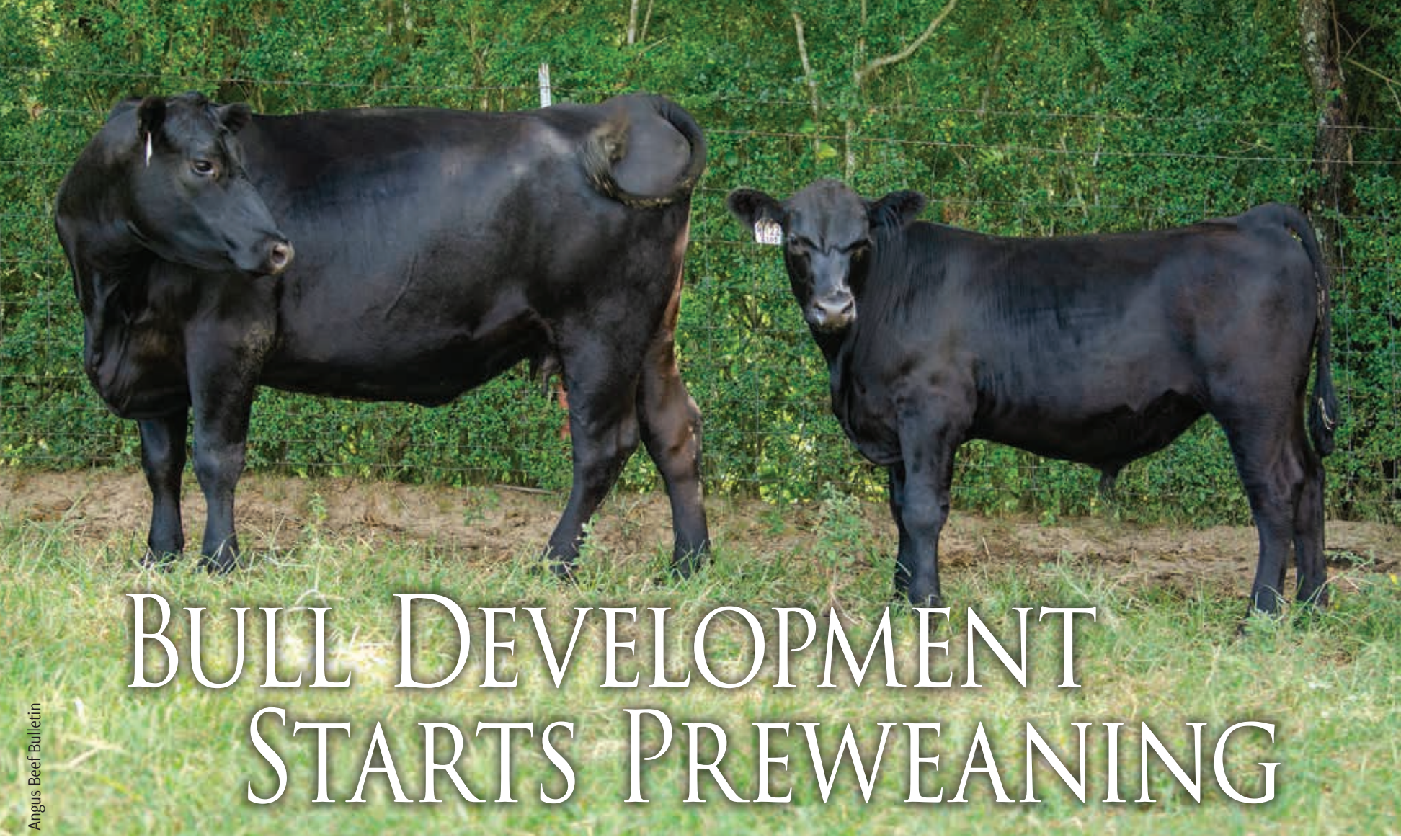

Angus Beef Bulletin

Bull Development Starts Preweaning

Nutritional management of your herd bull before weaning greatly affects sexual maturation.

by Troy Smith, field editor

You can "Google" it. Beef cattle producers seeking information about the nutritional development of breeding bulls can find it by searching online. They might obtain genuine hard copies of publications authored by experts on the subject. For some one-on-one time, they could go directly to the sources — typically ruminant nutritionists either engaged as consultants for hire or as educators employed by agricultural colleges.

The experts agree that sound bull development is pretty important to beef production, since bulls account for a significant portion of the genetic influence in a breeding herd. After all, each cow typically produces one calf per year, while a bull used for natural service may sire 20 or 30 calves — maybe more. DNA parenting technology has shown that some bulls are capable of siring more than 50 calves in a season.

On most cow-calf operations, bulls are the primary means for affecting genetic improvement in the next calf crop, and for influencing the production of daughters retained in the herd. Accordingly, producers often spend considerable time and plenty of money to select and purchase quality bulls.

If a producer considers a bull to be really good, according to numerical estimates of genetic merit and maybe because of the quality calves he has already sired, that producer probably hopes the bull remains sound, fertile and busy in the breeding pasture for several seasons. Certainly such an outcome would be influenced by nutrition during development.

Of course, there is some disagreement over how young bulls should be fed during development. Many people favor the use of high-energy diets, including relatively high amounts of grain to achieve rapid growth. Others prefer to target moderate rates of gain through forage-based diets offering lower levels of energy. There are yet others whose development strategies represent some kind of compromise. Regardless of the chosen ration, development programs seem to concentrate on how bull calves are fed after weaning.

"Overfeeding bulls can cause problems, including fat deposition in the scrotum, which is thought to compromise thermoregulation." — *Jason Smith*

Preweaning matters

However, ruminant nutritionist Jason Smith thinks too little attention is given to the preweaning period. Seldom is it a major consideration when contemplating bull development, but calfhood nutrition does have a big effect on the processes leading to sexual maturation in bulls.

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"It is commonly thought that postweaning nutrition has the greatest environmental influence on sexual development in bulls, yet there is compelling evidence to suggest preweaning nutritional management influences these outcomes to a substantial and, possibly, even a greater degree," says Smith, formerly a University of Tennessee Extension beef specialist who recently moved to Texas A&M University.

According to Smith, the significant role early nutrition management plays in bull development and subsequent indicators of fertility was discovered long ago. Research conducted in the 1950s showed nutrient restriction of bull calves from 1 week to 80 weeks of age dramatically increased age and decreased weight at puberty, which was accompanied by decreased sperm production. Yet the popular conception is that dam's milk and some forage will be sufficient until a calf is weaned.

"We want to believe the cow can take care of it," says Smith, restating the widely held perception that the dam will provide nursing bull calves with the nutrients required for growth at a level necessary to initiate sexual development. That's usually true in nutrient-rich production environments. However, Smith says, it should not be taken for granted when cows are maintained in nutrient-limited environments or for first-calf heifers.

"As a bull matures, he typically produces more sperm. He also produces more morphologically normal sperm. I believe those bulls are more successful because they are older, and not because of the development method." — *Jason Smith*

The nitty-gritty

Smith readily admits he is not a reproductive physiologist, but appreciation for early dietary effects on sexual development requires some understanding of physiology — the functions and mechanisms working within a living creature. More specifically, it requires some consideration of how organ systems work. Getting even more specific, Smith says, you have to "think about hormones."

Gonadotropins are hormones synthesized and secreted by the pituitary gland, and include luteinizing hormone (LH) and follicle-stimulating hormone (FSH). Their secretion is controlled by gonadotropin-releasing hormone (GnRH), which is produced by the hypothalamus.

Producers versed in the processes involved with estrous synchronization understand the roles these hormones play in the female reproductive cycle. In males, the same hormones serve different purposes.

According to Smith, release of gonadotropins and subsequent increases in testosterone (male hormone) occur between 8 weeks and 20 weeks of age. LH and FSH are considered to be the master regulators of Sertoli cell proliferation. That rapid growth in numbers of Sertoli cells, which are essential to testes development and spermatogenesis, ceases by 25 weeks of age. What all of that means is that a bull's lean testicular mass is likely predetermined by the time he is little more than 6 months old.

So, gonadotropins influence overall testicular size and the size of seminiferous tubules within the testes, which is where germination, maturation and transportation of sperm cells occur. However, there is still more hormonal activity involved. Metabolic hormones, including leptin, insulin and insulin-like growth factor-I (IGF-1), influence the reproductive hormones and processes already discussed. Leptin acts on the hypothalamus, which produces GnRH; and both insulin and IGF-1 affect testosterone production and spermatogenesis.

Smith cites studies that involved feeding high-energy diets to bull calves during the preweaning phase, which hastened puberty by about 25 days, compared to calves receiving low-energy diets. The onset of puberty was not affected by subsequently feeding postweaning diets with lower energy content. Also significant was the fact later puberty among bulls receiving low-energy preweaning diets could not be reversed by feeding high-energy diets to those bulls after weaning. So, energy restriction during the preweaning phase may have long-term consequences for physical and sexual development that might not be compensable by revving up postweaning nutrition.

"Evidence suggests that nutrition influences mechanisms that drive these outcomes before calves reach 26 weeks of age," says Smith. "It appears that nutrition can drive more change before weaning than afterward. And it looks like what happens early, due to nutrient restriction, probably can't be reversed."

Calling calfhood nutrition a critical but often overlooked component of bull development, Smith advises seedstock breeders that creep-feeding or creep-grazing can be applied to address nutrient restriction in production systems where forage quality or quantity may be limited.

A ruminant nutritionist can assist producers in choosing an appropriate creep ration incorporating the most economical and readily available cereal grains or byproduct

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feed ingredients. Smith says including an ionophore in the ration also offers advantages.

"Green creep" is a term sometimes applied to creep-grazing of high-quality forages located adjacent to pastures where dams and their nursing bull calves are grazing. Creep-gates located in the fence, or height adjustment of an electric fence, can allow the bull calves only to access the high-quality forage and return to the dams' side of the fence at will.

Postweaning development

While Smith thinks more breeders should pay more attention to preweaning nutrition, he's not suggesting postweaning nutrition should be ignored, as it is important to development and subsequent indicators of bull fertility. He also acknowledges the considerable concern over the negative consequences of overfeeding bulls during postweaning development. These may include negative effects to the physical soundness of bulls, as well as physiological effects. Reduced semen quality can be associated with bulls developed on diets so high in energy that bulls become too fat.

"Overfeeding bulls can cause problems, including fat deposition in the scrotum, which is thought to compromise thermoregulation," says Smith.

He explains that a bull's testes must be 4° to 6° Celsius (39.2° to 42.8° Fahrenheit) cooler than core body temperature. As scrotal fat increases, however, a subsequent rise in testes temperature follows as the fatty tissue inhibits the mechanism by which the testes' vascular system is cooled. When things get too hot, the result may be reduced motility and increased abnormal morphology of sperm cells.

Smith says aggressive feeding strategies utilizing high-energy diets also increase the risk of bulls developing rumen acidosis. This metabolic disorder is characterized by a rumen acidity level, or pH, of less than 5.5, while 6.5 to 7 is considered normal. In feedlots, acute acidosis can lead to severe illness and death. While pertinent research is limited, evidence suggests subacute acidosis in developing bulls may affect secretion of hormones, including suppression of testosterone and increases in cortisol, which may negatively affect semen quality.

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It's easy to warn seedstock breeders against overfeeding bulls, but Smith knows that breeders receive mixed signals. There is no denying that development on high-energy diets affords an opportunity to evaluate genetic potential for growth. Many bull buyers still subscribe to the notion that "fat is the prettiest color." Even cattlemen claiming they won't buy a fat bull still won't bid on a thin one. Smith says the goal should be to find the middle ground.

Smith reminds breeders that too little energy in the diet also may compromise reproduction. Corn and other grains aren't necessarily the enemy. Concentrates can be used, but certainly not at rates near those applicable to high-megacalorie finishing rations.

"For me, somewhere between 3 and 4 pounds (lb.) per day should be the goal for gain during development," suggests Smith.

Regarding the trend toward "aged range-ready bulls" marketed at 16-20 months of age, Smith notes that such bulls are sometimes promoted as "more fertile" and capable of breeding more cows because they were developed on diets utilizing modest levels of grain, or no grain at all. Smith agrees that these bulls may be more successful than yearling bulls developed on relatively high-energy diets.

"As a bull matures, he typically produces more sperm. He also produces more morphologically normal sperm. I believe those bulls are more successful because they are older, and not because of the development method."

Smith does advocate having all bulls "range ready" before the start of breeding season, meaning they should by fully transitioned to the diet they will consume after turnout. He warns against exposing bulls to sudden changes in diet, particularly an abrupt shift from a total mixed ration (TMR) to range or pasture. He advises seedstock producers to have bulls fully transitioned by the time they are delivered to buyers, simply because buyers may not do it themselves.

Smith advises consideration of mineral supplementation during bull development. While phosphorus has often been called the "repro mineral," he says trace minerals drive many mineral-related reproductive problems because dietary levels are either too low or too high, or because of high levels of antagonistic elements such as sulfur, molybdenum or iron.

"In my experience, trace minerals are important. However, trace-mineralized salt is not a satisfactory mineral program. It's salt," states Smith, recommending that bull development diets be formulated to meet National Research Council (NRC) requirements for trace minerals.

Neither should producers expect to adequately manage trace mineral requirements through a needle. Smith says an injectable trace mineral, if used, can serve as a form of insurance for cattle suspected of mineral deficiency. In his opinion, however, injectable mineral products cannot replace a dietary mineral program.

PHOTOS BY SHAUNA HERMEL

Editor's note: Troy Smith is a freelance writer from Sargent, Neb. Jason Smith presented at the 2019 Applied Reproductive Strategies in Beef Cattle (ARSBC) symposium Aug. 20-21 in Knoxville, Tenn. For comprehensive coverage of the event, visit the newsroom at *www.appliedreprostrategies.com*.