University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Congressional Research Service Reports | Congressional Research Service

1-1-2009

Biotechnology in Animal Agriculture: Status and Current Issues

Geoffrey S. Becker
Congressional Research Service

Tadlock Cowan
Congressional Research Service

Follow this and additional works at: http://digitalcommons.unl.edu/crsdocs

Part of the American Politics Commons

Becker, Geoffrey S. and Cowan, Tadlock, "Biotechnology in Animal Agriculture: Status and Current Issues" (2009). *Congressional Research Service Reports.* Paper 32.
http://digitalcommons.unl.edu/crsdocs/32

This Article is brought to you for free and open access by the Congressional Research Service at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Congressional Research Service Reports by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Congressional Research Service

Biotechnology in Animal Agriculture: Status and Current Issues

Geoffrey S. Becker
Specialist in Agricultural Policy

Tadlock Cowan
Analyst in Natural Resources and Rural Development

February 11, 2009

Congressional Research Service
7-5700
www.crs.gov
RL33334

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

Animal agriculture is being transformed by rapid advances in biotechnology—a term that encompasses a variety of technologies, including genetic engineering (GE), genetic modification, transgenics, recombinant DNA techniques, and cloning, among others. Producers are interested in the application of biotechnology to improve productivity, consistency, and quality; to introduce new food, fiber, and medical products; and to protect the environment. Potential human health applications of transgenic animals include producing biopharmaceuticals and generating organs, tissues, and cells for xenotransplantation. Criticisms of such applications involve issues ranging from food safety and social resistance to potential negative impacts on animal welfare and on ecosystems. Questions also have arisen about the adequacy of the current regulatory structure to assess and manage any risks created by these technologies.

On January 15, 2009, the U.S. Food and Drug Administration (FDA) released final guidance on how it is to regulate GE animals and products. FDA is to do so under its existing statutory authority and regulations. Generally, GE-derived foods, for example, are to be regulated like non-GE foods; if their composition does not differ from their conventional counterparts, they will not have to be labeled. Nonetheless, developers of GE animals and of GE-derived products must gain FDA pre-market approval.

On February 6, 2009, the FDA announced the first approval of a drug from a GE animal. The drug is a human anti-clotting agent produced in the milk of transgenic goats.

Although animal biotechnology involves many techniques other than cloning, this latter technology has attracted widespread attention. A final risk assessment and industry guidance on the safety of meat and milk from cloned cattle, pigs, and goats and their offspring were released January 15, 2008, by FDA. The documents generally echoed the FDA's December 28, 2006, draft risk assessment, which found that such products are as safe to eat as those of conventionally bred animals. The FDA also concluded that cloning poses the same risks to animal health as those found in animals created through other assisted reproductive technologies—although the frequency of such problems is higher in cloning. (Scientists stress that cloning is an assisted reproduction technique that does not involve any transfer or alteration of genes through GE.) The agency said it was no longer asking industry to refrain voluntarily from marketing the products of cloned animals and their offspring, although the U.S. Department of Agriculture (USDA) did ask that it be continued for products from clones (but not from the offspring of clones).

The Senate-passed version of the 2007-2008 farm bill would have delayed the FDA final risk assessment and continued the marketing moratorium until completion of newly mandated studies on the safety and on the market impacts of introducing such products. This delay was not retained in the enacted version of the bill (P.L. 110-234). Bills on animal cloning in the 110th Congress would have required all food from cloned animals or their offspring to be labeled, and prohibited food from cloned animals from being labeled as organic. These and other bills on cloning or other regulation of animal biotechnology could be offered in the 111th Congress.

Contents

Introduction 1
Animal Biotechnologies 2
- Embryo Transfer 3
- Transgenics 3
- In Vitro Fertilization 3
- Sexing Embryos 4
- Cloning 4
- Gene Knockout 5

Regulation and Oversight 5
- Food and Drug Administration (FDA) 5
- FDA Guidance on GE Animals 6
- U.S. Department of Agriculture (USDA) 7
- Other Authorities 8

Cloning Policy Developments 8
- FDA Risk Assessment 9
- European Views 11
- Other Views 12

Other Policy Concerns 13
- Environmental Issues 13
- Food Safety 14
- Consumer and Social Acceptance 15
- Labeling 16
- Animal Welfare 17
- Genetic Diversity 18
- Trade Issues 19

Congressional Activity 20

Tables

Table 1. Agricultural Applications of Animal Transgenics 4

Contacts

Author Contact Information 21

Introduction

The U.S. Food and Drug Administration (FDA) released two recent documents that renewed public and congressional interest in animal biotechnology in general and animal cloning in particular. On January 15, 2009, the agency released final guidance representing its current thinking on the regulation of genetically engineered (GE) animals for food or drugs. FDA did so under its existing statutory authority and regulations.[1] A year earlier, on January 15, 2008, FDA had unveiled its final risk assessment and industry guidance on the safety of milk and meat from cloned animals and their offspring. The FDA found that, generally, meat and milk products from cattle, pigs, and goats are as safe as products from their non-cloned counterparts.[2]

Still, some in the United States remain concerned about the safety and other impacts of GE animals and of animal cloning, and they continue to advocate a cautious approach to commercialization of such products. Outside of the United States, animal biotechnology, including both GE and cloning, is the focus of ongoing regulatory, policy and scientific discussions within the European Union (EU) as well as within the international organization for animal health, known by its French acronym, the OIE. (Cloning by itself is not considered to be genetic engineering; see discussion later in this report).

Biotechnology is a broadly defined term of relatively recent origin describing the range of modern knowledge, applications, and techniques underlying advances in many fields, notably health care and agriculture. Animal biotechnology has been defined as "that set of techniques by which living creatures are modified for the benefit of humans and other animals."[3] By its very nature, agricultural development is the history of humans modifying plants and animals to maximize desirable traits. For example, domestication and selective breeding of animals date back many thousands of years. Artificial insemination of livestock, notably dairy cattle, is a more recent technology, first finding wide commercial acceptance in the 1950s.

Discovery of the genetic code in the 1950s gave birth to modern techniques of biotechnology. One of the first commercial products of this new biotechnology in animal agriculture was bovine somatotropin (bST), a naturally occurring metabolic modifier that is now being manufactured in larger quantities through the use of recombinant DNA technology. Manufactured bST came onto

---

[1] CVM, FDA, Guidance for Industry: *Regulation of Genetically Engineered Animals Containing Heritable rDNA Constructs*. The guidance can be accessed through the FDA website at http://www.fda.gov/OHRMS/DOCKETS/98fr/FDA-2008-D-0394-gdl.pdf.

[2] FDA documents were posted on the Internet at http://www.fda.gov/cvm/cloning.htm on January 15, 2008.

[3] National Research Council (NRC), *Animal Biotechnology: Science-Based Concerns*, (Washington, DC, National Academy Press, 2002). (Hereafter cited as NRC, *Animal Biotechnology*.) Unless noted, this CRS report is based on material in that document and the following additional sources: Institute of Medicine (IOM) and NRC, *Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects* (Washington, DC, National Academy Press, 2004). (Hereafter cited as IOM-NRC, *Safety of Genetically Engineered Food*.); Council for Agricultural Science and Technology (CAST), *Biotechnology in Animal Agriculture: An Overview* (Issue Paper 23) (Washington, DC, February 2003). (Hereafter cited as CAST, *Animal Agriculture*.); Pew Initiative on Food and Biotechnology, *Issues in the Regulation of Genetically Engineered Plants and Animals*, (Washington, DC, Pew Initiative April 2004. See http://pewagbiotech.org/research/regulation/.) (Hereafter cited as Pew, *Issues in Regulation*.); Pew Initiative on Food and Biotechnology, *Post-Market Oversight of Biotech Foods* (Washington, DC, Pew Initiative April 2003) (and other Pew materials); information accessed through the websites of the Biotechnology Industry Organization at http://www.bio.org/; the Center for Food Safety, at http://www.centerforfoodsafety.org/; the Union of Concerned Scientists, at http://www.ucsusa.org/; and the Consumer Federation of America, at http://www.consumerfed.org/.

the market in 1994 and is now administered to as many as half of all U.S. dairy cattle to increase per-cow milk output. Although bST is being used commercially in approximately 20 countries, it is banned in the European Union (EU).

The first U.S. approval of a commercial product from a GE animal is for the drug ATryn, an anti-clotting agent being produced in the milk of transgenic goats. The FDA announced its approval on February 6, 2009.

Other developments include pigs that have been engineered for increased sow milk output to produce faster-growing piglets. Cloned cattle also have been developed to resist mastitis, and transgenic salmon with enhanced growth characteristics are under regulatory consideration for possible commercialization. Output traits such as drugs recovered from animal milk ("pharming"), milk that lacks allergenic proteins, and animal organs for human transplant (xenotransplantation) that resist rejection are other contemporary objectives of animal biotechnology research. In March 2006, researchers at the University of Missouri announced the creation of transgenic pigs whose tissue contains omega-3 fatty acids.[4] The consumption of omega-3 fatty acids, found primarily in fish, has been linked to lowered incidence of heart disease in humans. Similar research is also under way to produce omega-3 fatty acids in cow's milk and in chicken eggs.

This report describes several scientifically emerging animal biotechnologies that are raising a variety of questions concerning risks to humans, animals, and the environment, as well as ethical concerns. The report examines applications of the technologies and discusses major issues that may arise. Consumers, agricultural producers, the biotechnology industry, and federal regulatory bodies are debating the relative costs and benefits of these technologies. As technologies move toward commercialization, Congress is being asked to examine these issues and possibly to refine the current federal regulatory structure governing the technologies and their agricultural products.

Animal Biotechnologies

Given the breadth of the term "animal biotechnology," one might reasonably define it to include thousands of years of humans selectively breeding animals: observing desirable animal traits and attempting to breed those traits into successive lines of animals. One of the first modern forms of assisted reproductive technology (ART) was artificial insemination (AI). AI has been long established as a technological advance in traditional selective breeding and an important adjunct to the development of modern industrial animal production, especially in dairy and poultry. AI was adopted by producers and accepted by the public with virtually no controversy. For example, more than 70% of all U.S.-bred Holstein cows, by far the most widely used milk producers, are artificially inseminated.[5] Estrus synchronization, which improves the efficiency of AI by more accurately controlling when a female was in heat, is also an important animal biotechnology.

With the development in the 1970s and patenting in the 1980s of recombinant DNA techniques, and the subsequent analysis of genes, their resulting proteins, and the role played by the proteins in animal biochemical processes (functional genomics), modern biotechnology is increasingly

[4] *New York Times*, March 27, 2006.

[5] FDA, "A Primer on Cloning and Its Use in Livestock Operations," at http://www.fda.gov/cvm/CloningRA_Primer.htm.

equipped with a set of sophisticated tools holding the promise of transforming the selective breeding of animals. The range of new techniques and technologies could transform animal biotechnology in ways that plant biotechnology was transformed in the 1980s and 1990s.

Modern animal biotechnology is developing against the background of public experience with plant biotechnology, and controversy over the technologies may be a continuing feature of animal biotechnology development, not least because of the closer connection between humans and some animals and the belief that techniques developed for animals are only a step away from application to humans. Some of the better known animal biotechnologies follow. A number of them are types of assisted reproductive technology (ART).

Embryo Transfer

After AI and estrus synchronization, embryo transfer (ET) is the third most commonly used biotechnology. In ET, a donor cow of superior breeding is chemically induced to superovulate. The eggs are then fertilized within the donor, the embryo develops and is then removed and implanted in a recipient cow. Between removal and implantation, embryos may be frozen for safekeeping. Because of the relatively high costs, ET is used mostly within registered cowherds.

Transgenics

A prominent area of contemporary animal biotechnology research is the development of *transgenic animals* through genetic engineering (GE) technology.[6] Transgenic animals are produced by introducing an isolated DNA fragment into an embryo so that the resulting animal will express a desired trait. Transgenic animals may be generated by the introduction of foreign DNA obtained through animals of the same species, animals of different species, microbes, humans, cells, and *in vitro* nucleic acid synthesis. The only currently routine use of transgenic animals, primarily mice, is in the area of human disease research. The anti-clotting agent in goat milk is the first such application to be approved by the FDA. Potential agricultural applications for such genetic engineering, however, include improved feed use and faster growth; more resistance to disease; meat that is leaner or that has more of some other desirable quality; and possibly even animal waste that is more environmentally benign. **Table 1** provides examples of various objectives of animal biotechnology involving genetic modification.

In Vitro Fertilization

With in vitro fertilization (IVF), a technician removes unfertilized eggs (oocytes) from the donor cow's ovaries, usually recovering 6-8 useable oocytes. The oocytes mature in an incubator and are fertilized with sperm. The resulting zygotes incubate and develop in the laboratory before being placed into the recipient cow. While IVF can produce many fertilized embryos, the added expense of ET makes the procedure prohibitive in most cases.

[6] *Genetic engineering* (GE) here refers to the use of molecular biology to alter cells by inserting or removing genes. GE is a form of *genetic modification (GM)*, which refers more broadly to the practices of altering an organism's genetic composition by both GE and non-GE methods.

Sexing Embryos

The dairy industry prefers heifers and the beef industry prefers bulls. Embryo sexing methods in cattle have been developed using a bovine Y-chromosome probe. Technicians remove a few cells from the embryo and assess the DNA in these cells for the presence of a Y-chromosome. Presence of a Y-chromosome determines the embryo is male. Research is also developing in sperm sexing technology.

Table 1. Agricultural Applications of Animal Transgenics

Purpose	Animal model	Transgenic source
Faster growth/leaner meat	Cattle, swine, rabbits, sheep	Growth hormones/factors : *Human, Bovine, Porcine, Rat, Chicken*
Altered milk composition (higher protein)	Cattle	Extra copies of casein genes; disruption of lactoglobulin gene: *Cow*
Anti-clotting drug production in milk [a]	Goat	Human antithrombin gene
"Biosteel" production in milk [b]	Goat	Spider
Reduced phosphorus in swine feces	Swine	Phytase gene; *Bacteria*
Increased wool production	Sheep	Cysteine synthesis gene: *Bacteria*
		Growth factor: *Sheep*
Disease resistance	Swine, sheep, rabbit	Monoclonal antibodies: *Mouse*
		Viral envelope genes: *Sheep*
Xenotransplantation: Developing animal organs for human transplantation	Swine	CD55 (DAF-decay activating factor: *Human*
		CD59: *Human*

Source: GeneWatch UK, April 2002.

a. FDA approval for commercial use announced February 6, 2009. Source: FDA.

b. "Biosteel" is the trade name for spider web material intended to be produced in the milk of a transgenic goat. Said to be twenty times stronger than steel, "Biosteel" has an envisioned breaking strength of about 300,000 pounds per square inch and could produce microscopically fine, super strong fibers for industrial use.

Cloning

Cloning, discussed at greater length later in this report, is a biotechnology developing rapidly and with significant public controversy. Most people think of cloning as the creation of an organism that is genetically identical to another one. However, scientists use the term more broadly, to refer to production not only of such organisms but also of genetically identical cells, and to replication of DNA and other molecules. It also refers to a form of reproduction found naturally in many single-celled organisms, as well as plants and animals. Those differences in meaning and usage have caused some confusion in public debate about cloning, where the main area of controversy relates to artificial cloning involving higher organisms, including humans.[7]

[7] See CRS Report RL31358, *Human Cloning*, by Judith A. Johnson and Erin D. Williams.

Gene Knockout

This is a technique where researchers inactivate, or "knock out," a gene by replacing it or disrupting it with an artificial piece of DNA in order to determine what that particular gene does—e.g., cause or protect against some disease, alter metabolism, and so forth. A knockout mouse is a laboratory mouse subjected to this technology.[8]

Regulation and Oversight

The basic federal guidance for regulating the products of agricultural biotechnology is the Coordinated Framework for Regulation of Biotechnology (51 *Fed. Reg.* 23302), published in 1986 by the White House Office of Science and Technology Policy (OSTP). A key principle has been that GE products should continue to be regulated according to their characteristics and unique features, not their methods of production, that is, whether or not they were created through biotechnology. The framework provides a regulatory approach intended to ensure the safety of biotechnology research and products, using existing statutory authority and previous policy experience.

Some newer applications of biotechnology did not exist when the current regulatory framework was enunciated. The NRC animal biotechnology report concluded that this regulatory regime "might not be adequate to address unique problems and characteristics associated with animal biotechnologies" and that federal agency responsibilities are not clear.[9]

Food and Drug Administration (FDA)

Within the Department of Health and Human Services (HHS), the FDA regulates food, animal feed ingredients, and human and animal drugs, primarily under the Federal Food, Drug, and Cosmetic Act (FFDCA; 21 U.S.C. §301 *et seq.*). The FDA has stated that most—although probably not all—gene-based modifications of animals for production or therapeutic claims fall within the purview of the agency's Center for Veterinary Medicine (CVM), which regulates them under the FFDCA as new animal drugs. A new animal drug (NAD) must be approved by the agency after it is demonstrated to be safe to man and animals, as well as being effective. Regulation of transgenic animals as NADs, however, suggests to some observers (e.g., the Center for Food Safety, Union of Concerned Scientists) the inherent weakness of existing regulatory structures to respond adequately to the complexities that arise with animal biotechnology innovations.[10]

Primarily under the FFDCA, FDA's Center for Food Safety and Applied Nutrition (CFSAN) is responsible for assuring that domestic and imported foods are safe and properly labeled. Generally, FDA does not review new foods themselves for safety before they enter commerce but

[8] National Institutes of Health, National Human Genome Research Institute, "Knockout Mice," accessed January 21, 2009, at http://www.genome.gov/12514551.

[9] NRC, *Animal Biotechnology*, p. 14.

[10] See Center for Food Safety website, at http://www.centerforfoodsafety.org/geneticall7.cfm; and the Union of Concerned Scientists website, at http://www.ucsusa.org/food_and_agriculture/. Also see discussion of FDA's guidance for industry, later in this section.

does have enforcement authority to act if it finds foods that are adulterated under the act. All food *additives*, whether or not introduced through biotechnology, must receive FDA safety approval before they can be sold; the exception to pre-market approval are those on a list the FDA has determined to be "generally recognized as safe" (GRAS).[11] [12]

Sections of the FFDCA and of the Public Health Service Act (42 U.S.C. §262 *et seq*.) provide the authorities for FDA's Center for Drug Evaluation and Research and Center for Biologics Evaluation and Research to regulate the safety and effectiveness of human drugs and other medical products, including those produced by GM animals. Under these laws, the FDA requires pre-market review and licensing of such products, and requires that their production conditions ensure purity and potency.[13]

FDA Approval of Drug in Goat Milk

The FDA's approval of the drug ATryn was the first of a commercially available product from a GE animal. FDA announced its decision on February 6, 2009, and published the final rule as a new animal drug application (NADA) in the February 11, 2009, *Federal Register* (74 *Fed. Reg.* 6823). The drug is an anticoagulant for the treatment of human patients with hereditary antithrombin deficiency; it is derived from the milk of goats bred with the introduction of an rDNA construct directing the expression of the human gene antithrombin. The milk is being produced by a herd of GE dairy goats in Massachusetts, which, the agency stated, had not demonstrated any negative health problems over seven generations. Controls are in place to ensure that no milk or meat from the goats will enter the food or feed supply, according to FDA. Biotechnology industry officials expressed their support for the approval; a leading animal activist group, the Humane Society of the United States, countered that the action "seems to perpetuate the notion of [animals] being merely tools for human use rather than sentient creatures."

FDA Guidance on GE Animals

On January 15, 2009, FDA's CVM released its industry guidance on how it plans to regulate GE animals.[14] This final document hews closely (with a few modifications) to the draft version that FDA published on September 18, 2008. The final document asserts that FDA's authority to regulate GE animals comes under the new animal drug provisions of the FFDCA. A drug is defined by the act, in part, as "intended to affect the structure or any function in the body of man

[11] The FDA, as of early 2009, has not granted approval for any human foods from transgenic (or cloned) animals, although a "very limited number have been approved for rendering into animal feed components." The only FDA-approved product of biotechnology in wide commercial use is bST, and an application is pending for a GE salmon. (*Questions and Answers about Transgenic Fish*, at http://www.fda.gov/cvm/transgen.htm).

[12] Also see CRS Report RL34247, *Federal Regulation of Substances Generally Recognized As Safe (GRAS) and the Use of Carbon Monoxide in Packaging for Meat and Fish*, by Vanessa K. Burrows and Cynthia Brougher.

[13] NRC, *Animal Biotechnology*, p. 163. At a January 9, 2009 meeting, the FDA Blood Products Advisory Committee ruled that a new drug to prevent clots in humans, recombinant human antithrombin III produced in the milk of GE goats, is safe and effective. The FDA could make a final regulatory decision to approve the license application of its developer, GTC Biotherapeutics, soon. Source: "FDA issues final guidance to industry on transgenic animals," *Food Chemical News*, January 19, 2009.

[14] *Guidance for Industry: Regulation of Genetically Engineered Animals Containing Heritable rDNA Constructs*. FDA noted that much of the new guidance will be relevant also to non-heritable rDNA constructs (such as modifications intended for gene therapy); a separate guidance for non-heritable constructs might come later.

The agency states at the outset: "This guidance represents the Food and Drug Administration's (FDA's) current thinking on this topic. It does not create or confer any rights for or on any person and does not operate to bind FDA or the public. You can use an alternative approach if the approach satisfies the requirements of the applicable statutes and regulations."

or other animals." Also, part of the FFDCA definition of "new animal drug" is one intended for use in animals that is not generally recognized as safe and effective for use under the conditions prescribed or recommended, and that has not been used to a material extent or for a material time.

"The rDNA construct in a GE animal that is intended to affect the structure or function of the body of the GE animal, regardless of the intended use of products that may be produced by the GE animal, meets the FFDCA drug definition," the guidance states (on page 5). A new animal drug is considered "unsafe"unless FDA has approved an application for that particular use, or it is for investigational use and subject to an exemption from the drug approval requirement (among a few other specified exemptions). Therefore, most developers will have to submit to the "Investigational New Animal Drug" (INAD) process at FDA prior to shipping any GE animals or to marketing any food or feed derived from GE animals. In other words, it is illegal to introduce food from a GE animal into the food supply that has not been approved by FDA. The guidance lays out the pre-market approval process including the information to be required of developers.

Under the guidance, FDA will examine both the direct toxicity (including allergenicity) potential of food from a GE animal as well as any indirect toxicity. Generally, food and feed will be considered safe if the composition of edible materials from the GE animal can be shown to be as safe as from a non-GE animal. The labeling requirements for GE-derived foods would be the same as for other foods: FDA has oversight over the labeling of seafood, dairy products, and whole shell eggs, and USDA over the labeling of most meat, poultry, and egg products (see below). More specifically, food from GE animals would not have to be so labeled, except when it takes on a different character from its non-GE counterpart.

U.S. Department of Agriculture (USDA)

Several USDA agencies, operating under a number of statutory authorities, also have at least potential roles in the regulation of transgenic and cloned animals and their products. As several critical reviews have indicated, USDA has not had a clearly spelled out policy in this area, including whether it intends to exercise these authorities to regulate GE animals.[15] USDA's Animal and Plant Health Inspection Service (APHIS) earlier had expressed its intention to publish an advance notice of proposed rulemaking (ANPR) on GE animals, possibly in 2008.[16] Instead, in concert with the FDA's notice on its draft guidance, APHIS published, in the September 19, 2008, *Federal Register*, a request for information from the public and scientists on how GE animals might affect U.S. animal health. Comments were accepted until November 18, 2008, as they had been for the FDA draft guidance. Further APHIS action was pending in mid-January 2009.

APHIS has broad authority, under the Animal Health Protection Act (AHPA; 7 U.S.C. §8301 *et seq.*) to regulate animals and their movement to control the spread of diseases and pests to farm-raised animals. APHIS also administers the Viruses, Serums, Toxins, Antitoxins, and Analogous Products Act (21 U.S.C. §151-159), aimed at assuring the safety and effectiveness of animal

[15] See, for example, Pew, *Issues in Regulation*. Beginning on p. 139, the report contains an extensive discussion on how these and several other USDA authorities might be utilized for oversight of animal biotechnology.

[16] APHIS in 2007 established an Animals Branch within its Biotechnology Regulatory Services "to develop a regulatory framework for the possible regulation of genetically engineered animals." Source: APHIS website, "Regulation of Genetically Engineered Animals," at http://www.aphis.usda.gov/biotechnology/news_transgenic_animals.shtml.

vaccines and other biological products, including those of GM origin, and the Animal Welfare Act (7 U.S.C. §2131 *et seq.*), portions of which govern the humane treatment of several kinds of warm-blooded animals used in research (but generally not agricultural animals). Elsewhere at USDA, the Food Safety and Inspection Service (FSIS) is responsible for ensuring the safety and proper labeling of most food animals and meat and related products derived from them under the Federal Meat Inspection Act (21 U.S.C. §601 *et seq.*) and Poultry Products Inspection Act (21 U.S.C. §451 *et seq.*).

Other Authorities

Reports and studies have cited a number of other authorities and federal agencies that are or could be relevant. The National Environmental Policy Act (NEPA; 42 U.S.C. §4321 *et seq.*) requires federal agencies to consider the environmental impacts of their actions.[17] The Environmental Protection Agency derives its authority from, among other laws, the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA; 21 U.S.C. §301 *et seq.*); pesticides derived from living organisms, including those of biotechnology, are within its purview. The Interior Department's Fish and Wildlife Service and the Commerce Department's National Marine Fisheries Service have also been cited.[18]

Cloning Policy Developments

In 1997, scientists at the Roslyn Institute in Scotland used nuclei from the mammary cells of an adult sheep to clone "Dolly." Such nuclear transfer (NT) techniques were first developed in amphibians in the 1950s. They were first used in sheep in 1986, with the production of clones using nuclei taken from sheep embryos. The significance of Dolly was that she was cloned from differentiated cell types obtained from an adult (called "somatic cell nuclear transfer" or SCNT), rather than undifferentiated cells from an embryo ("embryonic NT").

Cloning in animal agriculture is generally not applied in isolation from other biotechnologies such as genetic engineering. Scientists note that cloning does not require fertilization and is not, by itself, a form of genetic engineering, i.e., altering, removing, or inserting genes into an animal's existing DNA. However, cloning can involve transgenic as well as non-transgenic cells.

SCNT is not yet a notably efficient technique ready for widespread commercial adoption. For example, only about 6% of the embryos transferred to recipient cows resulted in healthy, long-term surviving clones, according to a 2005 report.[19] The European Food Safety Authority (EFSA) recently reported that overall success rates vary by species, ranging from 0.5% to 5%.[20]

---

[17] The FDA guidance discusses how NEPA requirements will apply to the GE animal approval process.

[18] The FDA guidance on GE animals states that the agency will work with other relevant federal and state agencies should it receive a request for approval of a GE animal intended for release into the wild.

[19] D. N. Wells, "Animal Cloning: Problems and Prospects," *Review of Science and Technology*, 24(1): 251-264, 2005.

[20] European Food Safety Authority. *Draft Scientific Opinion on Food Safety, Animal Health and Welfare and Environmental Impact of Animals Derived from Cloning by Somatic Cell Nucleus Transfer (SCNT) and their Offspring and Products Obtained from the Animals*, Enorsed for public consultation December 19, 2007 and released January 11, 2008. Hereinafter cited as EFSA draft scientific opinion. Accessed on the Internet at http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1178676922939.htm.

Success rates are said to be improving, however. As more efficient cloning technologies, which can overcome the range of cloning abnormalities that have resulted from SCNT, are introduced, they could provide new opportunities in human medicine, agriculture, and animal welfare. This is the focus of much of the current international animal biotechnology research.

The EFSA draft scientific opinion estimated the number of live clones worldwide in 2007 to be less than 4,000 cattle and 1,500 pigs, of which about 750 cattle and 10 pig clones were in the United States. EFSA reported that life span data were limited, with only a few reports on cattle of six to seven years of age and no data available in 2007 on the full natural life span of livestock clones generally.[21]

FDA Risk Assessment

The FDA in July 2001 began asking companies to refrain voluntarily from marketing the products of cloned animals and their offspring until it could fully assess the scientific information on their safety. It subsequently issued two draft risk assessments on the matter, culminating in the release of a final risk assessment—and industry guidance that effectively lifted its voluntary moratorium—on January 15, 2008.

What Is Cloning?

Cloning, or somatic cell nuclear transfer, is a process by which animals are reproduced asexually.... In cloning, a differentiated somatic cell (a non-germ line cell from an existing animal) is introduced to an oöcyte (a cell that is the immediate precursor of a mature egg) that has had its nucleus (and thus its genome) removed, and then, following some manipulations, is induced to start replicating. If all goes well, the dividing cell is implanted into a female animal (dam), continues to develop normally, and is delivered just as any newborn.

—Animal Cloning: A Risk Assessment, p. 20

What's the Difference Between a Cloned and a GE Animal?

Clones covered by FDA's January 2008 risk assessment and guidance are "just clones"—that is, they are copies of individual conventionally-bred animals, and do not contain any rDNA constructs. What can be confusing is that an animal clone can be genetically engineered (i.e., have an rDNA construct introduced into it), and a GE animal can be reproduced by cloning. The September 2008 guidance covers GE animals, regardless of whether they were reproduced by cloning, but does not cover animal clones that do not contain an rDNA construct.

—Q and A to Accompany FDA's September 18, 2008 Draft Guidance

Some stakeholders, including several Members of Congress, wanted a continuation of the moratorium until more studies are completed on safety and other aspects of animal cloning. Their views were reflected in nonbinding language to accompany the omnibus spending measure for FY2008, which passed in late 2007, and binding language in the Senate version of the pending farm bill (H.R. 2419); see "Congressional Action," at the end of this report, for details.

In an October 2003 draft risk assessment, the FDA had concluded that "the current weight of evidence suggests that there are no biological reasons ... to indicate that consumption of edible products from clones of cattle, pigs, sheep or goats poses a greater risk than consumption of those products from their non-clone counterparts."[22] However, shortly after the assessment's

[21] Ibid.

[22] See http://www.fda.gov/cvm/Documents/CLRAES.pdf.

publication, many members of the FDA's Veterinary Medicine Advisory Committee stated that there were not enough data to fully understand any potential risks from this relatively new technology.[23]

On December 28, 2006, the FDA's CVM released another long-awaited risk assessment—also in draft form, along with a proposed risk management plan and draft guidance for industry—on the safety of animal clones and their offspring.[24] The lengthy risk assessment examined two important questions: the safety of food from cloned animals and their progeny, and the effects of the process on the health of these animals. FDA officials stressed that the risk assessment did not address any other issues, such as the social and ethical aspects of cloning or consumer acceptance of cloned animal products. The risk assessment also focused only on cloning from non-transgenic cells. This risk assessment is now final.[25]

The final risk assessment concluded—as had the December 26, 2006 draft—that the meat and milk of clones of adult cattle, pigs, and goats, and the meat and milk from the offspring of these clones, were as safe for human consumption as the food from conventionally bred animals. The FDA added that not enough data were available to reach the same conclusions about sheep clones (or other species) and recommended that they not yet be used for human food. The risk assessment arrived at these conclusions after analyzing physiological, anatomical, health, and behavioral data on the animals and evaluating available information on the chemical composition of their milk and meat. FDA said its final assessment was peer-reviewed by an independent panel of experts, who agreed with the findings. The final assessment also took into account many thousands of public comments and additional data that became available since the draft was prepared, the agency said.

The agency said it would not require any special measures (including labeling) relating to the use of food products or animal feed derived from cloned cattle, goats, and pigs because they are "no different from food derived from conventionally bred animals. Should a producer express a desire for voluntary labeling (e.g., 'this product is clone-free'), it will be considered on a case-by-case basis to ensure compliance with statutory requirements that labeling be truthful and not misleading."[26] The industry guidance states that products from the offspring of cloned animals of any species are suitable for food or feed consumption.

Upon release of the 2006 proposed assessment, FDA officials said they were continuing to ask livestock breeders and producers to keep food products from cloned animals and their offspring out of commerce. This moratorium was announced in July 2001 and remained in effect until the final guidance was released in January 2008. Although the FDA moratorium is no longer in effect, USDA has since been encouraging technology providers to maintain the voluntary moratorium, but for products from cloned animals only. Food products from cloned animals' offspring would not be similarly constrained. During a continuation of this moratorium, USDA

[23] "Panel Calls for More Data on Animal Cloning Risks," *Food Chemical News*, November 10, 2003.

[24] Availability of the draft documents was formally published in the January 3, 2007, *Federal Register* (72 FR 135-137; FDA docket no. 2003N-0573); comments were accepted until May 3, 2007.

[25] FDA documents were posted on the Internet at http://www.fda.gov/cvm/cloning.htm on January 15, 2008. They are the Risk Assessment, Risk Management Plan, and Guidance for Industry.

[26] "FDA Issues Documents on the Safety of Food from Animal Clones," FDA press release, January 15, 2008.

said it would "work closely with stakeholders to ensure a smooth and seamless transition into the marketplace for these products."[27]

Officials emphasized that, at least initially, almost all cloning-related foods will come not from the clones themselves but rather from their sexually reproduced offspring. Cloned animals—like other "elite" breeding animals such as a prized bull—are too valuable to use for food production, except possibly when they reach the end of their productive lives. The FDA observed that it can cost $20,000 or more to produce one such animal.

One ongoing question has been whether, in fact, milk and meat from the offspring of clones are entering the food supply. Several press accounts have quoted farmers and others who say they have sold such offspring to be slaughtered for food, and that the total number nationwide may be in the hundreds or even thousands. On the other hand, those numbers would amount to a small fraction of the total number of U.S. livestock slaughtered (e.g., 34 million cattle and 109 million hogs in 2007).[28]

FDA's January 2008 risk assessment did conclude that some animals involved in cloning (notably cattle and sheep surrogate dams) and some clones are at greater health risk than conventional animals. While the types of animal health problems observed in cloned animals are no different than those found with other assisted reproductive technologies, these problems appear more frequently in cloning than in the other technologies. Such problems include late gestational complications in the surrogate mothers, and increased risk of mortality and morbidity in calf and lamb clones that are apparently caused mainly by large offspring syndrome (LOS). Swine and goat clones and their mothers do not appear to experience any additional cloning-related problems, FDA reported.

FDA found that livestock clones as a group tend to have more health problems and death rates at or right after birth. However, the risk assessment added that most animals surviving the neonatal period appear to grow and develop normally, and that no increased risk of adverse health effects have been reported in clones approaching reproductive maturity. The agency said that the technology was too new to draw any conclusions on the relative longevity of livestock clones.

European Views

Cloning currently is not in commercial use in Europe, nor is there any specific authorization procedure in the European Union for products from cloned animals.[29] The European Food Safety Authority (EFSA) on July 24, 2008, released its scientific opinion on the food safety, animal health and welfare, and environmental impacts of animals derived from cloning. The EFSA opinion was limited to cattle and pigs, but its findings generally do not appear to be substantially different from those in the FDA assessment. According to EFSA, "Based on current knowledge, and considering the fact that the primary DNA sequence is unchanged in clones, there is no indication that differences exist in terms of food safety between food products from healthy cattle and pig clones and their progeny, compared with those from healthy conventionally-bred

[27] Statement by Bruce Knight, Under Secretary for Marketing and Regulatory Programs on FDA Risk Assessment on Animal Clones, January 15, 2008.

[28] See, for example, "Animal Clones' Offspring Are in Food Supply," *The Wall Street Journal* online, September 2, 2008.

[29] "EFSA launches its draft opinion on animal cloning for public consultation," EFSA press release, January 11, 2008.

animals." As with FDA, the EFSA conclusion is based on an examination of compositional and nutritional data, the probability for the presence of novel constituents, the health status of the animal, and available data on toxicity, allergenicity, and microbiology.

EFSA agreed that SCNT can be a successful reproductive technique, although death and disease rates of clones are significantly higher than those of conventionally reproduced animals. EFSA noted that surrogate dams have higher rates of failed pregnancies and other problems. "A significant proportion of clones, mainly within the juvenile period for bovines and perinatal period for pigs, has been found to be adversely affected, often severely and with fatal outcome. Most clones that survive the perinatal period are normal and healthy," however. Adverse health effects were not observed in the offspring of clones, although studies have not been conducted for their entire lifespans.[30]

EFSA also found no indication of new or additional environmental risks compared with conventionally bred animals.

The EFSA report findings are being used by the European Commission (EC), the European Parliament, and member states as they discuss their policies regarding animal cloning. There is disagreement over the issue among officials in the various European bodies. This was illustrated when the European Parliament in early September 2008 approved a resolution asking the EC to propose a comprehensive ban on cloning animals for food, out of animal health and welfare and ethical concerns.[31] However, at an initial discussion of the issue in early January 2009, EC commissioners indicated that there was time to consider a science-based risk assessment before deciding whether or not to ban cloning.[32]

Other Views

Critics, including a number of consumer advocacy and animal rights groups, oppose the use of cloned animals and their offspring for food. In October 2006, a coalition formally petitioned the FDA to impose a moratorium on producing foods from cloned animals, and to establish rules for mandatory pre-market review and approval of cloned foods by regulating clones as new drugs under the food and drug act. These consumer and animal welfare groups contend that FDA has ignored or minimized a number of food safety and animal welfare problems. These include the treatment of surrogate mothers with high doses of hormones and their clone offspring, who often have severely compromised immune systems, with large doses of antibiotics, which could enter the human food supply; imbalances in clones' hormone, protein, or fat levels that could compromise meat and milk safety and quality; the possibility of increased foodborne illnesses; and a wide variety of health problems and abnormalities in the animals themselves. Consumer advocates assert that there are no consumer benefits from cloning.

FDA disagrees, citing the potential to breed livestock that meet consumers' changing tastes for traits like leanness, tenderness, color, size of meat cuts, and so forth. These would be in addition

[30] "Scientific Opinion of the Scientific Committee on a request from the European Commission on Food Safety, Animal Health and Welfare and Environmental Impact of Animals derived from Cloning by Somatic Cell Nucleus Transfer (SCNT) and their Offspring and Products Obtained from those Animals," *The EFSA Journal* (2008) 767, 1-49; http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902019540.htm.

[31] "European Parliament urges ban on cloning for food," *Food Chemical News*, September 8, 2008.

[32] "EU not ready to ban animal cloning for food," *Food Chemical News*, January 19, 2009.

to potential producer-related benefits such as disease resistance, climate suitability, fertility, and improved physical qualities, FDA states.[33]

Opinion polls have suggested that the general public may not yet be ready for widespread animal cloning. A 2006 poll commissioned by the Pew Initiative on Food and Biotechnology, for example, found that Americans generally were not well informed about animal cloning, but 64% of those questioned are "uncomfortable" with it. Forty-three percent of Americans believed that foods from clones are unsafe, the survey found. Cloning opponents cite these types of findings to argue that products from cloned animals should be labeled so that consumers could avoid them if they wanted to. Some critics have urged the President to halt all FDA actions on cloning until a national panel that includes ethicists and religious leaders can consider the ethical and other social issues that they believe the technology has raised.

The NRC animal biotechnology report had stated that embryonic splitting and nuclear transfer using embryonic (not adult) cells were performed with some dairy cows to successfully produce genetically valuable offspring that were milked commercially and whose milk and meat did enter the food supply. Few concerns were raised by NRC authors about using these types of cloned animals for food, since they are generally believed to pose a low level of food safety concern. However, evaluating cloned-animal food composition "would be prudent to minimize any 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."[34] Other issues, notably consumer acceptance, social values, and animal welfare, could eventually overshadow any lingering questions about human health.

Other Policy Concerns

The following are among the policy concerns that have arisen along with the development of new biotechnologies in animal agriculture. Some may be more applicable to GE-related technologies than to cloning *per se*, although others, like social acceptance and animal welfare concerns, may apply to both.

Environmental Issues

Environmental concerns arising from emerging animal biotechnologies are largely speculative at this time because few products have been commercialized. For example, although the EFSA draft scientific opinion foresaw no environmental impact, it also noted that limited data were available on this aspect of animal cloning.

Industrial developers of agricultural biotechnology might argue that more efficient production of animal-based feeds could reduce the resources necessary to produce food and, thereby, reduce the environmental burden of animal production. Should the development and widespread adoption of the "EnviroPig" (tm), which produces less phosphorus in its waste, occur, it might be considered by some to be a positive environmental benefit of agricultural biotechnology.

[33] "A Primer on Cloning and Its Use in Livestock Operations," at http://www.fda.gov/cvm/CloningRA_Primer.htm.

[34] CAST, *Animal Agriculture*, p. 8.

The 2002 NRC animal biotechnology report noted potential negative environmental impacts of genetically altered animals. Escape, survival, and gene flow into wild populations were identified as major concerns. Of most concern to the NRC committee was the escape into the environment of "super" salmon that have been genetically modified for rapid growth, and the likelihood that they could then breed with wild populations in the environment.[35] Other genetically altered animals such as fish, insects, and shellfish could also potentially escape into natural environments and become feral, disrupt ecosystems, or introduce novel genes in a natural population.

The FDA guidance on GE animals notes that the agency will comply with requirements of the National Environmental Policy Act (NEPA). Environmental risks are likely to differ depending upon the animal and application. For example, the types of environmental concerns arising from a GE cow bred for resistance to mastitis will differ greatly from the concerns raised by a GE fresh-water fish engineered to grow more rapidly.[36] Material to accompany the FDA's final guidance notes that "although the agency has extensive experience in environmental assessment, including for fish, other federal and state agencies have overlapping or complementary authority and expertise" that FDA intends to tap. It also promised to make the results of environmental reviews public.[37]

Food Safety

Unexpected and unintended compositional changes arise with all forms of plant and animal genetic modification, including GE, concluded the IOM-NRC report on genetically engineered foods.[38] The report added that, so far, no GE-related adverse human health effects have been documented. However, the report's authors cited "sizeable gaps" in the ability to identify compositional changes caused by all forms of genetic modification—whether GE or conventional—and their relevance for human health, and they recommended new approaches for assessing the safety of new foods both before and after they enter the market.

Previous research and experience with commercializing transgenic plants suggested that negative effects on human health were virtually nonexistent. While not asserting that genetically modified organisms necessarily generate health problems, more recently reported research in peer-reviewed scientific journals has suggested that GMOs may raise food safety concerns:

- Australian researchers have published an article explaining that the transfer from a bean to a pea gene that expresses an insecticide protein has resulted in antibody production in mice fed the transgenic pea. The antibody reaction is a marker of allergic reaction.[39]
- Italian researchers at the University of Urbino had previously shown that absorption of transgenic soy by mice induced modifications in the nuclei of their

[35] NRC, *Animal Biotechnology*, p. 73.

[36] FDA, *Consumers Q&A*, accompanying its September 18, 2008, draft guidance.

[37] "FDA's Response to Public Comments," accessed January 21, 2008, at http://www.fda.gov/cvm/GEanimals.htm#Consumer%20Health%20Information.

[38] IOM-NRC, *Safety of Genetically Engineered Food*, p. 1.

[39] V. E. Prescott, P. M. Campbell, et al., "Transgenic Expression of Bean-Amylase Inhibitor in Peas Results in Altered Structure and Immunogenicity," *Journal of Agriculture and Food Chemistry*, 53(23); 9023-9030, November 2005.

liver cells. Recent research showed that a return to non-transgenic soy made the observed differences disappear.[40]

- Norwegian scientists at the University of Tromso demonstrated that the catalyst 35S CaMV, an element of the genetic structures used to modify a plant, can provoke gene expression in cultured human cells. This catalyst was previously believed to operate in this way only in plants.[41]

In the NRC animal biotechnology report, experts observed that the scientific principles for assessing the safety of GE animals are "qualitatively the same" as for non-GE animals.[42] However, because GE can introduce new proteins into foods, the potential for allergenicity, bioactivity, and/or toxicity responses should be considered, they said. Others have remarked that animals genetically engineered for nonfood products like pharmaceuticals or replacement organs might be of concern if such animals entered *or* affected the food supply.

Consumer and Social Acceptance

Criteria for selecting desirable traits to be produced through transgenic animals will likely be based on the demand for specific commercial characteristics. Even if scientific evidence is convincing that GE and cloned animal products are safe and beneficial for human consumption or economically valuable to producers, other concerns may limit marketplace and consumer acceptance.

Polls in recent years in the United States indicate that public knowledge about food and biotechnology generally remains limited. In two 2005 surveys, approximately half of those surveyed expressed opposition to the use of biotechnology in the food supply.[43] More than half of those in a 2005 Pew-sponsored poll said they opposed research into genetically modified animals, although opposition declined with increased knowledge. Many Americans have heard about animal cloning; two-thirds expressed discomfort with it—more of them out of religious or ethical concerns than food safety concerns. A majority of respondents to the Pew survey believe that regulators should take into account ethical and moral considerations. (See also the 2006 Pew findings on cloning, under "Cloning Policy Developments," section on "Other Views.")

Consumers may be less willing to accept the practice of genetically modifying animals than plants, some have argued, observing that people relate differently to animals, which many recognize as sentient beings. Some observers have expressed the concern that cloning farm animals might lead more quickly to human and pet cloning, which those observers oppose. Others believe that modifying animals, for example, to save human lives through xenotransplantation or the production of some important drug, might be more acceptable than doing so simply to produce more or cheaper food.

---

[40] M. Malatesta, C. Tiberi, et al., "Reversibility of Hepatocyte Nuclear Modifications in Mice Fed on Genetically Modified Soybean," *European Journal of Histochemistry*, 49(2):237-242, July-September 2005.

[41] M. R. Myhre, K. Fenton, et al., "The 35S CaMV Plant Virus Promoter Is Active in Human Enterocyte-like Cells," *European Food Research and Technology*, 222(1-2):185-193, January 2006.

[42] NRC, *Animal Biotechnology*, p. 65.

[43] Gallup poll on biotechnology and food safety, July 2005; Mellman Group/Public Opinion Strategies Poll Conducted for the Pew Initiative on Food and Biotechnology, October 2005. See http://www.pewagbiotech.org (accessed March 20, 2006).

Further, science alone cannot resolve ethical views that appear to vary widely:

> Some people, irrespective of the application of technology, consider genetic engineering of animals fundamentally unethical. Others, however, hold that the ethical significance of animal biotechnologies must derive from the risk and benefits to people, the animals, and/or the environment. Yet another view focuses on the right of humans to know what they are eating or how their food or pharmaceuticals are being produced and therefore labeling becomes an issue to be addressed.[44]

Food industry leaders appear sensitive to consumer unease with animal biotechnology in general and cloning in particular. Many companies are not yet ready to process and sell meat and milk from transgenic and cloned animals because, they believe, consumers may view the products as less safe than more conventionally produced food products. The food industry also does not want to be portrayed as overstepping any widely held ethical or moral concerns about the new technologies.[45]

Such observations led some skeptics of animal biotechnology to propose that the FDA not only consider the science and safety issues, but also these broader concerns. In the area of human reproductive health, for example, the FDA and other federal agencies have invoked particular moral arguments either to reinforce scientific arguments or to counterbalance scientific evidence. Others believe that the FDA should base its decisions only on scientific evidence, and perhaps some other body should be established to consider the ethical and cultural questions. As the NRC animal biotechnology report observed, regulatory decisions and enforcement involving animal biotechnology "are difficult in the absence of an ethical framework."[46]

Labeling

Some believe that segregating and labeling the products of biotechnology in agriculture, including meat and milk, would enable the consumer to choose whether or not to buy such products. Either segregating and labeling biotechnology products or failing to do so could contribute to public suspicion that these products are flawed or different in some negative way, which may lead to contradictory policy decisions.[47] As noted, the FDA guidance on GE animals does not require their products to be so labeled. Opponents of labeling argue that biotechnology products essentially are the same as more conventional products—and are subjected to the same rigorous safety standards—and therefore should be treated no differently in the marketplace. A study by USDA's Economic Research Service reported that consumers' willingness to pay for a food item declines when the food label indicates that it was produced with the aid of biotechnology.[48]

---

[44] NRC, *Animal Biotechnology*, p. 13.

[45] These concerns were explored in depth at an October 2006 symposium, "Animal Biotechnology: Considering Ethical Issues," sponsored by the Pew Initiative on Food and Biotechnology and by Michigan State University. Also reported by *Food Chemical News*, October 23, 2006.

[46] Ibid.

[47] C. T. Foreman, *Can U.S. Support for Food Biotechnology Be Salvaged?*, paper prepared for the American Enterprise Institute for Public Policy Research Conference on Biotechnology, the Media and Public Policy, June 12, 2003.

[48] A. Tegene, W. Huffman, et al., *The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions*, USDA, Economic Research Service, Technical Bulletin 1903, March 2003.

In December 2007, two leading U.S. livestock cloning companies announced they were creating a voluntary system for tracking cloned animals. The program, which they asserted "is designed to facilitate marketing claims," is to involve a national registry providing for the individual identification of each cloned animal, affidavits that owners will sign committing to proper marketing and disposal of such animals, and monetary deposits to be returned when such commitments are fulfilled. Consumer organizations immediately criticized the initiative, noting that it would not track the offspring of cloned animals and was not mandatory.[49]

However, fierce debate continues regarding even the *voluntary* labeling of products to denote that they are *not* derived from biotechnology—notably the use of so-called "rBST-free" labels on dairy products. Although FDA cleared rBST as safe for commercial use in 1994, and it has been widely adopted by U.S. dairy farmers, the substance continues to be viewed skeptically by some consumer advocates. They have convinced a number of dairy processors and retailers to label their products as free of added BST manufactured through the use of recombinant DNA technology. FDA guidance permits such labeling so long as it is not misleading, is presented in the proper context, and is adequately substantiated. For example, a firm cannot state that its product is "BST-free" because the substance occurs naturally in milk, or even simply that it is "rBST-free" because that could imply a compositional difference between naturally occurring and rBST, which there is not, FDA has ruled. But certain claims that no rBST was used could be acceptable, the agency stated.[50]

FDA has looked to the states to evaluate the acceptability of such labels, and a number of these states have challenged processors' use of them. Battles over such restrictions have been notable in Pennsylvania, Ohio, Utah, Kansas, and elsewhere.[51]

Meanwhile, USDA has reminded stakeholders that products from cloned animals are not eligible to be labeled as organic, under its National Organic Program (NOP). While cautioning that the organics program is a marketing, not a food safety, program, USDA also noted: "Cloning as a production method is incompatible with the Organic Foods Production Act and is prohibited under the NOP regulations."[52] However, the status of products from clone offspring is less clear. The Department noted that USDA's Agricultural Marketing Service, where the NOP is located, was preparing rulemaking to address the organic status of such offspring.[53]

Animal Welfare

Some aspects of gene transfer, and of cloning, have the potential to create infectious disease hazards and/or impaired reproduction. Looming large in the ethical debate are questions about whether genetic modifications, cloning, and other technologies stress animals unnecessarily,

---

[49] Sources: "Top U.S. Cloning Companies Announce New System to Track Cloned, Livestock," December 19, 2007, Viagen press release, and "Consumer Groups Displeased with Voluntary Animal Clone Registry," *FDA Week*, December 21, 2007.

[50] FDA, "Interim Guidance on the Voluntary Labeling of Milk and Milk Products From Cows That Have Not Been Treated With Recombinant Bovine Somatotropin," *Federal Register*, February 10, 1994.

[51] See, for example, "Dairy processors fight to save 'rBST-free' labels, March 3, 2008, and "Kansas is latest battleground in 'rBST-free' labeling fight," December 22, 2008, both in *Food Chemical News*.

[52] USDA, Questions and Answers, FDA's Final Risk Assessment, Management Plan and Industry Guidance on Animal Clones and their Progeny, January 2008.

[53] Ibid. Such a rule was not unveiled in 2008.

subject them to higher rates of disease and injury, and hasten death.[54] The NRC animal agriculture report noted, for example, that ruminants produced by *in vitro* culture or nuclear cell transfer methods tend to have higher birth weights and longer gestation periods than those produced by artificial insemination, creating potential calving problems. Nuclear transfer techniques to propagate genetic modifications may increase risks to the reproductive health and welfare of both the surrogate female animals and their transgenic offspring. The report cited other evidence of problems such as anatomical, physiological, or behavioral abnormalities in many transgenic animals.[55] Some scientists have countered that animal welfare problems have been exaggerated and tend to recede, particularly as the technologies are perfected. Most appear to agree, however, that animals originating from some forms of genetic modification or from cloning may require closer observation and care. (See also the section of this report on Cloning Policy Developments.)

In Europe, officials continue to consider the ethical dimensions of animal welfare in formulating their own cloning policies. The EC charged a separate panel, the European Group on Ethics in Science and New Technologies, with drafting an opinion. This group released an opinion on January 16, 2008, stating, in part:

> Considering the current level of suffering and health problems of surrogate dams and animal clones, the EGE has doubts as to whether cloning animals for food supply is ethically justified. Whether this applies also to progeny is open to further scientific research. At present, the EGE does not see convincing arguments to justify the production of food from clones and their offspring.

If such products were to be allowed into the market, certain requirements regarding food safety, animal welfare and traceability should be met, the group added.[56]

Genetic Diversity

Could the introduction of a few genetically altered or cloned "superspecies" bring too much genetic uniformity to herds? As genetic diversity declines, herds could be more susceptible to diseases, leading to large production losses and/or much heavier use of antibiotics and other animal drugs to treat them, some have argued. A related concern is that a relative handful of "elite" producers or breeders might hold the proprietary rights to these species, to the disadvantage of many farmers and ranchers. Some animal biotechnology researchers have pointed to the potential importance of preserving unaltered germlines in domestic animals because they could prove to be an invaluable "gene bank" in the event that novel infectious diseases or inheritable genetic defects were inadvertently introduced into modified subpopulations as a consequence of genetic modification.

[54] See also H. P. S. Kochhar, G. Adlakha-Hutcheon, and B. R. Evans, "Regulatory Considerations for Biotechnology-Derived Animals in Canada," *Review of Science and Technology*, 24(1):117-125, 2005.

[55] NRC, *Animal Biotechnology*, p. 11.

[56] "Ethical aspects of animal cloning for food supply," Opinion No. 23. The group's website is at http://ec.europa.eu/european_group_ethics/index_en.htm.

Trade Issues

If the United States were to be the first country to approve food products from cloned animals, how might the decision affect U.S. exports? Any exports of the products of animal biotechnology would presumably encounter a wide spectrum of foreign regulatory regimes, some more restrictive than the U.S. system. For example, the current European Union restriction on new biotechnology products is likely to encompass various restrictions on animal biotechnology as it does on plant biotechnology. On the other hand, researchers in a number of other countries, including some EU members, have been producing clones, and one—France—has published its own risk assessment on clones that, FDA has observed, generally agrees with the U.S. assessment.[57]

International guidelines pertaining to exports of animal products derived from biotechnology are being considered. The Codex Ad Hoc Intergovernmental Task Force on Foods Derived from Biotechnology held an initial meeting in September 2005 in Chiba, Japan, to determine the new work projects. Almost every country, except for the United States, proposed an animal biotechnology project. The task force agreed to move forward with a recombinant DNA (r-DNA) animal project, specifically to develop guidelines for how countries would assess the safety of foods derived from r-DNA animals.[58] At a meeting in November-December 2006 in Chiba, the task force, among other things, reviewed the developing guidelines, agreeing to limit their scope to food safety and nutritional issues (while recognizing the importance of others like animal welfare, environmental, and ethical concerns).[59]

USDA has said it would consider "discussion with industry on possible verification of its supply chain management plan to ensure that trading partners are aware of whether or not they receive cloned or non-cloned products."[60]

Imports of GE animals and their products into the United States also are of concern to some. In a December 2008 audit report, USDA's Office of Inspector General (OIG) concluded that the Department has not established an import control policy for such imports but needs to do so. "To mitigate any risks to the U.S. environment, agriculture, and commerce from unapproved transgenic plants and animals entering the U.S. food supply, USDA will need to monitor" foreign developments in such technologies more closely, OIG also noted.[61]

---

[57] Stephen F. Sundlof, then Director of FDA Center for Veterinary Medicine, transcript of a December 28, 2006, teleconference on the draft risk assessment.

[58] Codex is recognized by the World Trade Organization (WTO) as the body that sets food safety standards for facilitating international trade of food products. The WTO cites Codex texts as a benchmark in the Agreement on Sanitary and Phytosanitary Measures (SPS).

[59] The collaborative document is entitled *Proposed Draft Guideline for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Animals*. Codex adopted the guidelines at its Geneva meeting on June 30-July 5, 2008.

[60] Questions and Answers, FDA's Final Risk Assessment, Management Plan and Industry Guidance on Animal Clones and their Progeny.

[61] USDA, OIG, *United States Department of Agriculture Controls Over Importation of Transgenic Plants and Animals*, Audit Report No. 50601-17-Te, December 2008.

Congressional Activity

Members of Congress in the past have proposed various bills aimed at more closely regulating the plant and animal products of agricultural biotechnology generally, requiring such products to be labeled, and providing a means to recover any damages caused by the technology. As with human cloning, ethical issues concerning animal clones and other animal biotechnologies also may continue to be visible public issues. As before, the 111th Congress could be asked to play a larger role in weighing the benefits and costs of these evolving technologies, and to refine existing government oversight.

In the 110th Congress, the Senate-passed version of the 2007-2008 farm bill (H.R. 2419, in Section 7507) contained statutory language that would have required the FDA both to postpone publication of its final risk assessment until the completion of several newly mandated studies, and also to maintain the voluntary marketing moratorium until then. However, conferees deleted the Senate language from the final measure (signed into law as P.L. 110-234).

More specifically, the Senate bill would have directed the HHS Secretary to contract with the National Academy of Sciences to conduct a study on the safety of food products from cloned animals and the health effects and costs attributable to milk from cloned animals, with a report to Congress due within one year of enactment. The study was to address whether there were a sufficient number of studies to support the FDA draft assessment, and whether there were other pertinent ones that were not taken into account. It would have included an evaluation of potential public health effects and associated health care costs, and an evaluation of any consumer behavior and negative health and nutrition impacts resulting from a decrease in dairy consumption if milk from cloned animals and their offspring is commercialized.

Animal cloning-related bills (S. 414 and H.R. 992) were introduced in early 2007, both of which would have amended federal food safety laws to require that foods from cloned animals and their offspring be so labeled. Also introduced in early 2007 was S. 536/H.R. 1396, which would have prohibited the use of the “organic” label on food products from cloned livestock or their offspring. Another (H.R. 4855), introduced in late 2007, would have required studies like those in the Senate farm bill on the impacts of food products from cloned animals entering the food supply.

In late July 2008, three related bills were introduced that, their sponsor said, were to create a comprehensive framework for regulating GMOs. H.R. 6636 would have required the labeling of all foods produced with GE material. H.R. 6635 would have prescribed relatively stringent new regulations for FDA approval and oversight of GE crops. H.R. 6637 would have regulated business dealings between agricultural producers and the developers of genetically engineered plants and animals, and sought to hold biotechnology companies liable for any adverse on-farm impacts from their products.

Although these bills were not enacted, they could re-emerge, along with others, in the 111th Congress.

Author Contact Information

Geoffrey S. Becker
Specialist in Agricultural Policy
gbecker@crs.loc.gov, 7-7287

Tadlock Cowan
Analyst in Natural Resources and Rural Development
tcowan@crs.loc.gov, 7-7600