured at the 12th rib at 24 h post mortem. Samples of *longissimus dorsi* at 10-12 ribs were obtained and frozen at -18°C for subsequent colour (CIELAB), tenderness (shear force) and water holding capacity (WHC) assessment. Preplanned contrasts were used to test: effects of pasture type (RG vs RC), and linear and quadratic effects of supplementation time. Neither the type of pasture nor the length of the supplementation period had any effect ($P > 0.05$) on meat quality traits.

Table 1.

Item	RG	RC	RC14	RC28	RC42	SEM	RG vs RC	Linear	Quad
Lightness (L*)	34.20	36.51	33.20	34.48	34.94	1.07	0.40	0.50	0.10
Yellowness (b*)	16.46	18.91	18.28	18.28	18.85	0.77	0.58	0.90	0.70
Redness (a*)	15.40	17.50	16.12	16.63	17.61	0.69	0.60	0.81	0.13
WHC (%)	29.11	27.56	27.08	27.89	28.54	0.76	0.45	0.30	0.48
Shear force (lb)	11.21	10.80	11.49	11.65	13.56	1.14	0.80	0.10	0.59
Ultimate pH	5.50	5.42	5.42	5.39	5.44	0.10	0.28	0.99	0.23

[1] Probability, *P*=

Key Words: Meat quality traits, Time of supplementation, Red clover and ryegrass pasture

M91 Field pea inclusion in high grain diets for beef heifers improves beef tenderness without altering performance. K. R. Maddock Carlin*[1], G. P. Lardy[1], R. J. Maddock[2], B. Ilse[3], and V. L. Anderson[3], [1]*North Dakota State University, Fargo*, [2]*South Dakota State University, Brookings*, [3]*Carrington Research Extension Center, Carrington*.

The objective of this study was to determine the effects of increasing levels of field peas in feedlot diets on heifer performance, carcass quality, and sensory evaluation of steaks. One hundred eighteen heifers were blocked by BW (initial BW = 420 kg) in a randomized complete block design and allotted to 16 pens (four pens per treatment). Treatments were 0, 10, 20, and 30% dry rolled field peas (DM basis) replacing corn and canola meal in corn-based finishing diets. Heifers were fed for 74 d and transported to a commercial slaughter facility. Following a 24-h chill, ribeye area, fat depth, KPH, and HCW were measured and USDA grades were recorded. A 7-cm (approximate) portion of longissimus muscle was removed caudally from 12th rib location on the left side of each carcass. Longissimus muscle samples were vacuum packaged, aged for 14 d at 4°C, cut into 2.54 cm thick steaks, and frozen. One steak from each carcass was evaluated for Warner-Bratzler shear force (WBSF). A second steak from each carcass was evaluated by a trained taste panel for tenderness, juiciness, and flavor intensity using a scale of 1 to 8 (1 = extremely tough, dry, and bland; 8 = extremely tender, juicy, and intense beef flavor), and off-flavor intensity (1 = no off flavors; 4 = intense off flavors). No treatment differences were observed for DMI, ADG, G:F, USDA quality grade or yield grade ($P \geq 0.13$). Increasing level of dietary field peas quadratically decreased ($P = 0.001$) WBSF (4.30 ± 0.15 kg; 3.63 ± 0.15 kg; 3.68 ± 0.16 kg; 3.71 ± 0.15 kg for 0, 10, 20, and 30% peas, respectively). Sensory panel analysis indicated a linear increase in tenderness ratings (P = 0.002) with addition of peas (4.56 ± 0.18; 5.14 ± 0.17; 5.28 ± 0.18; 5.34 ± 0.18 for 0, 10, 20, and 30% peas, respectively). Sensory panel ratings indicated a tendency for greater juiciness ratings ($P = 0.14$) and no differences in flavor ($P = 0.21$) or off flavor ($P = 0.32$). The improved tenderness observed in this study has implications for improving beef acceptability and may provide consumers with a more consistent, tender beef product.

Key Words: Field peas, Tenderness, Feedlot

M92 Physical and sensorial traits of meat from different ovine categories. A. G. da Silva Sobrinho*, R. S. B. Pinheiro, H. B. A. de Souza, and S. M. Yamamoto, *Unesp- São Paulo State University, Jaboticabal, São Paulo, Brazil*.

Ovine meat consumers are very exigent in relation to physical and sensorial traits. So, it is important to know the specific meats characteristics from different ovine categories. In such circumstances, we should be able to increase our share of the market. For evaluating qualitative traits of meat from different ovine categories and muscles from different carcass cuts (shoulder-*Triceps brachii*, loin- *Longissimus lumborum* and leg-*Semimembranosus*), ½ Ile de France ½ Polwarth animals (6 uncastrated lambs, 6 discarded ewes and 6 discarded wether mutton) were used. Animals grazed *Cynodon dactylon* cv. Tifton - 85 and were daily concentrate supplemented with 1% of their live weight. Lambs were weaned with 17 kg and slaughtered at 32 kg of live weight, at around 5 months of age. Ewes and wethers were slaughtered with 55 kg and 60 months of age. There were no interactions between animal categories and carcass muscle cuts for pH_{45min} and pH_{24h}, with values of 6.49 and 5.58, respectively. In lambs, *Longissimus lumborum* and *Semimembranosus* luminosity was higher (40.42) than that of *Triceps brachii* (36.17). In adults, the evaluated muscles had the same luminosity value (34.40). The red level (18.97) was the same in all adults muscles. In relation to water holding capacity, there was no interaction between animal categories or muscles and the mean was 56.40%. Cooking losses were not affected by ovine categories, with exception of the losses observed in *Longissimus lumborum*, which were higher (46.44%) in lambs than in adult sheep (38.82%). In relation to shearing force, it was higher (2.77 kgf/cm^2) in adults meat, but it was equal in *Longissimus lumborum* from different categories (1.65 kgf/cm^2). The sensorial analysis did not differ in relation to flavor, color and preference, but lamb meats received higher scores (8.13) for tenderness than adults meat (6.90) and meat tenderness had negative correlation between instrumental and sensorial analyses (r = - 0.41). Meat of adult animals was tougher and darker than lambs meat, but other traits as pH, water holding capacity, flavor, color and preference were similar among lambs, ewes and wether.

Key Words: Meat, Color, Tenderness

M93 Changes in caspase activities post mortem and their relationships to shear force in porcine *longissumus* muscle. C. M. Kemp*, R. G. Bardsley, and T. Parr, *University of Nottingham, Nottingham, Nottinghamshire, UK*.

The objective of this study was to investigate the relationship between shear force and caspase activities and the levels of their specific substrates in porcine *longissmus* muscle (LM) during a post mortem conditioning period of 192 h. Caspases are a family of cysteine proteases predominantly associated with programmed cell death, targeting specific proteins for degradation. However, caspases are also essential in the development and remodelling of skeletal muscle (Fernando et al., 2002) and are also activated in early pathological events associated with hypoxia/ischemia (Gustafsson & Gottlieb, 2003), that are not too dissimilar to the hypoxic conditions that occur post mortem. Ten Large White gilts (81.2±1.98 kg) were slaughtered and samples of LM were taken at 0, 2, 4, 8, 16, 32 and 192 h post mortem. Samples were subsequently analyzed for caspase 3/7 and caspase 9 activity, protein levels of cleaved isoforms of known caspase substrates alpha spectrin and poly (ADP-ribose) polymerase (PARP), as well as shear force at 192 h. Immunoprobed Western blots detected the peptide fragments of alpha spectrin (120 kDa) and PARP (89 kDa), which are known indicators of caspase activity and apoptosis. Both caspase 3/7 activity and protein levels of the spectrin 120 kDa breakdown product peaked at 2 h post mortem and positive correlation between them was observed at this time point ($r = 0.59$, $P = 0.07$). There was a negative relationship between shear force and the 0:32 h ratio of caspase 3/7 ($r = -0.62$, $P = 0.053$), and caspase 9 activities ($r = -0.68$, $P = 0.044$). In addition there was a negative relationship between shear force and the level of alpha spectrin 120 kDa degradation product at 2 h ($r = -0.75$, $P=0.012$). The findings of this study indicate that changes in caspase activity and caspase-mediated cleavage of spectrin are occurring in LM in situ and both these factors exhibit negative relationships with shear force.

Key Words: Proteolysis, Shear force, Porcine

M94 Effects of adding sunflower or soybean seeds on fatty acid composition of intramuscular fat in feedlot heifers. J. A. Navarro*[1], F. J. Santini[1], G. J. Depetris[1], E. L. Villarreal[1], D. H. Rearte[1], and P. T. García[2], [1]*EEA INTA Balcarce, Fac. Cs. Agrarias, UNMdP, Balcarce, Buenos Aires, Argentina*, [2]*Inst. de Tecnología de Alimentos, INTA Castelar, Morón, Buenos Aires, Argentina*.

The objective of this study was to test the effects of fat supplementation with different proportions of sunflower or whole raw soybean seed on the heifers meat fatty acid profile. One hundred and five Angus heifers (147±19 kg) were used in a randomized complete block design. The lipid supplementation treatments, applied for 125 d., were: no oilseeds (CON), sunflower seed at 4% (LSF), at 6% (MSF), and at 8% (HSF), soybean seed at 15% (LSB), at 20% (MSB), and at 25% (HSB) on a dry matter basis. The basal diet consisted of corn silage, whole corn, sunflower meal and urea. Animals were slaughtered in commercial abattoir and the carcass was cooled for 24 h at 3°C. Samples of *longissimus dorsi* at 10-12 ribs were obtained and frozen at -18°C for fatty acids (FA) analysis. The results of the least square means comparisons are shown on the table. Control had less CLA than sunflower treatments, less PUFA/SFA ratio than sunflower and soybean treatments, higher *n*-6/*n*-3 ratio than soybean treatments. Sunflower treatments had higher CLA, less PUFA/SFA ratio, and higher *n*-6/*n*-3 ratio than soybean treatments. Increasing the proportion of sunflower in the diet caused a linear increase in the level of CLA, PUFA, *n*-6

FA, *n*-3 FA, and in the PUFA/SFA and *n*-6/*n*-3 ratio. Quadratic effect tended to occur for PUFA, *n*-6 FA and *n*-6/*n*-3 ratio when soybean was added. The data indicate that meat FA profile can be improved from a human health perspective by inclusion of oilseeds in the diet.

Table 1.

Item	CON	LSF	MSF	HSF	LSB	MSB	HSB	SEM
CLA*	0.31[bc]	0.39[abc]	0.40[ab]	0.44[a]	0.41[ab]	0.29[c]	0.33[bc]	0.02
SFA*	40.15	38.91	38.44	38.41	40.02	38.62	37.64	0.84
MUFA*	40.57[a]	40.56[a]	37.31[ab]	38.44[ab]	38.93[ab]	38.93[ab]	35.98[ab]	0.99
PUFA*	8.71[b]	9.10[b]	10.50[ab]	10.95[ab]	9.41[b]	13.19[a]	11.53[ab]	0.59
n-6 FA*	7.19[b]	7.48[b]	8.71[ab]	9.10[ab]	7.59[b]	10.88[a]	9.42[ab]	0.51
n-3 FA*	1.52[c]	1.63[c]	1.78[bc]	1.85[bc]	1.82[bc]	2.31[a]	2.12[ab]	0.09
PUFA/SFA	0.22[c]	0.23[bc]	0.28[abc]	0.29[abc]	0.24[bc]	0.34[a]	0.31[ab]	0.02
n-6/*n*-3	4.78[ab]	4.66[ab]	4.90[a]	4.95[a]	4.20[b]	4.73[ab]	4.46[ab]	0.14

*g/100g FA. [abc]Means within a row with unlike superscripts differ ($P < 0.05$).

Key Words: Sunflower and soybean seeds, Heifers, Meat fatty acids

M95 Effect of different breeds on fatty acid composition and cla concentration of beef cattle. A. A. Souza, L. Suguisawa*, H. N. Oliveira, and A. C. Silveira, *São Paulo State University, São Paulo, Brazil*.

Beef is the mainly source of fat on human diet. Manipulation of the fat acid composition becomes a way to produce a healthier cuts. The development of cuts with more tendernes and easier to prepare was the target of beef industries on last years, but now meat consumers are looking for not only tendernes and flavour, but healthier cuts too. The improve on usaturated fat acid and CLA concentrations are possibilities to improve quality of beef cuts. Forty two bullocks approximately 8 months and 240 kg, from Nellore, Angus, Angus x Nellore, Brangus, Simmental x Nellore, Simbrasil (5/8 S 3/8 N) and Simmental were evaluated. Animals were housed with a high concentrate diet, and slaughtered with 450 kg and 3 mm of backfat thickness. Angus and its crossbred had thicker backfat and marbling, but smaller ribeye area than Simmental and its crossbred. Simmental and its crossbred had more unsaturated fatty acids and higher concentrations of CLA than zebu and Angus cattle.

Table 1. Effect of different breeds on fatty acid composition and CLA concentration

Fatty acid	Angus	Brangus	1/2 Angus	Nellore	1/2 Simmental	Simbrasil	Simmental	SEM
				mg/g fatty acid				
C 18:2 cis 9 trans 11	4.13[a]	3.23[a]	4.52[ab]	3.82[a]	4.79[ab]	6.07[b]	4.74[ab]	0.32
Saturated (% total)	52.0[c]	51.0[bc]	47.3[ab]	49.8[abc]	48.5[abc]	46.2[a]	50.2[bc]	0.06
Unsaturated (% total)	48.0[a]	49.0[ab]	52.7[bc]	50.2[abc]	51.5[abc]	53.8[c]	49.8[ab]	0.06
Monounsat. (% unsaturat.)	88.7[abc]	90.9[bc]	86.6[ab]	92.4[c]	84.9[a]	85.9[ab]	86.9[ab]	0.05
Polyunsat. (% unsaturat.)	11.3[abc]	9.1[ab]	13.4[bc]	7.6[a]	15.1[c]	14.1[bc]	13.1[bc]	0.36
Total (%)	89.80	89.92	91.46	89.35	86.6	89.89	88.16	0.03

*means with unlike superscripts are different (P< 0.05)

Key Words: CLA, Fatty acids, Genetic Group

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M96 Response of μ- and m-Calpains in the Presence of Calpastatin After Hydrogen Peroxide-Induced Oxidation. E. M. Steadham*[1], K. R. Maddock Carlin[2], E. Huff-Lonergan[1], and S. M. Lonergan[1], [1]*Iowa State University*, *Ames*, [2]*North Dakota State Unversity*, *Fargo*.

The purpose of this study was to determine if μ-calpain and m-calpain differ in their response to oxidation under similar conditions. Purified porcine μ- or m-calpain (0.6 units) in 50 mM HEPES buffer, pH 7.5, were incubated on ice with the following treatment combinations: 1) Oxidation by treatment with 100 mM H_2O_2 for five minutes. 2) Two units calpastatin/unit of calpain, without oxidation. 3) Exposure to H_2O_2 for five minutes followed by treatment with calpastatin (2 units). 4) Incubation with calpastatin followed by H_2O_2 oxidation for five minutes. All treatments included 10 mM $CaCl_2$. Control treatments of μ- or m-calpain without $CaCl_2$ were included. After treatment, reactions were stopped by dividing the reaction mixture into sample buffers containing EDTA for casein zymography (to determine enzymatic activity) as well as electrophoresis on reducing and non-reducing polyacrylamide gels (to evaluate autolysis of the calpains). Samples treated similarly were also evaluated for enzymatic activity in vitro for comparison to casein zymography results. Incubation of μ- and m-calpain with hydrogen peroxide in the presence of calcium resulted in retained activity on casein gels and notably less autolysis than incubation of calpain with calcium in the absence of hydrogen peroxide, indicating that oxidation inhibited activation of both enzymes and prevented autolysis-induced activity loss in solution. Oxidation of μ-calpain/calpastatin complex promoted autolysis of μ-calpain and resulted in less retained μ-calpain activity. In contrast, oxidation did not promote autolysis and activation of m-calpain bound to calpastatin as evidenced by retained activity of m-calpain on casein zymograms. Since oxidative conditions exist in postmortem muscle, these observations reflect some of the influences that exist on calpain activity and subsequent meat quality. While these conditions are likely inherent in the conversion of muscle to meat, understanding the mechanisms could allow for better evaluation of procedures to optimize meat quality.

Key Words: Calpain, Calpastatin, Oxidation

M97 Effects of postmortem storage on μ- and m-calpain in bovine skeletal muscle. J. P. Camou*, J. A. Marchello, and D. E. Goll, *University of Arizona*, *Tucson*.

It is generally believed that the calpains are responsible for proteolytically-induced tenderization during postmortem storage. It is unclear whether these changes are caused by μ- or m-calpain or both. We have used casein zymography to determine the effects of postmortem storage on activities of μ- and m-calpain in five different bovine muscles, and the effects of incubating muscle at four different pH values on the calpain activities in that muscle. The *longissimus dorsi thoracis* (LDT), and *lumborum* (LDL), *semimembranosus* (ST), *triceps brachii* (TB), and *psoas major* (PM) muscles were sampled after 0, 7, 24, 31, 48, 72, 96, 120, and 144 h postmortem storage at 2-4 ^{0}C. Activity of μ-calpain declined rapidly during postmortem storage and was 29% or 2% (both ave. of 4 muscles) of original activity after 24 and 72 h, respectively. Activity of m-calpain declined more slowly during postmortem storage;

57% or 38% (ave. of 4 muscles) of original activity remained after 24 and 72 h, respectively. Activity of μ- and m-calpain in the TB muscle decreased more slowly than in the other 4 muscles; 38% or 18% of μ-calpain activity remained after 24 and 72 h postmortem, respectively and 77% or 56% of m-calpain activity remained after 24 and 72 h postmortem, respectively. After 144 h postmortem, 7-18% of the original m-calpain activity, but only 1-2% of the original μ-calpain activity remained. The zymogram assays were done at 25°C, and activities would be even less *in situ* in muscle stored at 2-4°C.

Zymogram assays of calpain activity in 3x1x0.5 cm slices of bovine diaphragm muscle incubated for 0, 24, 48, or 144 h postmortem at 2-4°C in Tris-MES buffers containing EGTA at pH values 7.5, 7.0, 6.5, or 5.8 showed that activities of μ- and m-calpain decreased at similar rates during postmortem storage under these conditions and that pH values of 7.5, 7.0, or 6.5 had little effect on rate of decline in activity; 16-36% of the original μ-calpain activity and 26-30% of the original m-calpain activity remained after 144 h. Neither μ- nor m-calpain had any activity after 24 h in muscle placed at pH 5.8.

Key Words: Calpain, Tenderness, Postmortem

M98 Effect of substitution of concentrate by sweet potato (*Ipomoea batatas* L.) meal in carcass traits of finishing pigs. O. E. Moron*, S. Pietrosemoli, A. Paez, C. Chirinos, and A. Marrugo, *Facultad de Agronomia. La Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*.

To assess the effect of substituting a commercial concentrate by sweet potato root (**R**) and foliage (**F**) meal on carcass traits of finishing pigs, 18 castrated males and female Duroc x Landrace (62 ± 3.9 kg and 165.2 ± 6.6 d of age) were balanced across 3 treatments in a completely randomized design: **T1**,100 % commercial concentrate (**CC**); **T2**, 60 % **CC** + 30 % **F** + 10 % **R**; **T3**, 50 % **CC** + 40 % **F** + 10 % **R**). Pigs had *ad libitum* access to feed, and the trial lasted until they reached 90 ± 5 kg final weight. Most carcass traits were negatively influenced by the substitution of CC by sweet potato meal. However, no differences were observed between treatments for kidney (avg: 0.21±0.02 kg), heart (avg: 0.2±0.02 kg), and pancreatic weights (avg: 0.1±0.01 kg).

Table I. Carcass traits of pigs receiving sweet potato diet.

	T1	T2	T3
Cold Carcass Weight, kg	66.2 ± 2.4a	58.0 ± 1.9b	56.9 ± 1.9b
Weight Loss 24 h, %	1.2 ± 0.3a	2.9 ± 0.3b	2.4 ± 0.3b
Cold Carcass Yield 24h, %	53.9 ± 5.1a	67.5 ± 4.2b	66.8 ± 4.2b
Leg Yield, %	10.4 ± 1.2[a]	14.1 ± 1.0b	13.1 ± 1.0ab
Eye Rib Yield, %	15.7 ± 1.6	18.9 ± 1.3	19.1 ± 1.3
Shoulder Yield, %	10.6 ± 1.2a	14.5 ± 1.0b	13.5 ± 1.0b
Rib Yield, %	29.4 ± 0.2	29.5 ± 0.2	30.0 ± 0.2
Lung, kg	0.6 ± 0.07a	0.9 ± 0.07b	0.8 ± 0.07ab
Head, kg	7.9 ± 0.2a	6.9 ± 0.2b	6.3 ± 0.2b

a,b: Within a row differ (p < 0, 05)

Key Words: *Ipomea batata*, Pig, Carcass traits