Does **CLONING** Have a Future?

Many producers feel cloning is a scientific theory that never will have broad applications. But the technology is improving, and its use in beef production may be closer than you think.

BY LINDA SLEICHTER

Thanks to science fiction, the word *cloning* causes some people to think of a complex process often resulting in deformed creatures. But the process actually is rather simple.

A clone is an animal genetically identical to the one that provided the donor DNA. Clones can be produced naturally through twinning or artificially.

Cloning research and application continues at CyAgra, a commercial cloning company in Manhattan, Kan.

"Basically, we fool Mother Nature in every step of the process," says Audi Spell, a research scientist with CyAgra. "We see cloning as a way to magnify the top genetics of a herd while culling out the low-end performing cattle."

Clones are produced artificially in the process of nuclear transfer. The process is categorized as embryonic- or somatic-cell nuclear transfers, depending on the origin of the DNA material.

Embryonic-cell nuclear transfer disassociates a fertilized embryo, which means the embryo is split into individual cells. Each of the individual cells has the ability to form a complete embryo genetically identical to the original.

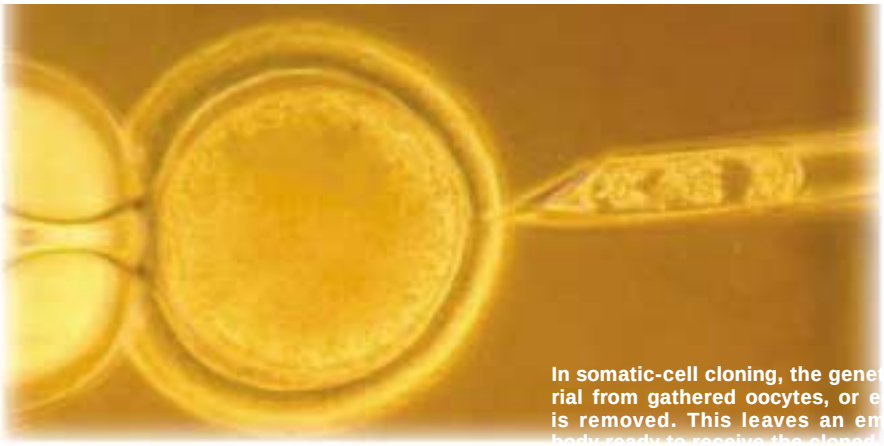
The second type of cloning, somatic-cell cloning, produced Dolly the Sheep and many of the cloned animals publicized recently. Somatic-cell cloning allows for the production of a clone by using a tissue sample from anywhere in the animal's body.

The donor cells for the cloning can be produced from a biopsy 6 millimeters (mm) in diameter or from a skin scraping from the ear, mammary gland, tail tip or other body part.

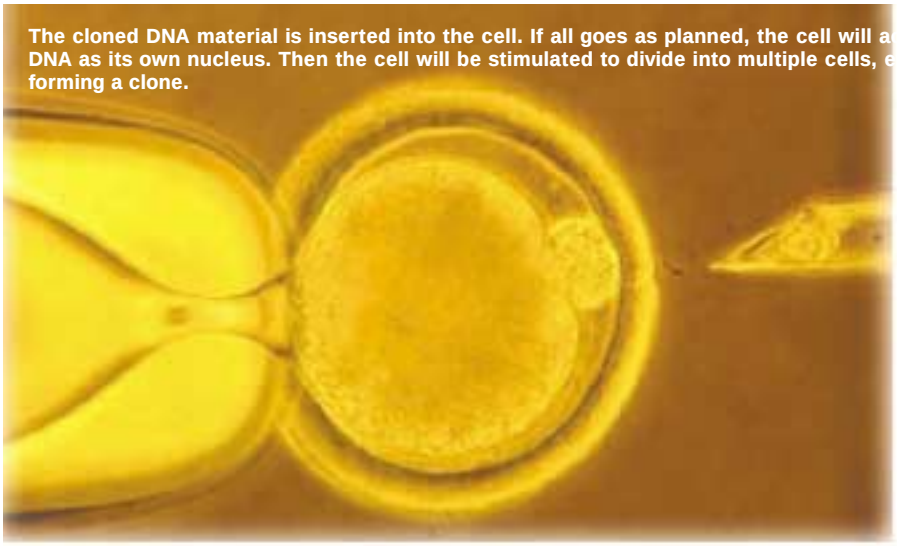
The tissue sample is disassociated and split into individual cells, from which the nuclei are removed. Meanwhile, the genetic material from gathered oocytes, or egg cells, is removed, leaving only the cell body.

The nuclei removed from the tissue sample cells, which contain the genetic coding for the animal, are then inserted into cell bodies that have had their DNA material removed. The cell — with the nucleus inserted into its cytoplasm — is then fooled, with the use of electric currents, into accepting the nucleus as its own.

Then, by varying the calcium levels in the cell, scientists stimulate it to react like a fertilized egg, splitting into additional cells.



In somatic-cell cloning, the gene rial from gathered oocytes, or e is removed. This leaves an em



The cloned DNA material is inserted into the cell. If all goes as planned, the cell will a DNA as its own nucleus. Then the cell will be stimulated to divide into multiple cells, e forming a clone.

PHOTOS COURTESY OF CYAGRA

Advantages and disadvantages

As with all new technology, cloning has to work out some "bugs."

Embryonic-cell cloning already is used in embryo transfer (ET) to increase pregnancy rate but has some limitations that somatic-cell cloning does not.

In embryonic-cell cloning,

the number of clones is limited to the number of cells in the original embryo at disassociation since the separated cells are the starting points for the new embryos.

In addition, the resulting animal will not match the sire or dam; rather, the cloned animal will be a cloning of the mating, which will produce an unproven animal.

Somatic-cell cloning has its own set of inefficiencies, Spell says. The donor cells provided are inconsistent, so the level of success varies greatly.

Freezing cloned embryos could lower efficiency even more. In addition, the calves produced seem weaker and sometimes much bigger at birth than their natural contemporaries. Early abortions are common.

"We may start with 200 to 300 oocytes and end up with two to three embryos," Spell says. "At 30 days into the pregnancy, we hope to see 50% to 60% conception. By 60 days, we lose an additional 25% to 30% of the clones."

Cost is another hurdle for cloning technology to overcome. Animals to carry the cloned embryos must be maintained, and the technology is such that the cost per animal is high.

"Some places ask $10,000 to $20,000 per live calf," Spell says. "If we can improve the efficiency of the process, that should drive the cost down."

CyAgra is working to eliminate other problems of cloning, including large birth weights. "Already we have seen a decrease in the average birth weight of cloned animals," Spell says.

He also says news reports that Dolly was aging faster than her contemporaries were exaggerated greatly. The scientist in charge of that research only commented that he noticed a slight increase in the sheep's rate of development. "Despite what much of the public thinks, we haven't seen any phenotypic difference in the aging of cloned animals as compared to naturally conceived animals," Spell says.

Angus breeders share views on cloning

ARDYCE O'NEILL
O'Neill Angus • Logan, Iowa

"I can foresee cloning being used more in the future to advance the herd, just like embryo transfer. However, as with any genetic changes, it needs to be used with caution. In the near future, we probably won't use it on our own cattle because of the size of our herd and the cost of cloning. It's an intriguing technology, and — if used with caution — it could have many applications in our industry."

ROB & LAURA ARMBRISTER
Grand River Angus Ranch • Jay, Okla.

"Cloning isn't something that we'll be using any time in the near future. We're having too much fun with embryo-transfer work and are constantly scheming on new matings to improve our operation and the breed as a whole. Cloning may have its place, especially in being able to modify and enhance some of the old, solid bloodlines with today's genetic diversity. Cloning could be used just as EPDs (expected progeny differences) … just one more tool to enhance what is already the best breed of cattle and produce a consistent, quality, safe product for the consumer to better compete with pork and poultry."

JIM KAST
101 Ranch • King Hill, Idaho

"In the future, if we find the 'perfect animal,' then cloning will allow us to do something great with those genetics. But I don't think we've found the perfect animal yet. An animal may have a great carcass, but it lacks growth. Another animal may have the growth needed, but its carcass traits don't measure up. When we find an animal that has the genetics needed all around, then cloning will provide us a way to provide a consistent product using those genetics. Personally, I won't be using this technology any time soon, partly due to the cost and partly because I don't know of an animal I would want to clone."

Future application

Despite its disadvantages, cloning continues to increase in popularity, due in large part to its many possibilities. Through transgenic animals, scientists may be able to produce organs for human transplant or proteins for antibiotics. One cow could produce hundreds of offspring, as compared to the dozens possible through ET. As the technology continues to improve, the possibilities increase.

Identification of animals is a concern, however. How can animals with identical DNA be distinguished?

"There are two methods I can recommend to the breed associations," Spell says. "One is going to be nose printing. There is some evidence that even between identical twins, there is a unique nose print to those animals. The other is retinal scanning. We are going to research that more and maybe collaborate with the breed associations to see if that will work."

Will cloning lower the genetic selection of the cattle industry? Spell doesn't think so.

"Personally, I think there are too many strong opinions in each breed, and each producer thinks he or she has the best bull," he explains. "And if you ask feedlot managers, they'll say we need to narrow the genetic diversity in order to provide a more consistent product. For those reasons, I don't think it will change the industry's genetic selection much."

Is it ethical to produce cloned animals?

Cloning does not invent new animals, it just copies existing ones, Spell says.

"We are simply making more copies of existing genetics, the same way embryo transfer and artificial insemination extends existing genetics," Spell says. "Cloning is just the next tool in reproductive technology to make agriculture more profitable."