









What Is Cloning?

Cloning: creating an organism with the *same DNA* currently available or previously existing animal

The word "clone," derived from the Greek <u>klon</u> refers to *asexual reproduction*

clones were created using *nuclear transfer* technology









































































































































USA (GTC. Inc.)-1999-Nature



GTC. Inc



Quality

- improving the size of livestock genetically
- milk
 - **more** milk or milk with <u>less lactose</u>, <u>Low cholesterol</u>, <u>low</u> <u>saturated fat content</u>, <u>milk with higher levels of β-casein</u> <u>and κ-casein</u>, produce a milk with a composition <u>similar to</u> <u>human milk</u> or unusually high milk protein content (important in cheese manufacture)
- more meat
 - In the past, farmers <u>used growth hormones</u> to spur the development of animals but this technique was problematic, especially since <u>residue of the hormones remained in the animal product</u>.

c) disease resistance

Disease-resistant livestock is not a reality just yet

Scientists are attempting to produce **disease-resistant animals**, such as: **mastitis-resistant cattle**, **BSE resistant FMD resistant**

but a very limited number of genes are currently known to be responsible for resistance to diseases in farm animals



which costs the U.S. dairy industry \$1.7 billion annually

b) nutritional supplements and pharmaceuticals

Milk-producing transgenic animals are especially useful for medicines

Products such as *insulin, growth hormone*, and *blood anti-clotting factors* may soon be or have already been obtained from the milk of transgenic cows, sheep, or goats.

Research is also underway to manufacture milk through transgenesis for treatment of debilitating diseases such as phenylketonuria (PKU), hereditary emphysema, and cystic fibrosis.

In 1997, the first transgenic cow, Rosie, produced human proteinenriched milk at 2.4 grams per liter. This transgenic milk is a more nutritionally balanced product than natural bovine milk and could be given to babies or the elderly with special nutritional or digestive needs. *Rosie's milk contains the human gene alpha-lactalbumin*. c) human gene therapy

A transgenic cow exists that produces a substance to help human red cells grow

Human gene therapy involves adding a normal copy of a gene (transgene) to the genome of a person carrying defective copies of the gene. The potential for treatments for the 5,000 named genetic diseases is huge and transgenic animals could play a role. For example, the A. I. Virtanen Institute in Finland produced a calf with a gene that makes the substance that promotes the growth of red cells in humans.

3. Industrial Applications

Uses in industry include material fabrication and safety tests of chemicals.

In 2001, two scientists at Nexia Biotechnologies in Canada spliced spider genes into the cells of lactating goats. The *goats began to manufacture silk along with their milk* and secrete tiny silk strands from their body by the bucketful. They can be used be used in such applications as *military uniforms, medical microsutures, and tennis racket strings*

Toxicity-sensitive transgenic animals have been produced for chemical safety testing. Microorganisms have been engineered to *produce a wide variety of proteins*, which in turn can produce *enzymes that can speed up industrial chemical reactions*.







Facts about modern biotechnology industry

Biotechnology is a US\$30 billion a year industry that has produced some 160 drugs and vaccines.

- There are more than **370 biotech drug products and vaccines currently in clinical trials** targeting more than **200 diseases**, including various cancers, Alzheimer's disease, heart disease, diabetes, multiple sclerosis, AIDS and arthritis.
- Market capitalization, the total value of publicly traded biotech companies (U.S.) at market prices, was US\$311 billion as of mid-March 2004.

Biotechnology is one of the most **research-intensive** industries in the world. The U.S. biotech industry spent **\$17.9 billion** on research and development in 2003.

From www.biotechinstitute.org



Transgenic Animal Production 1. Microinjection in pronucleus Most common method of gene transfer Useful for gene addition only 2. Transfection (Retroviral, sperm-mediated) 3. Embryonic stem cells Developed method for the mouse only Useful for gene addition and deletion

4.Somatic cell nuclear transfer

















Template:DNA from muscle	tissue
extracted	extracted
QIA kit	QIA kit
Primer:pBC1(F&R)	Primer:pBC1(F&R)

Pharmaceutically related products derived from transgenic animals					
Product	Use	Product development stage	Organization		
5G1.1	Rheumatoid arthritis Nephritis	Preclinical	Alexion-GTC Biotherapeutics		
a-1 Antitrypsin	Hereditary emphysema Cystic fibrosis	I-T	Bayer-PPL ARC		
α-Fetoprotein (rhAFP)	Myasthenia gravis Multiple sclerosis Rheumatoid arthritis	Phase II	Merrimack-GTC		
A8X-EGF	Cancer	Phase II	Abgenix-Amgen		
ABX-IL8	Rheumatoid arthritis	1-T	Abgenix-GTC		
Antithrombin II (ATryn#)	Emboli Thromboses	Phase III Seeking marketing approval	GTC		
Bile salt-stimulated lipase	Cystic fibrosis Fat malabsorbtion	I=T	AstraZeneca-PPL		
Butyrylcholinesterase (Protexia**)	Biodefense	Preclinical	Nexia		
C1 inhibitor	Hereditary angloedema	Phase III	Pharming		
Calcitonin	Osteoporosis	I-T	PPL		
CD137 agonist	Solid tumors	Preclinical	Mayo Clinic-GTC		
CFTR	lon transport Cystic fibrosis	I-T	GTC		
Collagen	Rheumatoid arthritis	Preclinical	Pharming		
CTLA4Ig	Rheumatoid arthritis	Preclinical	Bristol-Myers Squibb GTC		
D2E7	Rheumatoid arthritis	Preclinical	Abbott-GTC		
Erythropoletin	Anemia	Preclinical	Avigenics		
Extracellular superoxide dismutase	Ischemic reperfusion injury	1-1	Pharming		
Factor VII	Hemophilia A	Preclinical	ARC-Pharming		
Factor IX	Blood coagulation Hemophilia	Preclinical	GTC PPL ARC Pharming		
			in a starting		

G-CSF	Leukopenia	Preclinical	Avigenics
Glucagon-like peptide-1	Type 2 diabetes	I-T	PPL
Glucosidase	Glycogen storage disease	I-T	Pharming
Glutamic acid decarboxylase	Type 1 diabetes	I-T	GTC-BioSyn
Hemoglabin	Blood substitute development	I-T	Baxter
Human growth hormone	Growth failure Turner's syndrome Cachexia	ΗT	GTC
Human serum albumin	Blood pressure Trauma Burn treatment	Preclinical	Fresenius-GTC
Humanized antibodies	Various indications	Phases I, II and III	Medarex
Humanized polyclonal antibodies	Various indications	Preclinical	Hematech Avigenics
huN901	Small-cell lung cancer	Preclinical	ImmunoGen-GTC
Insulin	Diabetes	I-T	GTC
Interferon	Antiviral	Preclinical	Avigenics
Lactoferrin	Immunomodulatory Anti-inflammatory	GRAS filing Phase I	Pharming
Lysozyme	Antimicrobial Immune modulator	1-T	UC-Davis
Merozoite surface protein 1	Malarial vaccine	Preclinical	GTC
PR0542	H/V/A/DS	Preclinical	Propenics-GTC

Pharmaceutically related products derived from transgenic animals				
Product	Use	Product development stage	Organization	
Prolactin	Enhancement of immunity	I-T	GTC	
Protein C	Blood coagulation	I-T	ARC PPL	
Remicade®	Crohn's disease Rheumatoid arthritis	Preclinical	Centocor-GTC	
Rotavirus virus-like particles	Vaccine development	Preclinical	Bioprotein	
Spider silk (Biosteel ^{thr})	Materials development	Preclinical	Nexia	
Tissue plasminogen activator	Dissolution of blood clots Heart attacks	I-T	Genzyme	
Tissues or organs	Engineered for xenotransplantation	Preclinical	Alexion Bresagen Novartis Mayo Clinic	
Tysabri® (formerly Antegren®)	Neurological disorders	Preclinical	Elan-GTC	
Xenomouse® (fully human antibodies)	Various indications	Various	Abgenix	





















