

FAT & FERTILE?



By Heather Smith-Thomas

Photo by Kathy Pimentel



Several studies in the past 2 decades have shown that bulls have lower fertility when fed high-energy diets during their growing period. Overfat young bulls not only have more foot and leg problems, less endurance (for breeding cows), but fat in the scrotum can greatly reduce a bull's fertility. Traditionally, bulls are put on feed gain tests at weaning (on high-energy diets), to determine which ones have fastest rates of gain, but the Canadian research showed that this practice is very detrimental to fertility. Fat deposited in the scrotum insulates the testicles and also interferes with the heat exchange (in the coils of blood vessels on top of the testicles in the neck of the scrotum), making the testicles too warm for optimum sperm production and storage.

Many studies on bull fertility have been done at Lethbridge Research Centre in Alberta, under the direction of Glenn Coulter and John Kastelic. Ongoing studies are looking at younger bulls, determining age at puberty, factors that influence age at puberty (the effects of nutrition on sexual development), and how the fat deposits in overfed young bulls interfere with fertility.

Leonardo F.C. Brito, DVM, MSc, MVetSc, Department of Large Animal Clinical Sciences, University of

Saskatchewan, has been working with the researchers at Lethbridge on the studies with very young bulls. The calves in the study are weaned young, and put on various types of diets. "The focus of our study is mainly on their sexual development, looking at bull calves from 2 to 16 months of age. In one experiment, we observed that the young bulls fed high amounts of concentrate (22 percent) from 2 to 16 months of age accumulated more fat around the testicular vascular cone (in the neck of the scrotum), had more fat in the scrotum itself, and higher scrotal surface temperature when compared to young bulls fed 3.5 to 8 percent concentrate or plain silage," says Brito.

"Young bulls can accumulate fat around the blood vessels in the scrotal neck, right above the testicles, and this interferes with normal heat regulation. A very important physiological process occurs there, in the large coils of blood vessels. Under normal conditions the cooler venous blood, coming up from the scrotum and returning to the body, tends to cool down the arterial blood coming down from the body into the scrotum," explains Brito. The large vessels in this area also radiate and dissipate heat out through the skin. This important heat exchange is altered if there is too much insulating fat.

"We know that if this thermoregulation mechanism is impaired, the testicular temperature will increase, leading to abnormal sperm production. In all mammals that have scrotums, the testicles are kept a little cooler than body temperature. If scrotal temperature is increased even a little bit, spermatogenesis is impaired; you see more abnormal sperm in the ejaculate," he says.

"When these calves are fed the high concentrate diet (to boost weight gain), they accumulate more fat around these blood vessels, hindering normal spermatogenesis. In studies at Lethbridge in the 1980's, researchers looked at bulls fed high concentrate diets, and found these bulls had a lower proportion of normal sperm, and sperm production was also impaired. At that time they speculated that the problem was fat in the scrotum, and with our current studies we are able to show that this is indeed, the reason," says Brito.

"We have definitely shown there is more fat around the blood vessels in the scrotal neck, using an ultrasound probe to

measure the fat depth. We've been able to determine there is more fat in the scrotum also, because when these young bulls are sent to slaughter we collect the scrotums and weigh them. These bulls had heavier scrotums because of the extra fat. Before they went to slaughter we examined them with an infrared thermography camera which gave us the temperature of the scrotal surface. In these bulls we found that the scrotal surface was higher than in bulls fed a low to medium energy diet," he says.

The researchers feel that the bulls accumulate fat in the scrotum more readily than they do in the rest of the body. Even when overfat bulls are put on a diet, the scrotal fat tends to be the last to disappear. "It's harder to lose that fat (deposited in the scrotum) than it is to lose the fat in the body," he says. Just as the fat around internal organs is last to leave when an animal (or human) loses weight, the scrotal fat remains longer, even after the weight loss.

"During a breeding soundness exam on a fat bull, when you palpate the scrotum, you find that there is not a well defined scrotal neck. We call this a straight-sided scrotum; there is so much fat in that area above the testicles that there is no scrotal neck—it's all the same," says Brito.

"Most of these bulls have very poor quality semen, mostly because they have a lot of sperm defects. We tell the owner that this bull needs to lose weight before he will be able to breed cows, and should be tested again after losing weight. But it is harder to lose that fat. Once it's there it can be more permanent than the rest of the body fat," he says.

A high concentrate diet can also lead to feet problems, due to abnormal hoof growth from laminitis. There is also some indication that high energy intake in young bulls may increase the risk of rumen inflammation and liver abscesses, which may lead to development of vesiculitis (inflammation of seminal vesicles) and infection of the vesicular glands. Other problems associated with this type of diet include abnormal bone and cartilage growth, resulting in stiffness and lameness.

"Last year we had a visitor from Sweden who was working with young bulls there, and looking at pathological changes in the musculoskeletal system. She was finding quite a bit of damaged

cartilage in really young bulls that were slaughtered after their performance gain test. They didn't have any clinical signs yet, but she found some striking pathologies in their joints," says Brito. Those bulls would not have stayed sound very long. They would probably develop sore joints or arthritis at a young age, which would keep them from breeding cows.

"What we are trying to do now in our studies is determine when these young bulls really need optimum nutrition for early sexual development. The point that is really crucial is before they are weaned. That's when they need good nutrition. After that, if they just have a maintenance diet, they do just fine. What the breeder is most interested in is hastening sexual development and puberty. We know that the hormonal changes that lead to initiation of spermatogenesis and then to puberty happen between 2 and 6 months in bulls," explains Brito.

Most people who are feeding bulls to try to hasten puberty are feeding calves that are already weaned—at 7 to 8 months of age. "They put these calves on a high-energy diet hoping they will mature earlier, and that's just not the case. It's too late. The hormonal increase that triggers the start of sexual development has already occurred," he says. This is a factor of genetics—and nutrition when the bull is quite young.

"The earlier that those hormones increase, the earlier the bull will reach puberty, so there is definitely a genetic component. There have been studies here at the University that studied a group of bulls to determine which half of the group reached puberty first and which half were the last. We looked at hormonal changes during this very early period, and were able to show which ones would mature early—because they had an early increase in hormone concentrations. That's the genetic component," he explains.

"In my studies with young calves, when I looked at different levels of nutrition, the bulls that had better nutrition had the highest hormone increase. So the changes are aided by proper nutrition; those bulls matured earlier. The problem is that these bulls were the ones fed the high concentrate (and developed more fat). What we are trying to do now is give these bulls the

high concentrate diet only during the period from 2 to 6 months, and then put them on a normal maintenance diet after that, to try to see if we can get them to mature earlier without getting them fat. That's the goal of our current study," he says.

"In real life, however, beef bull breeders are not managing these calves' nutrition at 2 to 6 months of age," says Brito. The cow is usually feeding the calf adequately. There would be no need to increase a calf's nutrition unless the cow is not milking well.

"There have been some studies show that bull calves raised by first calf heifer dams mature more slowly, with delayed sexual development. They had a lower plane of nutrition than calves from mature dams. There is indication that they have a smaller scrotal circumference as yearlings, than calves from older dams. One study even suggested there should be a correction factor, if the bull was raised by a heifer. Some of the bulls raised by heifers might benefit from creep feed. Not all of them would need it, and there's probably a limit to how much you can influence their normal hormone secretion. Probably a well fed, good milking cow is the best you can do, and there would be no benefit to creep feeding those calves. You would only be getting them fat. Someday we hope to do an experiment comparing the bull calves from cows with those from first calf heifers, and whether or not they are creep fed," he says. "The experiment in which we feed the calves high concentrate diets very early and then change them to normal maintenance diet to avoid the fat, is just starting this year. We won't have the results on that for another year."