1420 The callipyge phenomenon: evidence for unusual genetic inheritance. N. E. Cockett*[1], T. L. Shay[1], S. Berghmans[2], S. P. Jackson[3], G. D. Snowder[4], C. Carpenter[1], and M. Georges[2], [1]*Utah State University, Logan, UT,* [2]*University of Liége, Belgium,* [3]*Texas Tech University, Lubbock, TX,* [4]*USDA, ARS U.S. Sheep Experiment Station, Dubois, ID.*

In 1983, a male lamb exhibiting a pronounced muscular hypertrophy, particularly noticeable in the hind quarters, was born into a commercial Dorset flock in Oklahoma. The ram was premonitorily called *Solid Gold*. He subsequently produced offspring expressing the unusual phenotype, which is referred to as *callipyge* [<Gk *calli-* beautiful + *-pyge* buttocks]. Animals demonstrating the callipyge phenotype are all descendants of this founder ram. These animals produce leaner, higher yielding carcasses but there is some concern with decreased tenderness of the loin. Skeletal muscle tissue derived from callipyge animals exhibits hypertrophy of the fast twitch muscle fibers; however, the hypertrophy is absent at birth and develops only after approximately three weeks of age. Genetic characterization of the locus has demonstrated a unique mode of inheritance termed "polar overdominance", in which only heterozygous offspring inheriting the mutation from their sire express the phenotype. The three other genotypes are normal in appearance. Progeny data indicate that reactivation of the maternal callipyge allele occurs after passage through the male germ line, although this reactivation is not absolute. The gene has been mapped to the distal end of ovine chromosome 18.

Key Words: Ovine, Callipyge, Polar Overdominance

1421 Basis of gametic imprinting. A. Ruvinsky*, *University of New England, Australia.*

The fundamental assumption of Mendelian genetics is that behaviour of an allele is identical whether it arrives to a zygote through paternal or maternal germ line pathway. Gametic imprinting phenomena discovered and studied in mammals during the last 15 years show limitation of the classical view at least in special cases. Two main independent sources of evidence were essential to describe gametic imprinting. The first approach based on genetic and cytogenetic evidence demonstrated that some maternally and paternally derived regions of certain chromosomes were not equivalent. It was found that paternal or maternal disomy of the regions containing particular genes caused significant effects on viability and development of progeny. The second set of data was obtained by nuclear transplantations and parthenogenetic activation of mammalian oocytes. These data suggested that the contribution of parental genomes was not equivalent and differential imprinting of nuclear genes during gametogenesis was very likely. The recent mouse genetic imprinting map reveals more than a dozen regions on nine different chromosomes. The number of loci found in mice, which show gametic imprinting, is about 20. It is generally accepted that gametic imprinting is a mammalian invention and there are differences in imprinting pattern between species. Most hypotheses propose involvement of imprinted genes in the control of fetal growth and fetal-maternal interactions, thus keeping a balance between contradictory fetal and maternal requirements. Molecular mechanisms responsible for gametic imprinting still remain to be studied, but for several genes like *Igf2r* and *H19* it was shown that imprinting marks are imposed by a parent-specific methylation process during gametogenesis. These marks are resistant to global demethylation during cleavage and to global *de novo* methylation after implantation and maintain different methylation patterns in paternal and maternal alleles of imprinted genes. Retardation or acceleration of growth seems to be a typical consequence of abnormal imprinting in mammalian species including farm animals. About 20–25% of all transgene loci studied demonstrate similarities with imprinted genes. For instance, methylation of some transgenes is dependent on parental gametic pathway and reversible in the next generation. There are data indicating that selection of modifier genes may change the effects of gametic imprinting. It is possible that future selection and crossbreeding programmes may take gametic imprinting into consideration.

Key Words: Gametic Imprinting, Growth and Development, Methylation

1422 Effect of callipyge (CLPG) genotypes on growth, carcass, and reproduction traits. B. A. Freking* and K. A. Leymaster, *USDA-ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

Genotypic and phenotypic data collected from flocks segregating at the CLPG locus were used to estimate genotypic effects on growth, carcass, and female reproduction traits. The grandparent generation consisted of nine Dorset rams of callipyge phenotype (CN genotype) exposed to 255 Romanov ewes (NN genotype). The parent generation involved inter se matings of eight F1 rams of callipyge phenotype with 152 phenotypically normal and callipyge F1 ewes. F2 ewe and wether lambs (n=362) from two years of inter se matings were serially slaughtered to obtain carcass data. Two F2 rams of each predicted genotype (CC, CN, NC, NN) from the third year of inter se matings were selected and exposed to F2 ewes (n=184) producing F3 progeny in 1997 and 1998 to evaluate female reproduction traits. The statistical model for F2 data fitted effects of year, sex, sire, regressions on polar overdominance (PO) contrast of genotypic probabilities, and the interaction of PO with linear and quadratic regressions on carcass weight. Growth traits were similar among genotypes. When tested at 25.6 kg carcass weight, PO was highly significant ($P<.001$) for carcass traits except carcass ash. Least-squares means of CN genotype, expressed as a percent of combined normal genotypes were: live weight, 94; pelt weight, 90; liver weight, 88; kidney-pelvic fat, 71; 12th-rib fat depth, 62; carcass length, 96; shoulder width, 102; rump width, 104; longissimus area, 133; and weight of carcass water, protein, fat, and ash, 111, 112, 77, and 98, respectively. CN genotype carcasses consisted of 24.3% fat and 71.3% fat-free lean compared to 31.5% and 64.0% for normal genotypes. Data collected on F2 ewes at slaughter indicated CN genotypes produced .2 corpora lutea less ($P>.05$) than normal genotypes at 215 d age. Callipyge genotypes can be used in structured mating systems to make improvements in dressing percentage, lean growth rate, muscle shape, and carcass composition.

Key Words: Sheep, Callipyge, Genotypic Effects

1423 Muscle growth, carcass composition, and meat tenderness of callipyge lamb: A review. M. Koohmaraie*, S. D. Shackelford, T. L. Wheeler, *USDA-ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

The objective of this paper is to review the published results on muscle growth, carcass composition and meat tenderness of callipyge lambs. The callipyge condition is characterized by increased muscling and decreased fatness. Callipyge does not affect slaughter weight or hot carcass weight, but increases the dressing percentage. The callipyge phenotype reduces subcutaneous, intermuscular, intramuscular, and perinephric fatness. The weight of dissected muscle is about 28% higher in callipyge carcasses. Not all muscles are affected by callipyge and affected muscles are not all affected equally. The increase in the weight of the affected muscles ranged from 18.8% (quadriceps femoris) to 42.1% (biceps femoris). The increased muscling associated with the callipyge phenotype appears to be the result of increased muscle fiber hypertrophy, not hyperplasia. The fractional accretion rate was not different, but the fractional synthesis (22% in longissimus, and 16% in biceps femoris) and the fractional degradation (35% in longissimus and 34% in biceps femoris) rates were decreased in 8 wk old callipyge lambs. Indices of meat tenderness indicate that callipyge longissimus is tough and undergoes minimal postmortem tenderization. Warner-Bratzler shear force of hypertrophied muscles was increased 11% to 145% in callipyge carcasses. Rates of pH and temperature decline, ultimate pH, sarcomere length, and the amount and crosslinking of collagen are not different between callipyge and normal lambs and, thus, are not the cause of callipyge longissimus toughness. What is different between callipyge and normal longissimus is the rate and extent of postmortem degradation of key myofibril and associated proteins whose degradation has been shown to be responsible for postmortem meat tenderization. Muscles that are hypertrophied have elevated calpastatin activities ranging from 19 to 126%. The simple correlation between change in muscle weight and percent change in calpastatin activity was .97. Reduced postmortem tenderization in callipyge lambs is most likely due to increased calpastatin activity.

Key Words: Callipyge, Muscle, Calpastatin

1424 The callipyge phenomenon; Challenges and opportunities: Toughness intervention methods. M. B. Solomon*, *U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD.*

Consumers continue to request the desire for leaner meats. Lambs expressing the callipyge gene have been identified as having superior-leaner carcasses compared to normal muscled lambs. However, the longissimus muscle, a major merchandised muscle in lamb has repeatedly been shown to be significantly less tender in callipyge lamb compared to normal muscled lambs. Pre-harvest factors, such as genetics, sex and production/management practices thus far have shown no promise at alleviating this tenderness problem. A number of post-harvest intervention strategies have been introduced to alleviate this tenderness problem. Included in these strategies are: postmortem aging, carcass electrical stimulation (ES), the combination of freezing and thawing prior to aging, calcium chloride (CaCl) injection, and the Hydrodyne process. Some of these strategies have exhibited various degrees of success. Post-harvest strategies to improve callipyge longissimus tenderness will be discussed.

Key Words: Callipyge, Tenderness, Strategies

1425 Economics of callipyge lamb production. J. Busboom[1]*, T. Wahl[1], and G. Snowder[2], [1]*Washington State Univ., Pullman* [2]*USSES, Dubois.*

This paper examines the economic implications of callipyge (**CLPG**) lamb production from farm to table. Price relative to competing meats and excess fat are important factors affecting lamb demand and CLPG genetics improves those factors. The CLPG phenotype does not affect number or weight of lambs weaned or post-weaning ADG. However, the CLPG phenotype improves post-weaning feed efficiency at least 10%, dressing percentage about 7.5%, and yields of wholesale leg (11.8%), loin (4.7%), rack (2.5%), and shoulder (2.3%). Total production costs for a 59.1 kg lamb are 4% lower in CLPG lambs due to improved feed efficiency. Assuming pelt and offal value pays for slaughter costs, cost of N and CLPG carcasses are the same as for live lambs, $81 and $78, respectively, but because of differences in dressing percentage the N carcass weighs 29.2 kg and the CLPG carcass, 31.4 kg. Thus, carcass costs for N and CLPG lambs are $2.77/kg and $2.49/kg, respectively. The combination of decreased feed costs and increased dressing percentage and primal cut yield lowers the price required to recover meat costs for leg, loin, rack and shoulder from $3.30 to $2.65/kg, $5.85 to $5.01, $6.60 to $5.77, and $2.18 to $1.92, respectively. Successful marketing of CLPG loin and rack depends on the use of one of several post-harvest treatments to improve meat tenderness. Moisture-enhanced pork is accepted by consumers and often sells for a premium; and moisture-enhancement may be appropriate for CLPG lamb. The meat cost per kilogram (including a $.10 per kilogram treatment cost) of tenderized and moisture-enhanced CLPG leg, loin, rack and shoulder containing 10% added water and ingredients would be lowered to $2.51, $4.65, $5.34, and $1.85, respectively. That represents a total of a 20.9% reduction in meat cost per kilogram. If accepted by consumers, moisture-enhanced CLPG lamb has the potential to decrease the cost of lamb to consumers and increase lamb industry profitability. The economic value of lower fat and cholesterol, reduced seam fat, and improved visual appeal of CLPG lamb needs to be quantitated.

Key Words: Callipyge, Tenderness, Economic value

1426 Genetic aspects of callipyge implementation by the sheep industry. K. A. Leymaster* and B. A. Freking, *USDA-ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

The objective is to discuss industry breeding structures and mating systems that manage callipyge alleles to produce relevant distributions of genotypes. Based on the polar overdominance model of gene action, the mutant callipyge allele (C) and the normal wild type allele (N) interact to cause expression of callipyge (CN genotype with C allele from the sire and N allele from the dam) and normal (CC, NC, and NN genotypes) phenotypes. Subjective evaluation of sheep generally distinguishes between callipyge and normal phenotypes, allowing reliable detection of CN sheep. All genotypes can be determined by progeny testing or predicted by use of flanking genetic markers. The C allele can be introgressed by mating CC, CN, or NC rams of any breed to NN ewes of the intended breed. Resulting callipyge (CN) crossbred rams are mated to NN ewes of the intended breed and the process is repeated. This strategy results in a 1-yr generation interval for rams while annually halving the remaining original source of germ plasm imparting C. The C allele may eventually be fixed by mating CN rams and ewes and using available methods to identify CC progeny. In time, CC rams could be mated to CN ewes, relying on subjective evaluation to assign callipyge (CN) ewes to the carrier flock and normal (CC) sheep to the homozygous flock. Terminal sire mating systems are ideally suited to produce CN progeny expressing the callipyge phenotype. Rams of specialized terminal sire lines homozygous for the C allele are mated to noncarrier purebred, F_1, or composite ewes, producing callipyge market lambs. Heterozygous rams are also useful under certain situations; for example, CN or NC rams mated to NN ewes produce callipyge market lambs and noncarrier lambs available as replacement stock. Effective industry exploitation of callipyge alleles requires use of well-managed purebred and crossbred mating systems. Perhaps the callipyge phenomenon will encourage and stimulate the industry to evaluate its breeding structure, resulting in more prudent use of genetic resources.

Key Words: Callipyge, Introgression, Mating Systems