

Symposium: Meat Science and Muscle Biology: Meat Quality: Regulation of Intramuscular Fat Deposition

61 The value of marbling in consumer acceptance of beef. L. R. Corah*, *Certified Angus Beef LLC, Wooster, OH.*

In 1925, the USDA implemented the quality grading system to address consumer confusion related to meat quality. Since that original role, marbling has become an important component of meat quality in both the domestic and global marketplace. Most research studies have shown that as marbling levels increase, the overall consumer acceptability increases. The triad of flavor, tenderness, and juiciness are considered by most scientists to be the key components of eating satisfaction. Although the magnitude will vary by study, marbling contributes to each of these three attributes. Recent research at Texas Tech University shows that tenderness is important, but flavor is two and a half times as important in overall consumer acceptability of beef. In the past eight years, cattle markets have started to reflect these consumer preferences as the Choice-Select and Premium Choice-Low Choice spreads have widened from historical levels of \$2-4/cwt to \$10-12/cwt in the last three years. A recent Cattle-Fax analysis suggests that the impact of Premium Choice and Prime adds \$500 million plus annually of added value to the producer.

Key Words: Marbling, Consumer Acceptance, Beef

62 Renewing the interest on marbling in pork products. C. M. Schultz Kaster*, R. C. Johnson, and J. O. Matthews, *Farmland Foods Inc., Kansas City, MO.*

This presentation will describe some of the current information on the impact of marbling in pork. The pork industry has dramatically changed its definitions of quality over the past twenty years progressing from weight to leanness to muscle quality and more recently to measure of palatability. Marbling is a means for a visual assessment of perceived product quality, and already has consumer meaning due to its use with quality grades in the beef industry. However, marbling had been allowed to diminish in pork as pigs were made leaner. The contribution of marbling to palatability has been debated particularly as it relates to tenderness. Color and pH are both key indicators of quality, and are widely used for selection in the pork industry. Marbling has emerged as a means to differentiate high end product, particularly for the foodservice industry driven by celebrated chefs and menu nomenclature. Ideal amounts of marbling are still being determined, and may vary depending on the market, and increasing marbling may come with negative effects like steatosis in ham muscles, increased fat content for nutritional labeling, and negative consumer perceptions of too much fat. Increasing marbling may come at a cost that impacts production or genetic costs depending on the level desired. Demand for this product is still being determined directly by retail outlets offering a higher tier of pork, or by chefs using it on menus on a limited basis. The possibility exists that increase marbling in all pork may indirectly increase demand if it contributes to the improvement of palatability in the general pork population.

Key Words: Pork, Marbling, Quality

63 Cellular regulation of intramuscular adipose tissue deposition and composition. S. B. Smith*¹, H. Kawachi², C. B. Choi³, C. W. Choi⁴, and J. E. Sawyer¹, ¹Texas A&M University, College Station, ²Kyoto University, Kyoto, Sakyo-ku, Japan, ³Yeungnam University, Gyeongsan, Korea, ⁴National Institute of Animal Science, Suwon, Korea.

It is well documented that grain feeding stimulates adipogenesis in beef cattle, whereas pasture feeding depresses the development of adipose tissues, including intramuscular (i.m.) adipose tissue. Production practices that depress adipogenesis also limit the synthesis of monounsaturated fatty acids (MUFA). Insulin stimulates glucose incorporation into fatty acids *in vitro* in s.c. and i.m. adipose tissues of long-fed cattle fed a high-concentrate diet, but has no effect on adipose tissues of long-fed cattle fed a hay-based diet. Marbling scores and s.c. adipose tissue MUFA are depressed by hay feeding, even when cattle are raised to the same BW endpoint. Conversely, the accumulation of i.m. adipose tissue in beef cattle is enhanced by feeding supplemental vitamin C and zinc, and is depressed by supplemental vitamin A. In preadipocyte cultures, vitamins A and D both decrease glycerol-3-phosphate dehydrogenase (GPDH) activity, an index of adipocyte differentiation, whereas incubation of bovine preadipocytes with L-ascorbic acid-2-phosphate increases GPDH activity. Exposing bovine preadipocytes to zinc also stimulates adipogenesis, putatively by inhibiting nitric oxide (NO) production. However, incubation of bovine preadipocytes with arginine, a biological precursor of NO, strongly promotes differentiation in concert with increased expression of stearoyl-CoA desaturase (SCD). This suggests that the effect of either arginine or zinc on adipogenesis is independent of NO synthesis in bovine preadipocytes. Enhanced expression of SCD is associated with a greater accumulation of MUFA both in bovine preadipocyte cultures and during development in growing steers. In bovine preadipocytes, *trans*-10, *cis*-12 conjugated linoleic acid (t10,c12 CLA) strongly depresses adipocyte differentiation and SCD gene expression, thereby reducing MUFA concentrations. This suggests that any production practice that elevates t10,c12 CLA in bovine adipose tissue will reduce i.m. adipose tissue development, in concert with a depressed accumulation of MUFA.

Key Words: Adipose Tissue, Fatty Acid, Growth

64 Nutritional regulation of intramuscular fat deposition. J. S. Drouillard* and C. D. Reinhardt, *Kansas State University, Manhattan.*

Demand for high-value, well-marbled beef products has spawned interest in nutritional strategies that increase marbling. USDA statistics for yield and quality grades reported during the last 10 years reveal an alarming trend for production of fatter carcasses with less marbling. Escalation of feed prices, particularly energy sources, has pushed production costs to unprecedented levels, suggesting that feeding to fatter compositional endpoints may become cost prohibitive. This forces beef producers to seek alternative means of affecting beef quality while feeding to lean, efficient endpoints. There is evidence to suggest that rigorous grain processing methods, such as flaking, decrease marbling scores relative to overall fat deposition and retail yield. Roughages, which are essential for maintaining digestive health, are costly relative to nutrient density.

Some studies suggest that low roughage levels lead to fatter carcasses with less marbling. Feeding fats and oils has, until recently, been practiced widely by feedlots, particularly in the Southern Plains. Though low levels can enhance carcass quality, levels often determined necessary to optimize efficiency (3-4%) may reduce marbling accretion relative to other body fat depots. Similarly, distiller's grains can enhance carcass quality when fed at low levels, while higher levels can have deleterious consequences for marbling, or at least can have a negative impact on the ratio of marbling to external fat deposition. Ruminal degradability and concentration of dietary protein also can influence marbling deposition. Higher levels of dietary protein have consistently increased quality grade of cattle fed diets consisting of flaked, rolled, or ensiled grains. This may have implications for diets containing distiller's grains, as the protein has low to moderate ruminal degradability. Methyl donor compounds, including choline and betaine, have improved marbling in several experiments, though results have been variable. Radical changes in ingredient and nutrient price relationships may force producers to re-evaluate diet composition as it relates to marbling.

Key Words: Beef, Marbling, Nutrition

65 Genetic regulation of intramuscular fat deposition. D. W. Moser*, *Kansas State University, Manhattan.*

Like most carcass traits, marbling score and percent intramuscular fat are highly heritable, and should respond well to selection. Significant breed differences exist in both beef and swine, but within-breed variation is

also great. In swine, long term selection for lean growth has decreased marbling. The Angus beef breed has recently shown an increasing genetic trend for marbling, but most other beef breeds have shown little or no change in the past few decades. Direct measurement of marbling requires harvest of the animal, so producers practice selection on genetic predictions generated from progeny test data and ultrasound measurements of sires and progeny, as well as genetic marker tests. Progeny testing is the most accurate, but requires the greatest amount of time, and usually, the most expense. Automated grading of carcasses and electronic animal identification may allow greater volumes and quality of carcass data to be collected for use in genetic evaluation. Ultrasound measurement of intramuscular fat in live cattle has been used successfully in cattle for many years, and has gained wider use in swine. Serum leptin has also been suggested for use as a selection criterion to increase marbling. Genetic tests for marbling have been developed for both species. In beef, tests for thyroglobulin gene mutations for use in predicting marbling score and quality grade have been marketed since 2000, but validation studies of these tests generally show modest effects. Other genes, such as leptin, have also been suggested as having effects on marbling, and for most commercial genetic marbling tests, the underlying genes are unknown or not publicly revealed. In swine, the *rendement napole* gene has been shown to affect marbling. Most swine breeding companies have proprietary marker tests for a variety of production and meat quality traits. The most promising opportunities for increased rate of genetic change for intramuscular fat in both species lie with genetic analyses that combine carcass data, ultrasound measures of live animals, and test results from large panels of genetic markers.

Key Words: Intramuscular Fat, Marbling, Selection