Animal Biotechnology: Science-Based Concerns

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Opening Statement
by

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Associated With Products of Animal Biotechnology

Good morning. On behalf of the National Academies, I would like to welcome those of you in the room as well as those of you listening on the Web. I am pleased to be here with some of my fellow committee members to release the findings of our new report, Animal Biotechnology: Science-Based Concerns.

Research on genetic engineering has led to an increase in the development of a substantial variety of food and agricultural goods as well as pharmaceutical and other products that promote human health. The federal regulatory system for genetically engineered animals and their products has been subject to increasing attention and discussion among research scientists and policy-makers, as well as the public. In 2001, the Food and Drug Administration's Center for Veterinary Medicine recognized that it was an opportune time to ask the National Research Council to identify the science-based risks and concerns associated with animal biotechnology prior to any regulatory review of the food and environmental safety of these products. Specifically, we were charged to:

One, develop a listing of risk issues in the areas of food safety, environmental safety, and animal safety. Two, provide criteria for selection of risk issues that should be considered most important and that need to be addressed or managed. And three, identify and justify risk issues that were considered but not identified as important.

Although future policy decisions regarding the use of animal biotechnology will no doubt take into consideration the potential benefits as well as the potential risks, the committee was not asked to examine benefits. Nor was it asked to make policy recommendations. Because it was difficult to compare environmental, food-safety, and animal welfare risks, the committee instead attempted to prioritize concerns within each main area.

The primary criterion for selection of concerns that emerged from committee discussions in each of these areas is based on the judgment of the immediacy and potential severity of the risk based on scientific information. We also categorized risks by examining the products and their potential differences with similar products derived from conventional practices.

This report is "a snapshot in time," with the technology continuing to rapidly advance. In fact, some major advances were reported during the brief period in which this report was being prepared. We sense that animal biotechnology will evolve at a similar rate to that occurring with plant biotechnology. Because this technology is new, however, we were often challenged by the paucity of data that might have provided stronger insights into the relative risks for the techniques and applications being discussed.

The technologies that were examined include: introduction of new genes, modification of genes, and propagation by nuclear transfer of nearly identical copies of an animal, what's termed "cloning." These technologies make it possible to create animals with useful novel properties for dairy, meat, or fiber production, for environmental control of waste production, and for production of useful products for biomedical purposes.

Although many of the details of the techniques described will no doubt soon become outdated and replaced by new ones not yet considered, some general issues will remain. In particular, there will probably always be concerns regarding the use of unnecessary genes in DNA constructs used for generation of engineered animals. There will also be concerns about the use of vectors with the potential to be mobilized or to otherwise contribute sequences to other organisms, and the effects of the technology on the welfare of the engineered animals themselves.

The principles for assessing the safety of food from genetically engineered animals are qualitatively the same as for non-engineered animals, but animals genetically engineered for non-food products, such as pharmaceuticals, might present additional concerns relating to the nature of the products that they produce. For example, female animals might be genetically engineered to produce non-food products in their milk or eggs, but the males produced through this process or the unused females might be considered for entry into the food supply. The safety of food products that are derived from animals engineered for non-food purposes might present a concern if the non-food product is found in parts of the animal that may be sold.

The genetic engineering of animals intended for use as food will involve the expression of new proteins in animals; hence the safety, including the potential allergenicity, of introducing new proteins into the food supply might be a concern. The probability that particular novel gene products might trigger such responses in some consumers is thought to be low, but because of the potentially significant impacts on individuals who may be sensitive, we viewed allergenicity as a moderate level of food safety concern. A lower level of food safety concern exists that transgenically derived proteins used to enhance a trait such as growth or disease resistance could retain their bioactivity after consumption. Products that might induce toxicity were of least concern because they would likely be identified by current food safety assessment procedures.

Animal biotechnology may produce foods with changed nutritional attributes. These products might include eggs that are lower in cholesterol or meat with enhanced vitamin content and lower fat. If these changed products were labeled in order to appeal to targeted consumers and identifiable to those who might have medical or other reasons to avoid such foods, they would be of low concern.

The cloning of animals from somatic cells is a new and rapidly changing technology. This made it difficult to draw conclusions regarding the safety of milk, meat, or other products from animals that are themselves somatic cell clones. The key scientific issue was whether and to what degree the genomic reprogramming that occurs with somatic cell cloning results in gene expression that raises food safety concerns. There are currently no data to indicate whether abnormalities in patterns of gene expression persist in adult clones and are associated with food safety risks. Nor are there substantial analytical data comparing the composition of meat and milk products of somatic cell clones, their offspring, and conventionally bred animals. Somatic cell cloned cattle reportedly are

physiologically, immunologically, and behaviorally normal. They also exhibit puberty at the expected age, with high rates of conception upon artificial insemination. We felt that it was difficult to identify concerns without additional data regarding food product composition, which could be gathered using available analytical tests. There is no current evidence that food products derived from adult somatic cell clones or their progeny present a food safety concern.

We also considered potential risks associated with the cloning technologies of embryo splitting, and nuclear transfer using embryonic cells, which is an older, different technique than somatic cell nuclear transfer. Based on current scientific understanding, products of clones produced through embryo splitting and nuclear transfer using embryonic cells were regarded as posing a low level of food safety concern. Nevertheless, the committee believes that an evaluation of the composition of food products derived from cloned animals using available procedures would be prudent to minimize any remaining food safety concerns. The products of offspring of cloned animals were regarded as posing no food safety concern because they are the result of natural matings.

The committee considered environmental issues to be a significant science-based concern associated with animal biotechnology, in large part due to the uncertainty inherent in identifying environmental problems early on and the difficulty of remediation once a problem has been identified. We focused our attention on engineered animals that are intended to remain in confinement but escape or are inadvertently released into natural environments. This could result in the transgene spreading through reproduction with wild individuals of the same species. The likelihood of a transgenic animal becoming established in the environment and the level of concern regarding such a likelihood is dependent on two factors: its ability to escape and disperse in diverse communities, and its survival and reproductive success in that environment. Our greatest concerns were with species that become feral easily, are highly mobile, and have a history of causing extensive community damage. They include insects, shellfish, fish, and mice and rats. At the other end of the spectrum, less mobile and highly domesticated animals that do not become feral easily, such as domestic chickens, cattle, and sheep, present the least concern. Also transgenic animals produced for human medical benefits, such as xenotransplantation and pharmaceutical production, have little chance of becoming established in the environment. The impacts of any short- or long-term environmental harms from genetically engineered animals are dependent on the stability and resilience of the communities that would absorb these individuals. Those that are most stable will sustain the least harm, while those that are the least stable will sustain the greatest harm.

When we looked at the modification of animals for biomedical purposes, we identified several areas of concern, particularly with the transplantation of animal tissue and organs into humans, which is known as xenotransplantation. Xenotransplantation has inherent risks, among them the possibility of novel infectious disease. It is not expected that humans will consume animals engineered to produce non-food products, but the committee has a concern regarding the adequacy of controls in place to ensure restriction on the use of carcasses from such animals. Entry of surplus animals into the food chain poses a concern because of the possibility of people being exposed to transgenes and their expressed products.

The effects of genetic manipulation on animal health and welfare are of significant public concern. Our committee considered the following facets of animal welfare in discussing transgenic and cloning technologies: their potential to cause pain, physical, and psychological distress; behavioral abnormality; physiological abnormality; and/or health problems - and conversely their potential to alleviate or reduce these problems. For example, a number of species of hoofed animals produced by in vitro culture or nuclear cell transfer methods, whether or not they carry a transgene, tend to have higher birth weights and longer gestation times than offspring produced by artificial insemination. Because of this, difficult calvings can be a problem and might require special husbandry or veterinary procedures such as caesarian sections. Additional health and welfare problems requiring special attention include respiratory distress, lack of suckling reflex, and a variety of pathological conditions.

The techniques in use for the production of transgenic animals are inefficient.
Unexpected phenotypic effects, especially on anatomical, physiological, or behavioral traits of genetically engineered animals can occur. Work with knockout and cloned mice has demonstrated, in some instances, elevated levels of aggression and impairment of learning and motor skills, suggesting additional studies of cloned livestock are warranted. An important animal welfare concern related to xenotransplantation is the management and housing of pigs intended for use as organ source animals. The pigs are maintained in sterile, often isolated environments to minimize transmission of disease to human recipients, but this environment might result in abnormal behavioral development.

Although our charge was limited to addressing science-based concerns about animal biotechnology, the committee also took account of policy and institutional concerns. We noted that many factors influence the nature of scientific research and that the interpretation of data and technologies often have impacts on social, political, economic, religious, and spiritual conditions or values which, in turn, might impact health and the environment.

New technologies, such as biotechnology, are often characterized by a variety of uncertainties resulting in unexpected outcomes. Uncertainty also relates to the difficulty of placing the potential impacts into the policy context within which proposed biotechnologies will be addressed.

The current regulatory framework might not be adequate to address unique problems and characteristics associated with animal biotechnologies. The responsibilities of federal agencies for regulating animal biotechnology are unclear. In addition to the potential lack of clarity about regulatory responsibilities and data collection requirements, we also had a concern about the legal and technical capacity of the agencies to address potential hazards, particularly in the environmental area.

My colleagues and I will now take your questions. Please step to a microphone, and whether you are here or submitting a question via e-mail, please identify yourself and your organization. Thank you.

Scientists seek more control over bioengineered beasts
Report warns of risks to gene pool, humans' health

San Francisco Chronicle
CHRONICLE SECTIONS

Tom Abate, Chronicle Staff Writer Wednesday, August 21, 2002

Warning that bioengineered animals could escape into the wild and muddy the gene pool, a new scientific report calls for more oversight of the entire field, including assessments of whether biotech meat or dairy products might cause allergies if eaten.

The report released Tuesday by the National Research Council offers the first comprehensive look at the potential environmental and health risks of using gene-splicing and cloning to create animals that could not have been bred through traditional means.

The National Research Council report was requested by the U.S. Food and Drug Administration, which is fashioning new rules to govern the many ways in which corporate and academic scientists are redesigning animals.

Some firms hope to create fish that grow faster or cattle that have an extra copy of the genes that make meat lean. Drug companies are bioengineering cows to produce medicines in their milk. A Dutch scientist hopes to use flies in a similar fashion. Other scientists are modifying pigs to, one day, transplant their hearts into human patients. A Canadian firm is growing superstrong spider silk in goats.

Looking at this range of activities, the report questioned whether federal rulemakers were up to the task.

"The current regulatory framework might not be adequate to address unique problems and characteristics associated with animal biotechnologies," the report said.

SENATE CONSIDERS SEAFOOD LABEL

Meanwhile, one biotech firm's bid to sell a fast-growing salmon has already provoked a legislative reaction in Sacramento.

The state Senate could vote as early as today on a bill that would require California stores to label genetically engineered seafood -- even though Aqua Bounty of Massachusetts says its biotech salmon is still about a year away from final FDA review.

Although it trod controversial ground, the National Research Council report drew praise from proponents and opponents of biotechnology.

"We were quite pleased to see the NRC report," said Joseph McGonigle, vice president of Aqua Bounty. "It clearly identifies the scientific areas of risk and leaves aside the wild claims."

For instance, although the council's top concern was that "highly mobile" biotech animals, like the salmon, might escape, McGonigle said the panel noted that they would need an evolutionary advantage to hurt wild fish -- a caveat that he said cleared his firm's sexually sterilized salmon.

Joseph Mendelson, legal director for the Center for Food Safety in Washington, D.C., and a leading opponent of biotech agriculture, also took comfort from the study.

"With all the issues the report raises, the FDA clearly has to act now to create mandatory safety and environmental reviews," he said.

Joy Mench, a professor of animal welfare at UC Davis and one of the 12 scientists on the panel, said it was up to the FDA and other federal agencies to beef up the rules and systems to manage this burgeoning effort to bioengineer animals.

"This report raises issues that people are going to have to look at and make risk-based recommendations," Mench said.

MAJOR POINTS OF REPORT

Among the key findings:

Cats, goats, fish and other animals that can easily go feral pose the greatest risk of escaping and cross-breeding with unforeseen consequences for the genetic future of these species.

Current rules seem to completely overlook efforts to bioengineer insects, which would be particularly difficult to quarantine or capture if problems arose.

The panel found moderate concern that animals bioengineered for food purposes might produce proteins that would cause allergies or other reactions and said this "will have to be assessed."

The study found no evidence that food from cloned animals was any different from the classic variety but noted an absence of comparative studies.

The panel noted "the theoretical possibility" that bioengineering pigs for use as transplant donors could lead to the creation of a new infectious agent that might spread through the human population.

CAN'T MAKE EXACT ASSESSMENTS

Mench said the panelists found it difficult to make blanket statements about the safety of eating bioengineered animal products because there are so many different approaches.

"This is all so new that we don't have the data yet to make precise risk assessments," Mench said.

Meanwhile, academic and commercial scientists pushing the biotech envelope are running up against regulatory roadblocks.

At UC Davis, animal scientist James Murray is raising genetically engineered goats to test techniques he hopes to introduce in dairy cows. When the goats reach the end of their research life, he destroys them because the FDA doesn't want them turned into food.

"We want to know what the FDA is going to require to put these animals in the food chain," he said. "They should be eaten. There is no reason not to."

On the Web The National Research Council report is available at national-academies.org. *E-mail Tom Abate at tabate@sfchronicle.com.*

herald sun.com

Panel: Monitor Biotech Animal Food

By EMILY GERSEMA, Associated Press Writer
August 21, 2002 1:54 pm

WASHINGTON (AP) -- A report by a panel of scientists is feeding consumer groups' claims that federal regulators should work to ensure food safety by tightening oversight of animal cloning and genetic modification.

The National Research Council released a report Tuesday that evaluated risks of animal biotechnology, including food safety. The Food and Drug Administration commissioned the report in response to questions about whether dairy and other food products from cloned animals might be unsafe to eat or drink.

While foods made from cloned animals probably are safe, the committee said, products from transgenic animals -- those altered with genes from other species or from drugs -- might not be.

The panel believes the federal government needs to balance addressing people's concerns with allowing the technology to advance, said council chairman John Vandenbergh, zoology professor at North Carolina State University.

"By identifying these concerns, we hope we can help this technology be applied as safely as possible without denying the public its potential benefits," he said in a written statement.

The panel wasn't asked to recommend policy changes, but it said the three agencies monitoring biotechnology -- the FDA, the Department of Agriculture and the Environmental Protection Agency -- need to toughen guidelines and clearly define their responsibilities.

The report also questioned "the legal and technical capacity of the agencies to address potential hazards, particularly in the environmental area."

Genetically engineered animals could become an environmental problem should they escape, squeezing out their relatives in the wild by taking control of the food supply and wiping out weaker animals, the group said.

Rebecca Goldburg, a spokeswoman for Environmental Defense, said the report underscores the need for stronger federal oversight, especially in the case of altered fish.

The population of farmed Atlantic salmon is quickly growing, she said, and it has escaped the fish farms, taking control of territory where wild salmon spawn.

"The few remaining wild Atlantic salmon in the U.S. are on the endangered species list," Goldburg said. "Genetically engineered Atlantic salmon ... could further imperil wild salmon."

The Center for Food Safety said the report demonstrated that the government shouldn't allow modified animals to be used in food production.

"You don't rectify the regulatory inadequacies by letting it come on the market," said Joseph Mendelson, legal director for the Center. "That is potentially going to lead to terrible results for human health and the environment."

The industry, however, believes the benefits of transgenics and cloning outweigh the risks.

Scientists have worked mostly with cows, introducing genes to produce drugs or plasma in large quantities in milk.

People should realize that scientists aren't trying to play with nature, said Lisa Dry, spokeswoman for the Washington-based Biotechnology Industry Organization. Rather, they are trying to develop drug therapies through transgenics and cloning.

Citing Hematech Inc.'s research as an example, Dry noted that the Sioux Falls, S.D., company and its partner, Kirin Brewing Co., are harvesting disease-fighting human antibodies in cow's milk. The proteins will be used to treat illnesses ranging from tetanus to earache-causing viruses.

"These are important treatments that you just can't get any other way," Dry said.

The FDA is considering whether cloned animals will require government approval before they can be sold for food. Farmers and companies owning cloned animals aren't allowed to sell the animals until the debate is resolved.

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