International New York Times

Data 27-11-2015
Pagina 1+6
Foglio 1 / 2

# Unease as gene editing finds its stride

SIOUX CENTER, IOWA

## Scientists begin to excel at altering animals, from cows to household pets

BY AMY HARMON

Other than the few small luxuries afforded them, like private access to a large patch of grass, there was nothing to mark the two hornless dairy calves born last spring at a breeding facility here as early specimens in a new era of humanity's dominion over nature.

But unlike a vast majority of their dairy brethren, these calves, both bulls, will never sprout horns. That means they will not need to undergo dehorning, routinely performed by farmers to prevent injuries and which the American Veterinary Medical Association says is "considered to be quite painful."

Instead, when the calves were both just a single cell in a petri dish, scientists at a start-up company called Recombinetics used the headline-grabbing new tools of gene editing to swap out the smidgen of genetic code that makes dairy cattle have horns for the one that makes Angus beef cattle have none. And because the tweak was then copied into all of their cells, including reproductive ones, it will also be passed on to subsequent generations.

"It's pretty cool," said Micah Schouten, the calves' caretaker, looking at his charges.

The uproar over the new ease and precision with which scientists can manipulate the DNA of living things has centered largely on the deeply complicated prospect of similarly editing human embryos. But with the federal government's approval last week of a fast-growing salmon as the first genetically altered animal Americans can eat, a menagerie of gene-edited animals is already being raised on farms and in laboratories around the world — some designed for food, some to fight disease, some, yes, as pets.

Just this week, researchers reported having edited mosquitoes so that they will no longer carry the parasite that causes malaria. And the power to reshape other species, scientists and

*COWS, PAGE 6*

# New edits to animal genes cut down on rough drafts, but not on worries

*COWS, FROM PAGE 1*

bioethicists say, raises questions that are both unique to animals and may bear on the looming prospect of fiddling with our own.

"We're going to see a stream of edited animals coming through because it's so easy," said Bruce Whitelaw, a professor of animal biotechnology at the Roslin Institute at the University of Edinburgh. "It's going to change the societal question to 'If we could do it, would we want it?' to 'Next year we will have it; will we allow it?'"

Animal breeders have for centuries scoured species for desirable traits and combined them the old-fashioned way, by selective mating. But that process can take decades to achieve a particular goal, like cows that are both resistant to disease and produce a lot of milk. And until recently, the techniques used to manipulate DNA had been expensive and difficult to make work in many animals.

But the new tools, which have collectively earned the moniker "gene editing" to reflect the relative ease of their use, have made all manner of previously impossible or impractical goals sufficiently fast and cheap for many to find worth pursuing. "It's like a find-replace function in the three billion letters of the genome of these animals," said Scott Fahrenkrug, the chief executive of Recombinetics, based in St. Paul. "It allows us to bring the natural variation that exists across a species and quickly bring it under one hood."

At Roslin, for instance, Dr. Whitelaw has changed three genes in domesticated pigs vulnerable to African swine fever, which can devastate herds, to resemble those from wild pigs who are resistant to the disease. He is now breeding them to put them to the test.

With a tool called Talens, Recombinetics says it has created gene-edited pigs that can be fattened with less food and Brazilian beef cattle that grow large muscles, yielding more meat that may also be more tender. Others are working on chickens that produce only females for egg-laying and cattle that produce only males, since females are less efficient at converting feed to muscle.

Chinese researchers have produced meatier cashmere goats that also conveniently grow longer hair for soft sweaters; miniature pigs lacking a growth gene to be sold as novelty pets; and bulky beagles lacking a muscle-inhibiting gene, an edit that could make for faster dogs.

Using the most powerful of the new tools, called Crispr-Cas9, in pursuit of treatments for human disease, researchers are also altering pigs in hopes of making them grow human organs and creating "gene drives" that would ensure that the edit to make mosquitoes malaria-proof, for instance, would spread through the whole population.

The rapid advent of gene-edited animals threatens to outstrip public discussion of their risks and benefits, bioethicists warn.

"This essay is, in essence, a plea — let's not ignore the nonhuman part of the biosphere," Alta Charo of the University of Wisconsin and Henry T. Greely of Stanford University caution in a piece titled "Crispr Critters and Crispr Cracks," published in The American Journal of Bioethics. "Not only is it much larger than the human part, but it is much more susceptible to unobserved or unfettered — but not unimportant — changes."

The discussion of gene-edited animals in farming, in particular, is likely to be colored by the existing debate over the merits of genetically engineered food, which for decades has largely centered on corn and soybeans, altered with older technology to resist pests and tolerate herbicides. Opposition to such crops — popularly known as GMOs, for genetically modified organisms — has prompted some retailers to decline to sell food made with them and efforts to pass legislation to label them, even as farmers have widely embraced them and scientific organizations have said they are as safe for human health and the environment as conventional crops.

Many of the new generation of edited animals do not contain DNA from another species, a frequently cited concern among opponents of genetically engineered foods, which incorporate genes from bacteria. But some consumers may still have difficulty reaching consensus on what, if anything, should be done to the DNA of animals.

"Animals on some level will always be more controversial," said Greg Jaffe, director of biotechnology for the Center for Science in the Public Interest, a nonprofit consumer advocacy group. "If only because people think of them as closer to humans."

Advocates of the technology argue that it can make farming more efficient to help feed a growing world population with less of a toll on the environment. One projection published in a leading animal breeding journal, Genetics Selection Evolution, suggests that genome-editing could significantly increase the efficiency the livestock industry is able to achieve through conventional breeding within the same time period.

Today's chickens, for instance, produce nearly 80 percent more meat for the same amount of feed as the chickens of the 1950s; if chicken breeders had had access to genome technology over that time, said John Hickey, a quantitative geneticist and one of the authors of the paper, farmers would have been able to achieve that increase and also be able to grow chickens on half the land.

Others say the technology could benefit human health. The National Science Foundation is underwriting an effort to create dairy cattle that can resist a parasite that causes sleeping sickness in sub-Saharan Africa, a blight often

treated with an antimicrobial drug that makes its way into the animal whose meat is consumed by humans.

Several projects underway to edit genetic resistance to a variety of diseases in livestock could theoretically reduce the overuse of antibiotics, which has made it harder to treat human bacterial infections. With funds from the United States Department of Agriculture, Bhanu Telugu, a University of Maryland researcher, is trying to design pigs so they can no longer serve as a reservoir for the flu virus. He argues for genome editing on behalf of animal health, too. "If we know we can eliminate the disease and we don't, it is in my mind animal cruelty," he said.

Still, gene-editing tools are known to sometimes make changes to genes other than their intended targets, raising flags for consumer advocates about how the changes might affect an animal's health or the composition of milk or meat.

"You are reducing the universe of potential risks by moving into these techniques," said Doug Gurian-Sherman, a senior scientist at the Center for Food Safety, a consumer advocacy organization that has been at the forefront of opposition to genetically engineered plants and animals. "But that is not to say we should not still proceed with great caution."

And some animal rights advocates say gene-editing is simply a means to prop up an industry that causes animals to suffer.

"Even if they can point to good intentions, it's just exacerbating the problem," said David Byer of People for the Ethical Treatment of Animals, which has lobbied the dairy industry to stop dehorning cattle. "People should stop consuming dairy or meat or eggs, not further manipulate animals by playing with their DNA."

The Food and Drug Administration has not said how or whether it will regulate the gene-edited animals to come. But even with the government's stamp of approval, biotechnology advocates know that farmers are unlikely to embrace the technology if they fear consumers will reject it.

And it has not helped the popularity of genetically engineered crops that their chief benefits so far — easier control of weeds and pests for corn and soybean farmers — are not terribly compelling to the eating public.

That is one reason Recombinetics has begun to show off its hornless calves.

Dehorning, which involves burning off horn-buds to stop the flow of blood to the horn tissue, has already garnered a degree of popular concern. Videos of the burning procedure carried out on Holsteins, the black-and-white breed largely responsible for the nation's milk supply, and circulated by animal rights groups, draw long strings of critical comments.

"We know there's a negative public perception of dehorning, and it's certainly not a fun chore for the farmers," said Lindsey Worden, the executive director for genetics at the Holstein Association.

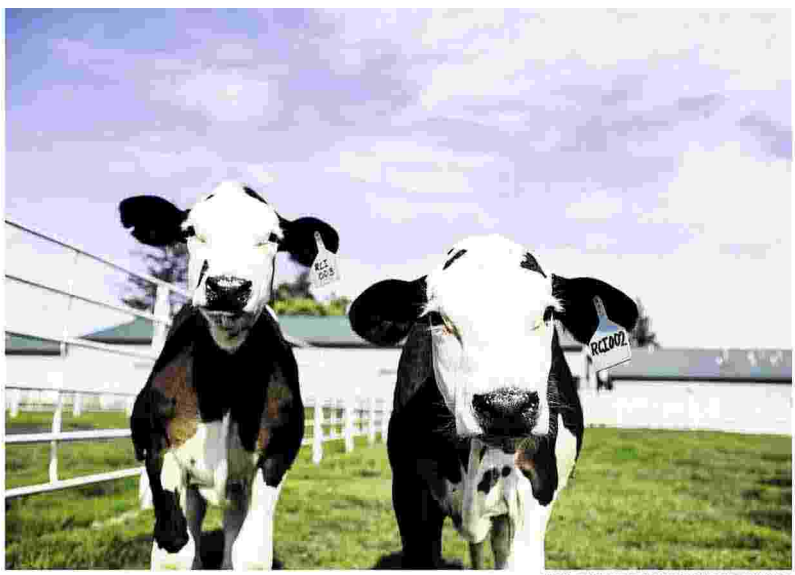
A small fraction of Holsteins are naturally hornless, and several companies, including General Mills, Dannon and Walmart, have encouraged their dairy suppliers to increase their population through conventional breeding. Farmers have made some headway, with the population of hornless Holsteins climbing to about 4 percent last year from 3 percent in 2013.

But it is slow going. That is why several dairy breeders say they are keeping tabs on Recombinetics' two hornless calves, which have just been shipped to the University of California, Davis, to be monitored for their health and well-being. There, in a few months, they will be attached to a machine that will harvest their sperm, each with edited DNA, which will be used to create a new generation of hornless cows.

Whether they will become commonplace or remain curiosities may depend largely on how the public comes to view gene editing and its various applications.

"Sometimes you can have nice benefits for animals and farmers and society but still have controversy among consumers," said Jamie Jonker, vice president for sustainability and scientific affairs at the National Milk Producers Federation. "I think dairy farmers are going to want to see how this is interpreted by the general public."

**"It's going to change the societal question to 'If we could do it, would we want it?' to 'Next year we will have it; will we allow it?'"**



JENN ACKERMAN FOR THE NEW YORK TIMES

**A pair of dairy calves in Sioux Center, Iowa. Scientists used gene editing to alter their genetic code so the calves, both bulls, would never grow horns, and neither will their offspring.**