New Insights in the Development of Marbling in Beef Cattle

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As the industry moves towards more value based marketing programs, feeders as well as producers who retain ownership on their calves are becoming more concerned about the type and kind of cattle they are feeding. During the past five years a greater emphasis has been put on selecting genetics that excel in marbling and/or lean muscle growth. Research has shown that genetics have the biggest impact on carcass quality. With the help of EPD's we have been able to make progress in improving carcass quality. However we are finding out that one poor management decision may wipe out all the genetic progress that has taken generations to build.

It has long been thought that marbling is a late developing tissue. This philosophy is based on the body's prioritization of fuel use. Calories are first used to meet bone growth, then muscle growth followed by fat development (Figure 1.). Because the individual patterns of growth overlap we are able to manage cattle of different biological types to similar targeted endpoints. For example, if we were to feed a set of small framed straight bred British cattle we may need to develop some additional frame size in them by growing them at an average daily gain (ADG) of only 1.5 lb. before we put them on a finishing ration. By doing this we hopefully increase their final body size without causing them to be over finished. Likewise, if we have a set of large framed continental cross cattle we can bring them in to the feed yard and start pushing them right away with a targeted ADG above 3.0 lb. When we do this the needed ADG to maximize muscle growth is 2.0 –2.5 lbs per day, but we have additional intake that can go to support fat growth. Even though the two groups of cattle are physiologically different, we have targeted a similar endpoint.

Feeders were convinced that growth implants should be administered on the front end of the finishing phase further away from the harvest date so that marbling development wouldn't be hindered. In the mid 90's a research project was conducted by Dr. Robbi Pritchard, ruminant nutritionist at South Dakota State University, who compared the use of a low potency or a high potency implant administered early in the finishing phase. The results were contrary to previous beliefs. Cattle receiving a low potency implant (Ralgro) on day 1 followed by a high potency implant (Revalor – s) on day 56 graded 60% choice or better. Where as cattle receiving a high potency implant, Synovex Plus or Revelor – s, on day 1 graded 43% and 51% choice respectfully. The results suggested to us that marbling development maybe taking place earlier than was assumed and that early management decisions could alter percent choice dramatically.

To better understand the development of marbling we conducted a serial harvest study with 85 non-implanted Angus steers of known age and genetic background to quantify the rate and extent at which marbling develops. Steers were serially harvested at 5 targeted carcass endpoints of 450, 550, 650, 750, and 850 lbs. Yield grades ranged from

an average of 2.2 at harvest group 1 to 4.7 at harvest group 5. Marbling and back fat were plotted over hot carcass weight gain. Figure 2 shows the rate and extend at which marbling developed compared to back fat with increasing hot carcass weight. Early in the finishing phase marbling was developing at a greater rate than back fat indicated by the steeper slope of the line; but on the tail end of the finishing phase back fat was increasing at a faster rate than marbling. We found that marbling is an intrinsic component of growth developing throughout an animals life. It is likely that marbling can not be increased beyond the animals genetic potential.

Even though we were beginning to understand the changes in growth of the animal we wanted to test our hypothesis that "*management factors early in an animals' life could impact the outcome of marbling development*". Growth promoting implants stimulate lean growth and increase frame size causing a shift in the animals physiological maturity which delays fattening. However, we did not know if the implant would delay marbling development also. To test the effect of an implant on marbling development, 180 Angus and Limousin cross Angus steer calves were backgrounded to a weight of 650 lbs before being allotted to one of three treatments; 1) Control, non-implanted; 2) Early Implant, implanted with an estradiol-trenbolone acetate implant on day 1 weighing 650 lbs; 3) Delayed Implant, implanted at 750 lbs with an estradiol-trenbolone acetate implant on day 56. The steers were fed for 155 days. Steers receiving an implant at 650 lbs at the beginning of the trial had lower marbling scores than the control steers, while those receiving an implant at 750 lbs had marbling scores that were not different from controls. The big difference was in the carcasses that graded in the upper 2/3 part of Choice. Non-implanted steers had 24% grade in the upper 2/3 Choice. The early implant, which had more time on feed after implanting , had 8 % in the upper 2/3 part of choice while the delayed treatment had 23% of carcasses grading in the upper 2/3 part of choice. When the implant is administered too early, the body is depositing more muscle tissue and the calories that would normally support muscle and fat growth are now needed to support the added muscle growth demanded by the implant. The cattle that received the implant later were consuming more feed and receiving a diet that had more energy in it. Consequently the later implanted cattle were able to have enough intake to meet the demand of both tissues. A sample set of steers was harvested from each treatment at 650 and 750 lbs to develop regression lines for marbling development. Figure 3 shows the regression lines for each treatment. Steers which received an implant at the beginning of the trial were not able to catch up and would require an estimated 123 lbs of additional empty body weight gain to reach an intramuscular fat content of 4% which is considered Choice minus.

Early weaning research at the University of Illinois would support the theory that marbling is an early developing tissue. Researchers compared traditional weaning times versus early weaning. The cattle that were weaned early were started on feed right away. Even though the early weaned calves had lower average daily gains in the finishing phase they had a caloric intake early in life that was above and beyond what was need to support normal growth. Marbling development was advanced over traditional weaned calves. Does this mean that producers should creep their calves to increase quality grade? The data would suggest, that if calves can sustain their normal growth curve

without additional supplementation then creep feeding won't increase grade. However, if the calves are growing below their growth potential, due to inadequate nutrition, then creep feeding or early weaning should help their ability to grade. This theory may also explain why sick cattle have been found to be poor grading cattle. Typically, when cattle get sick on arrival into the lot, feed intake is suppressed. When feed intake is lower the animal does not have enough calories to meet the prioritization of tissue development. If an implant is administered at this time the effect is compounded. The result is cattle that, regardless of genetic ability to deposit marbling, can not over come the deficit.

It is important for us to remember the prioritization of a fuel source for normal growth, when making management decisions that may alter the growth curve of a steer. Likewise, health status and starting diets have a dramatic impact on marbling development. Producers should also realize that there is no magical time to administer an implant. It is a matter of matching the implant with the correct level of potency to the diet and biological type of cattle being fed. By delaying the implant until the animal has sufficient caloric intake to support not only muscle growth, but marbling development which improves the percentage of cattle that can grade choice. Further research at SDSU is concentrating on additional management factors and stresses that may affect marbling development.

Figure 1. Normal Postnatal Growth Curves of Bone, Muscle, and Fat

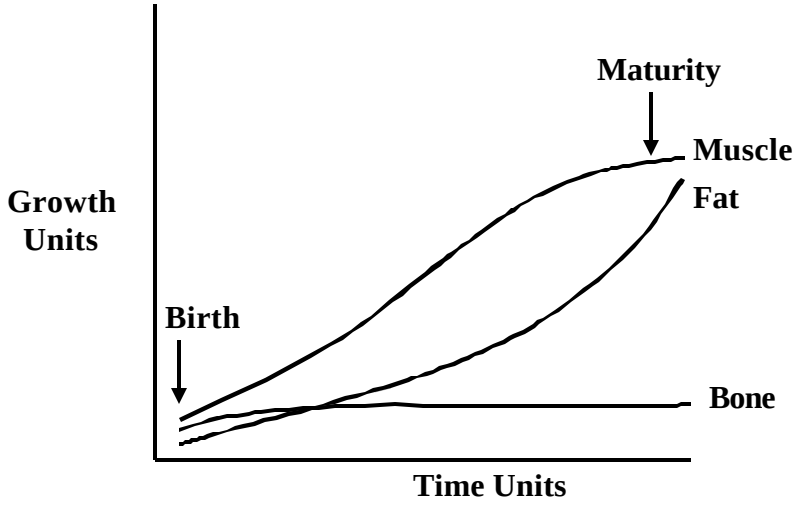

Figure 2. Backfat and Marbling Regressed Against Hot Carcass Weight

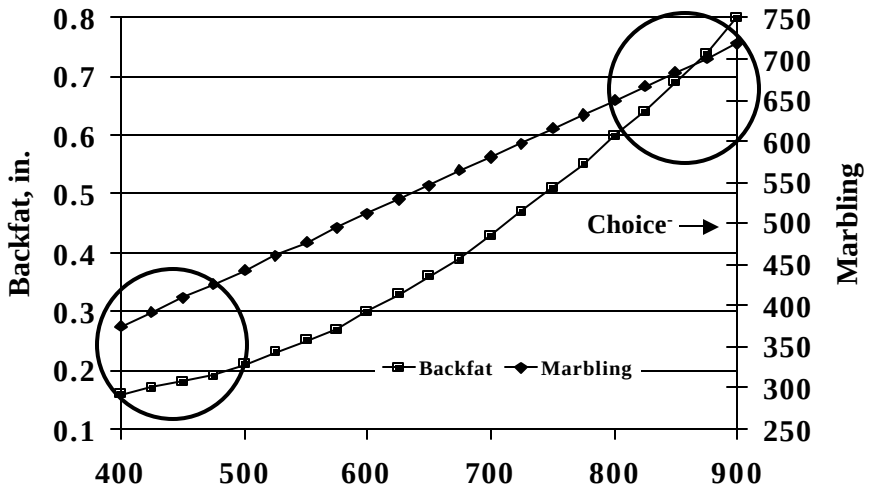

Figure 3. Percent 12th Rib Lipid Content x Empty Body Wt.