

Counting Eggs

Research indicates follicle size may be a sign of cow fertility.

by Amy Spillman

Tom Geary, a reproductive physiologist at the U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) Fort Keogh Livestock and Range Research Laboratory in Miles City, Mont., says only two out of three beef cows that are bred actually give birth. Identifying the most fertile cows could help producers achieve higher pregnancy rates in their herds and make their operations more efficient.

For several years Geary has been collaborating with professor Michael F. Smith, a reproductive physiologist at the University of Missouri-Columbia (MU). They have been looking for different physiological indicators of fertility in beef cows.

Now, George Perry, a graduate student of Smith's who has been working with Geary, may have discovered a new indicator of beef cow fertility, at least in some situations: the size of egg-bearing structures called follicles. Their studies may ultimately benefit producers who would like to artificially inseminate (AI) all their beef cows at the same time and to rapidly improve the genetics of their herds.

Inside the reproductive system

A beef cow has a 21-day estrous cycle, the



► Technician George Perry conducts a radioimmunoassay to measure progesterone concentration in serum samples from cows that ovulated different-sized follicles.

period from one estrus (or heat) to the next. The estrous cycle is largely controlled by structures called follicles on the cow's ovaries and the hormones these structures produce.

As a cow approaches estrus, a follicle containing an oocyte (egg) appears like a blister on an ovary. The follicle contains cells that produce estrogen. As the follicle grows, the estrogen eventually reaches a threshold level that causes the cow to be in heat. Shortly thereafter, the cow ovulates: the follicle ruptures and releases the egg into the uterus. Later, another hormone, progesterone, is produced. It prepares the uterus for pregnancy and helps maintain the pregnancy.

Geary says, "Many research projects have been conducted in which natural hormones are administered to beef cows to synchronize ovulation. But cows that are artificially inseminated after induced ovulation seem less fertile than cows inseminated after a natural heat."

As part of his doctoral research, Perry wanted to figure out why this decrease in fertility occurs. Earlier studies had shown that when dairy cows were induced to ovulate, they exhibited a wide range of follicle sizes.

"We hypothesized that the synchronized beef cows would also ovulate with a wide range of follicle sizes," Perry says. "This could affect estrogen and progesterone levels — and fertility."

To test this hypothesis, in 2001 the researchers studied 45 cows at the University of Missouri. Perry measured their ovulating follicles when they were induced to ovulate, but before they were AIed. Using an ultrasound machine, he classified each cow's ovulatory follicle as small [less than 12 millimeters (mm)], medium (12.5-16 mm) or large (more than 16 mm). About four weeks after the cows were inseminated, he used ultrasound to determine if they were pregnant.

The scientists found that 25 days after breeding, only about 57% of the



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► Natural or induced ovulation of a large follicle results in normal fertility and the birth of a live calf.

cows with small follicles were pregnant, and by Day 60 only 29% were still pregnant. Of the cows with large follicles, however, 67% were pregnant at Day 25, and they all remained pregnant through Day 60. Even more impressive, 78% of the cows with medium follicles were pregnant at Day 25, and 71% were still pregnant at Day 60.

These results convinced the scientists to repeat the study on a larger scale. In 2002 they began research on 273 cows at the Fort Keogh lab. They noticed the same general trend of small-follicle cows having lower fertility.

Because there were more animals, the researchers could compare more specific follicle size groups. All embryonic deaths occurred in the synchronized cows with ovulatory follicles less than or equal to 11 mm.

Though their data reiterated the importance of follicle size, the scientists determined something else during the Fort Keogh study. Cows that expressed a natural heat also had ovulatory follicles of varying sizes. But regardless of whether the follicles were small, medium or large, the cows' fertility rates were similar.

Natural heat vs. induced ovulation

Cows in heat allow other cows to mount them, showing producers when to breed them. However, heat detection is unnecessary in cows that are induced to ovulate at a specific time.

Although the cows in the Fort Keogh study were all supposed to ovulate at the same time,

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not all of them did. To detect those that came into heat naturally, the researchers outfitted the entire herd with electronic transmitters.

“The transmitters are glued to the tailhead of the cows and allow us to continuously monitor for mount activity,” Geary explains. “A computer records the time and duration of each mount.”

Perry adds, “We considered a cow to be in standing estrus, or heat, when she received three mounts lasting two seconds or longer

within a four-hour period.” At that point, the researchers measured her follicle size.

The follicle sizes of the cows that exhibited a natural heat varied just as much as those of cows induced to ovulate. However, it appears that if the follicle is capable of ovulating naturally, it doesn’t matter what size it is. A cow in standing estrus with an 11-mm follicle has the same chance of becoming pregnant and maintaining the pregnancy as a cow with a 16-mm follicle. Follicle size seems to affect fertility only if cows are induced to ovulate.

The bigger picture

Although follicle size isn’t quite the

fertility indicator the researchers thought, the information they gathered could still benefit U.S. beef producers and help them manage herds more efficiently.

Geary explains, “Currently, less than 6% of U.S. beef cows are artificially inseminated because of the cost associated with detecting when a cow is in heat. But scientists in industry and academia continue to look for more effective ways of inducing ovulation, so producers won’t need to dedicate valuable resources to heat detection.”

“Our follicle research will help us focus on where problems are occurring with current estrus synchronization and artificial

insemination protocols,” Perry adds.

Ultimately, such protocols will allow cattle producers to inseminate a large number of animals at once with genetically superior germ plasm and to simplify the management of pregnant animals.



Editor's Note: Amy Spillman, formerly with ARS, wrote this article, which was published in its original format under the title “Can Egg Follicle Size Indicate Cow Fertility?” in the April 2003 issue of *Agricultural Research* magazine. This research is part of *Food Animal Production*, an ARS National Program (#101) described on the World Wide Web at www.nps.ars.usda.gov.



► Reproductive physiologist Tom Geary prepares to take a blood sample from a cow to measure her hormones. An ultrasound monitor on the right indicates this cow is 45 days pregnant.