



Is the Market Ready for Meat from Cloned Cattle ?



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OUTLINE

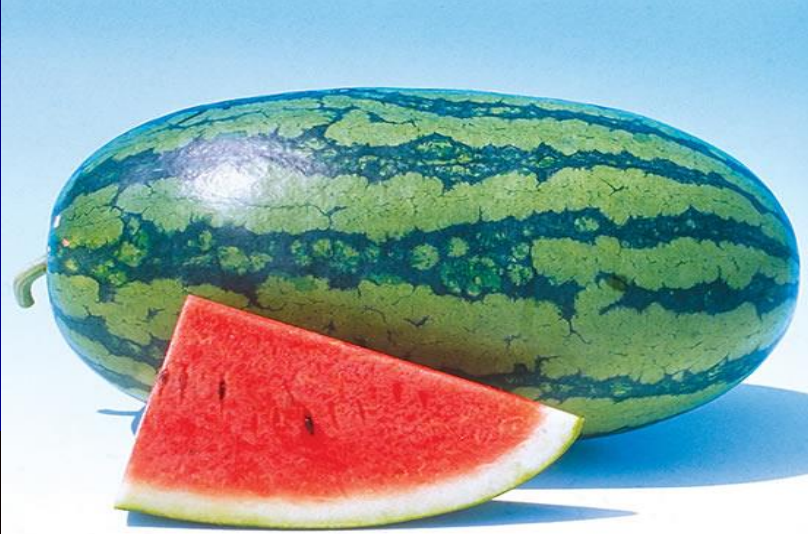


- **What is a clone ?**
 - Embryo splitting
 - Nuclear transfer
 - Embryo
 - Adult
- **What are the concerns ?**
 - Food Safety
 - Animal Welfare and Ethical Issues
- **Public Opinion**



Have I ever eaten a clone?

YES





What is a clone ?



- Cloning, in horticulture and biology, any organism whose genetic information is identical to that of a "mother organism" from which it was created.
- Food from clones has been a part of our diet for years. Many common fruits (e.g., pears, apples, oranges and lemons) and several vegetables (e.g., potatoes and truffles) are clones.



Have a ever eaten products from a cloned animal? YES

- Holstein Association USA (Brattleboro, VT) first registered clones from embryo splitting (ETS) in 1982 and clones from embryo nuclear transfer (ETN) in 1989.
- Most of us have probably ingested meat and dairy products from livestock cloned by natural reproduction (monozygotic siblings), mechanical embryo-splitting, or even nuclear transfer from an embryonic donor cell into an enucleated oocyte.



Cloning by "natural reproduction" (monozygotic twins)

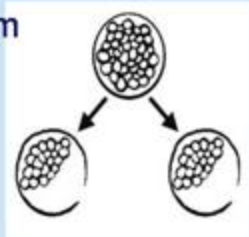




Mechanical embryo splitting

Cloning by Embryo Splitting

Embryo is split to form two half-embryos



Embryos are transferred to an unrelated surrogate mother



Pregnancy is monitored by ultrasound



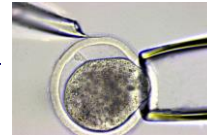
Sheep gives birth to identical twins

The Holstein association of America has registered 2319 embryo split clones (ETS) through October 2002 – probably the most widely recognized were **DUPLICATE** and **DIVIDE**.

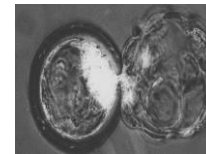
Nuclear transfer from an embryonic donor cell into an "empty" recipient egg.



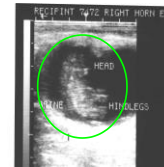
Donor Embryo



Donor cell nucleus is transferred to recipient egg



Cloned embryo is transferred to surrogate mother



Pregnancy is monitored by ultrasound





Cattle clones have been in US population since early 80s*

Holstein Association USA first registered clones from nuclear transfer in 1989

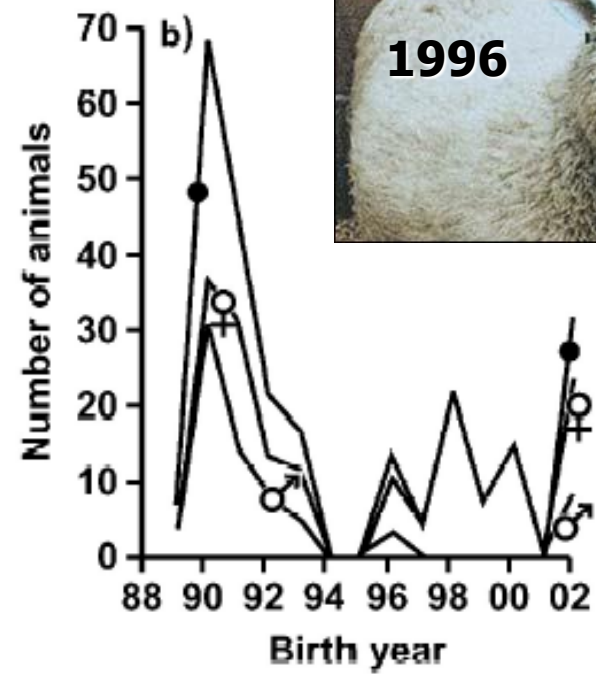
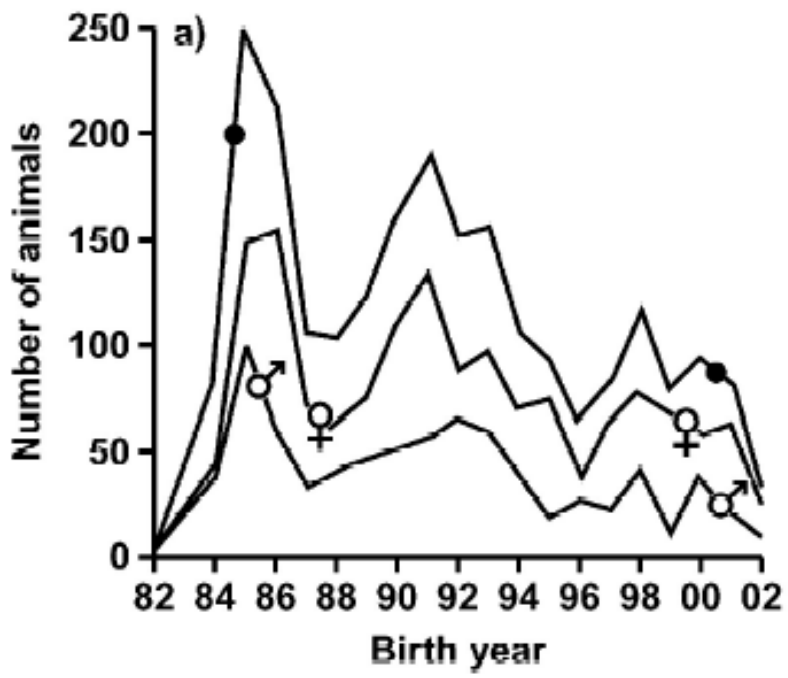
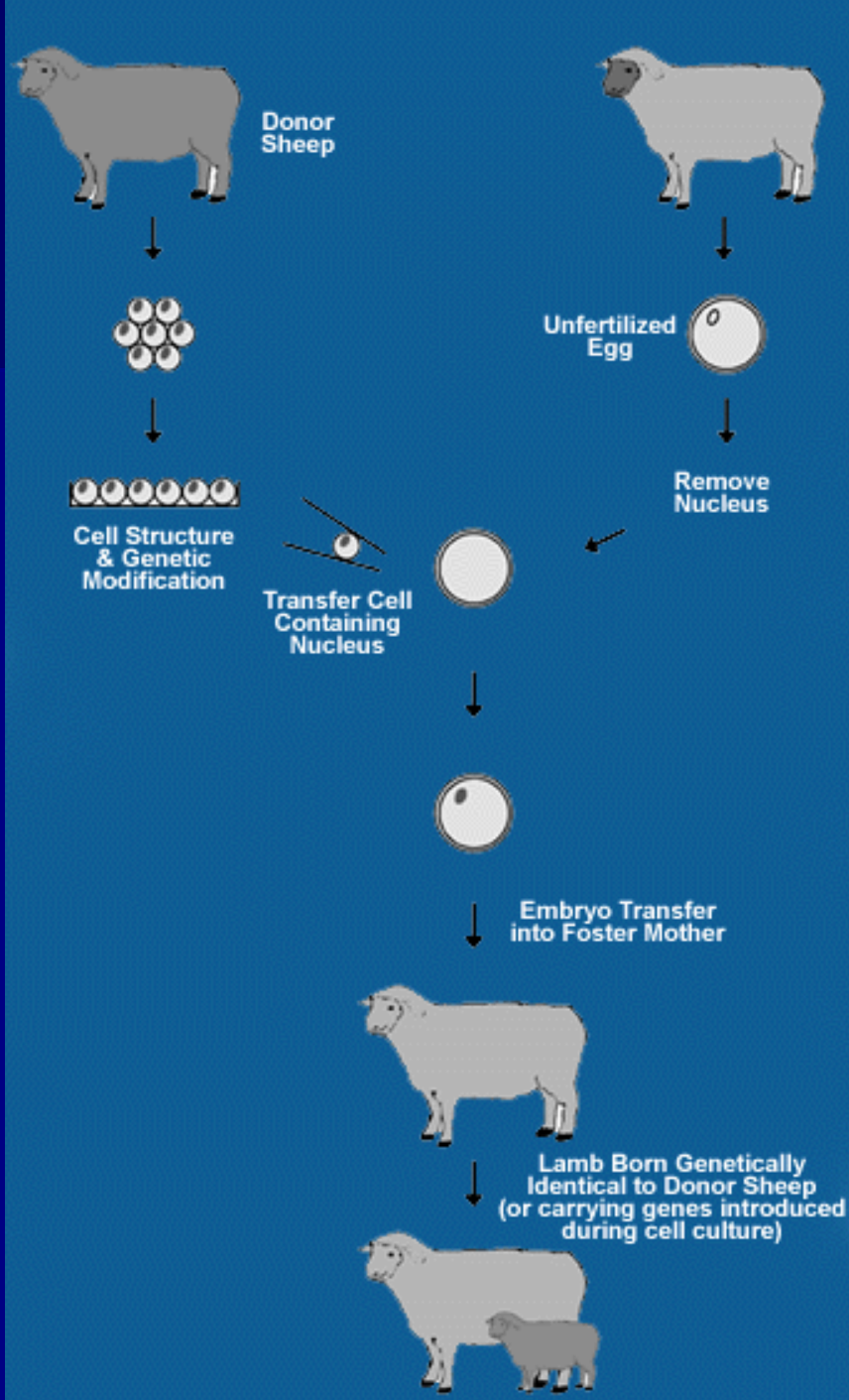


Figure 1. Numbers of registered US Holsteins resulting from a) embryo splitting or b) nuclear transfer by gender (all animals: ●, males: ♂, females: ♀) and birth year.

*Norman et al. Performance of Holstein Clones in the United States
J. Dairy Sci. 2004. 87:729-738



Dolly (1996), the first adult somatic cell nuclear transfer (SCNT) clone





Cloning rapidly became entangled with the debate over human cloning

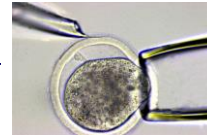
Ensuing discussion failed to elaborate on the reasons as to why cloning was developed



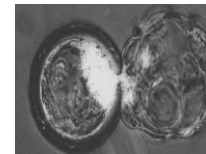
Nuclear transfer from an embryonic donor cell into an "empty" recipient egg.



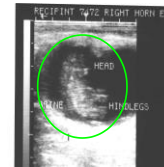
Donor Embryo



Donor cell nucleus is transferred to recipient egg



Cloned embryo is transferred to surrogate mother

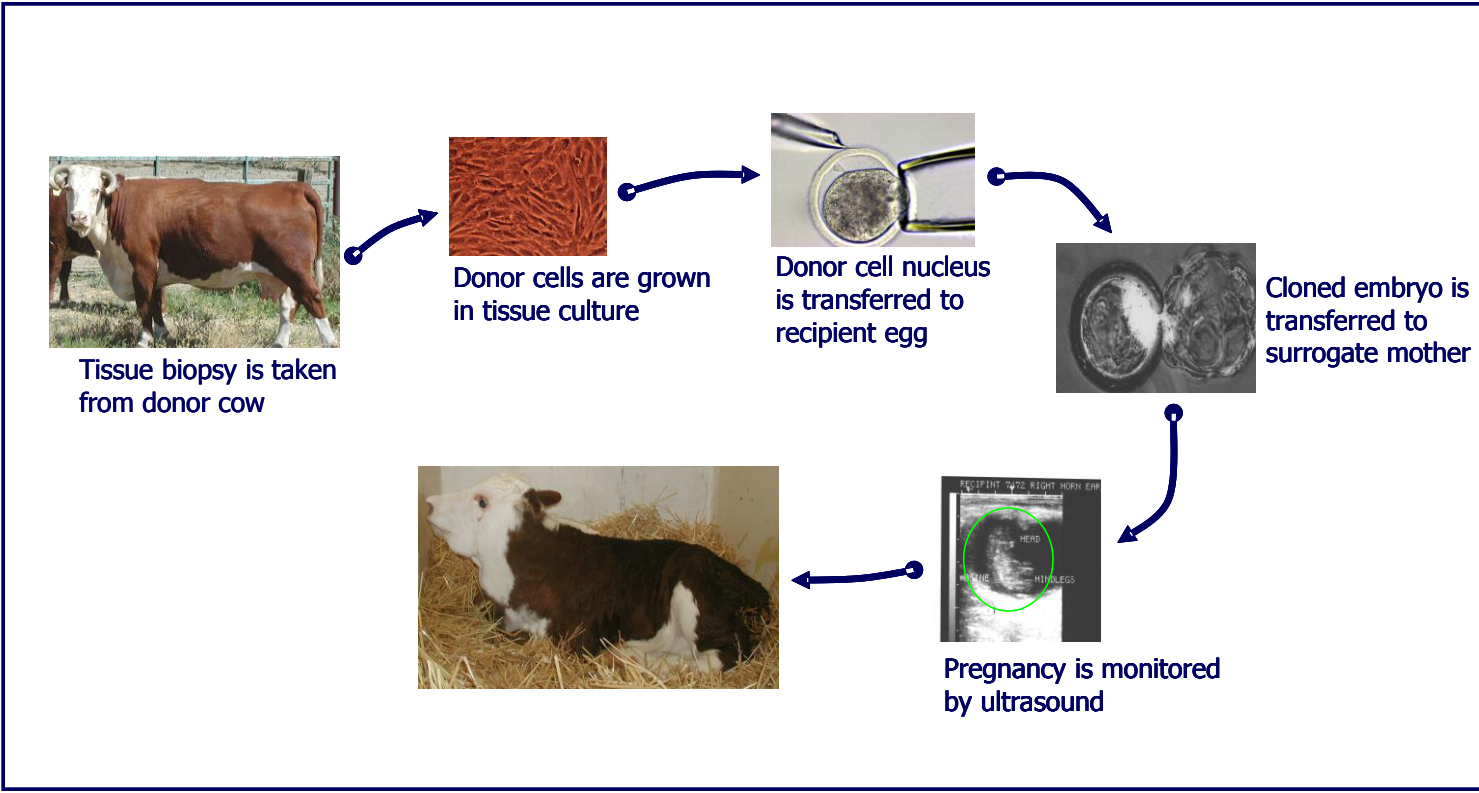


Pregnancy is monitored by ultrasound





Nuclear transfer from an adult donor cell into an enucleated oocyte.





Who's Buying?

Full Flush



A Club Calf Icon

His success is measured by the siring of Champion Club Calves across the U. S. His offspring have been named champions from County and State Fairs to being Champions at the prestigious Western National Stock Show. Full Flush was cloned because the demand for his semen was greater than what the founder Full Flush could produce.

Cloning price

1 st	\$15,000
2 nd	\$12,500
3 rd	\$10,000
4 th	\$7,500
5 th	\$7,000
6 th +	\$6,000



Born in November of 2001. Pictured are the five Full Flush Cloned Calves.

Photographed at a year of age see how the Full Flush Clones have developed.



Woodhill Evergreen 120



The Legendary Brood Cow

The Legendary Brood Cow that made history when she sold for \$200,000 in 1998 to become one of the Foundation Donors in the breeding program at Castle Hill Farms. Castle Hill cloned her because they wanted 120 to have a greater influence in their breeding program. Woodhill Evergreen 120's clone was born in March of 2002

George Hibbert, Manager at Castle Hill Farm, reports that the Clone of Woodhill Evergreen 120, "Castle Hill Evergreen C500", freshened on January 25, 2004 with a beautiful heifer calf. George says both calf and mother are doing great. George tells us "she is what we had hoped for when we cloned the 120 cow. She has been a trouble free heifer. She developed a nice udder and is raising an exciting calf".



George Hibbert, Manager of Castle Hill Farm, picking up his prize clone.



Glacier Rebalas 513

The Embodiment of a Brood Cow



Considered by many as the embodiment of a Brood Cow, Glacier Rebalas 513 has certainly influenced the Red Angus breed through her sons, Glacier Logan 210, Glacier Marias 548, Glacier Rebalas 901 to mention a few. R2 Ranch, LLC and Glacier Red Angus formed a partnership to clone Rebalas so that her influence would continue to be felt in their genetic programs.

Glacier Rebalas 513 (founder)



Two Clones born Oct 2002





JDJ MS CIGAR G58

Continuing To Transmit Through Her Clone



A tremendous Brood Cow for the Byrd Cattle Company. Ms Cigar was one of the early clones produced by Cyagra, Inc.



The clone BCC MS CIGAR 126-CLONE was born in March of 2001



She is Fresh!!!!

BCC MS CIGAR126-CLONE is the first clone produced by Cyagra to have her own natural calf. Calving in March of 2003 with an awesome bull calf. Pictured are MS Cigar 126-Clone and her natural calf.



Clone of Ms Mark K 111



Ms Mark K111's clone, KSU111, is first Hereford clone born in the spring of 2001

Ms Mark K111, founder, with her clone!





Feisty Fannie A World Leader in Horn



The 9 Lives of Feisty Fannie

The Clones Win 3 Classes at the Horn Showcase!
Eileen Feisty Leigh CF2 came in with an astounding 67 " to win Division II Class C.
Starr Feisty Leigh CF2 measured in at 63 1/4 " to win Class Bin the same Division.
Finale Feisty Leigh CF2 finished on top of Class A in Division II with a measurement of 61 3/8".
 It was a site to behold the nine clones and there founder Feisty Fannie all line up in the pens at the 2005 Fall Horn Showcase in Ft. Worth, Texas

The World's Longest Tip to Tip Horn Female of the Texas Longhorn Breed is Day's Feisty Fannie. Her record setting measurement of 80 3/4" at the Horn Measuring in November 2005 marked her as the World's First 80" Longhorn Tip to Tip.

Feisty Fannie's Clones are starting the next phase on their genetic contribution to the Moser herd. They are **starting to freshen!** The excitement begins to see which mating will be the best.

Clone Continues at World Record Pace

Eileen Feisty Leigh CF2 hits the coveted 70 inch Tip to Tip mark. At just 33 months of age Feisty Leigh has set the mark that all others will strive for in the future. Most Longhorns are Mature animals before they reach this mark. What is even more exciting is that her 8 clone mates are not far behind her.

At what age will Feisty Leigh surpass her Founder?



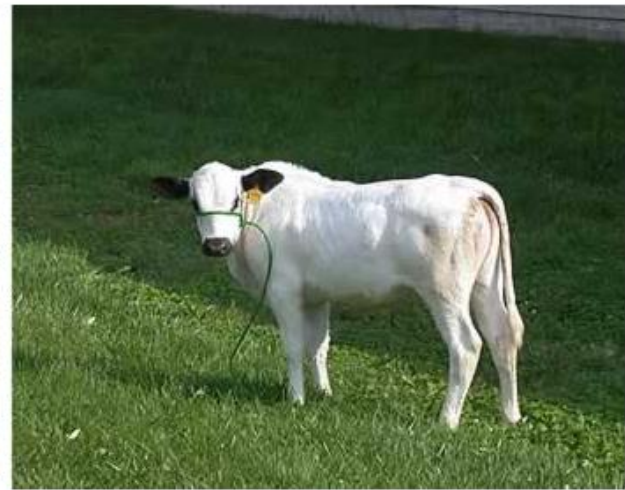


"Houdini"

A Legend Among Bulls



This Houdini is not a magic act. He is the real thing, all bucking, twisting, and thrashing bit of him. Houdini is considered to be the greatest sire of bucking bulls in the Rodeo Business. With his advancing age it was an easy choice for Homestead Genetics to proceed with cloning him. "We will need another Houdini for semen production when the founder needs to retire", says Gene Baker





Who's Buying?

"Alicia"



An International Star

Winner at the prestigious International Dairy Show in Madison, WI and at the Royal Winter Fair in Canada, Shoremar S Alicia was cloned in 2001. The clone calf, born in winter of 2002, was one of the favorites when she was at Cyagra. Using the merchandising options that cloning creates, Alicia's owners sold Alicia's Clone before it was born for \$100,000 in October of 2002.

Shoremar S Alicia 3E-97
6-10 2x 365d 35,760 4.3 1541 3.2 1147
All-American Age Cow 2003
All-American & All-Canadian 5-Year Old 2000
All-American People's Choice Winner 2000
Holstien International Cow of the Year 2000
All-Canadian 4-Year Old 1999
All-Canadian Jr. 2 Year Old 1997
Nominated for Qll – Queen of the Breed 2004



Shoremar BKB S Alicia 2-ETN
VG - 88 (VG-MS)
She is working on her 2 Year Old Record



Problems with Cloned Cows (aka Large Offspring Syndrome)

- Placental abnormalities.
- Fetal overgrowth, prolonged gestation.
- Stillbirth, hypoxia, respiratory failure and circulatory problems, lack of post-natal vigour.
- Increased body temperature at birth.
- Malformations in the urogenital tract (hydronephrosis, testicular hypoplasia).
- Malformations in liver and brain.
- Immune dysfunction, lymphoid hypoplasia, anaemia, thymic atrophy.
- Bacterial and viral infections.



- 10 years after Dolly, between 1 and 10% of cloned embryo transfers result in live births
- 42% of cloned calves die between delivery and 150 days of life; the most common abnormalities were: enlarged umbilical cord (37%), respiratory problems (19%), calves depressed/ prolonged recumbency (20%) and contracted flexor tendons (21%).



Potential applications – “Game changing”

- Production of superior clonal lines of dairy females or superior herd bulls
- Genetically identical herds well suited to a particular ranch environment
- Cloned animals at slaughter would be the ultimate in genetic consistency
- *Currently, pregnancy maintenance is too low and there is an unacceptably high percentage of abnormal calves born.*



Likely applications – “Incremental”

Until success rates improve significantly
(to approximately equivalent to AI)

- Genetic insurance policy
- Very valuable breeding animals
- Valuable “novelty” animals with high resale value
- Rancher’s favorite cow
- Pharmaceutical production ie clone genetically modified cells to make drugs in a mammalian system



The FDA continues to call for a voluntary prohibition of the marketing of milk or meat from adult SCNT clones and their offspring



Are the milk and meat from SCNT clones safe for human consumption?

1. All studies have shown that food products derived from clones fall within normal industry standards or previously reported values for milk and meat.
2. Sample sizes are small in all studies – although there are an increasing number of studies published

FDA ASSESSMENT OF ANIMAL CLONING (12/06)

“food products derived from animal clones and their offspring are likely to be as safe to eat as food from their non-clone counterparts, based on all the evidence available.”



Animal Welfare Concerns

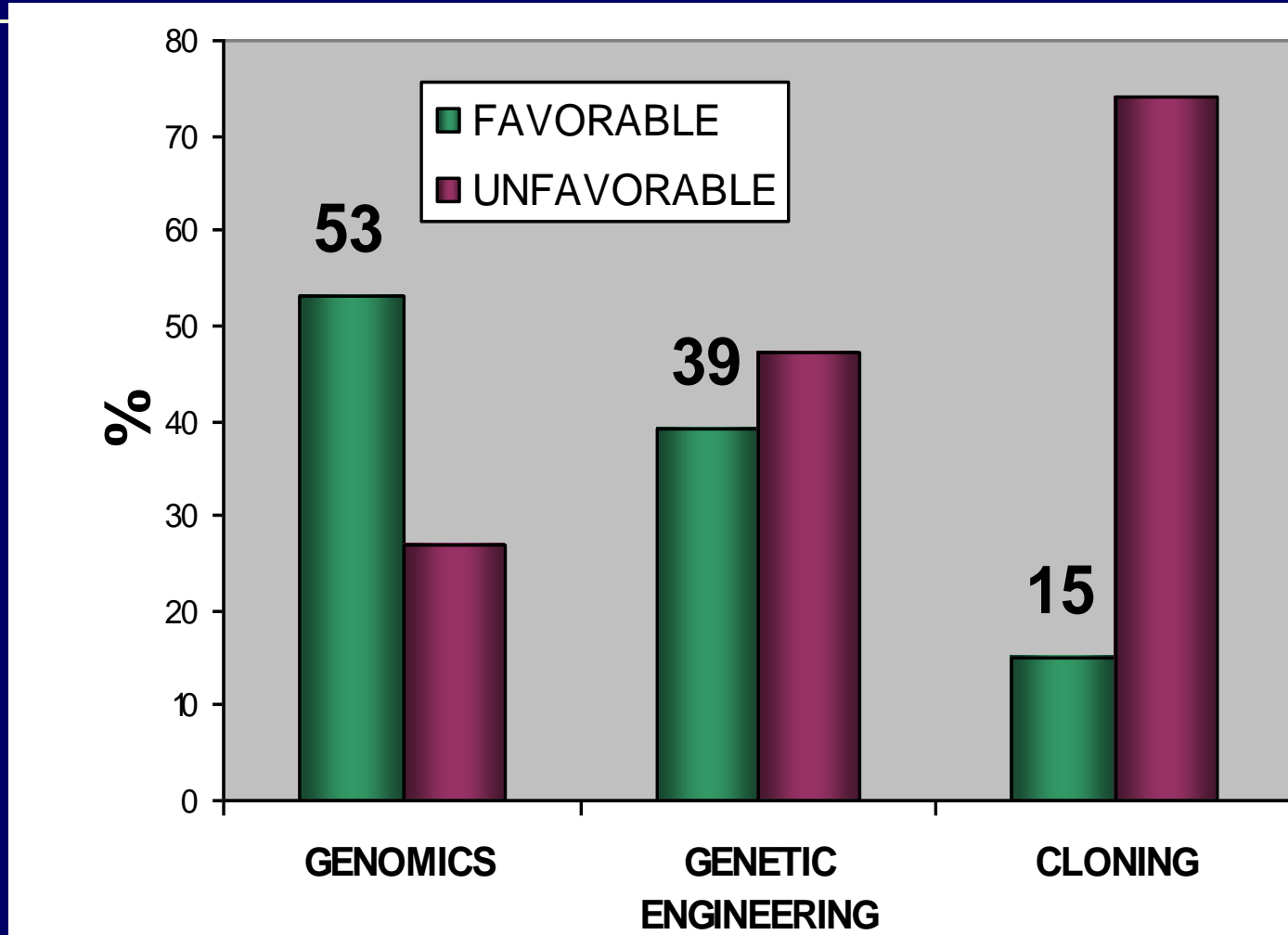
- Large calf syndrome
- Under-developed respiratory, cardiovascular, and renal systems

FDA ASSESSMENT OF ANIMAL CLONING (12/06)

“Cloning technology does not present any type of risk that is not present with other forms of reproduction. However, the adverse outcomes may occur at a higher frequency with cloning than with other assisted reproductive technologies now in common use, such as *in vitro* fertilization or embryo transfer.”



Public Attitudes Towards Specific "Animal Biotechnologies" (IFIC, 2005)





"The public opposes animal biotechnology.."



- The majority (56%) of Americans oppose scientific research into genetic modifications of animals.

<http://pewagbiotech.org/research/2005update/2005summary.pdf>

- In a survey of New Jersey consumers, Hallman found that two-thirds of respondents disapproved of traditional animal crossbreeding techniques and half found them "morally wrong".

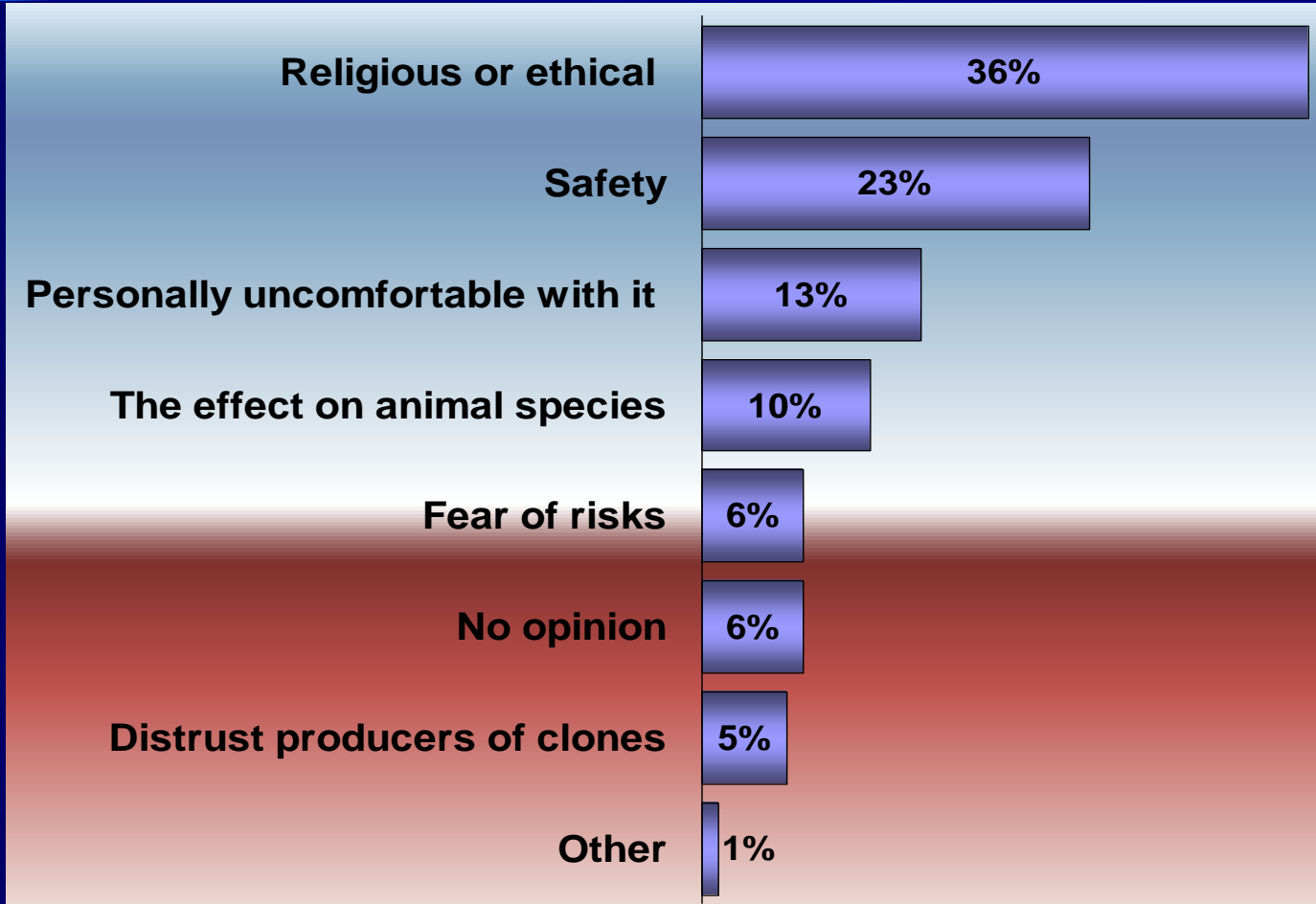
Schilling, B. J., Hallman, W. K., Adelaja, A. O., and Marxen, L. J. 2002. *Consumer Knowledge of Food Biotechnology: A Descriptive Study of U. S. Residents*. Food Policy Institute, Cook College, Rutgers - The State University of New Jersey. 25p. <http://www.foodpolicyinstitute.org/>

The public opposed the genetic modification of animals





Of the Americans who are uncomfortable or unsure about animal cloning; their primary concern is:





What clones will be labeled?

- Several legislative bills calling for the mandatory labeling of products derived from clones **and their offspring** have been introduced at the state and national level.
- What is not clear is whether the intent of such labels is to address food safety concerns or ethical misgivings.
- If it is the latter, then it is unclear why clones produced using embryo splitting and embryonic cell nuclear transfer techniques should be exempt from these labeling requirements.



Question to processors who plan to ban clones.....

Do you plan to monitor and prevent the milk and meat from clones created by embryo splitting and embryonic cell nuclear transfer from entering your processing chain?

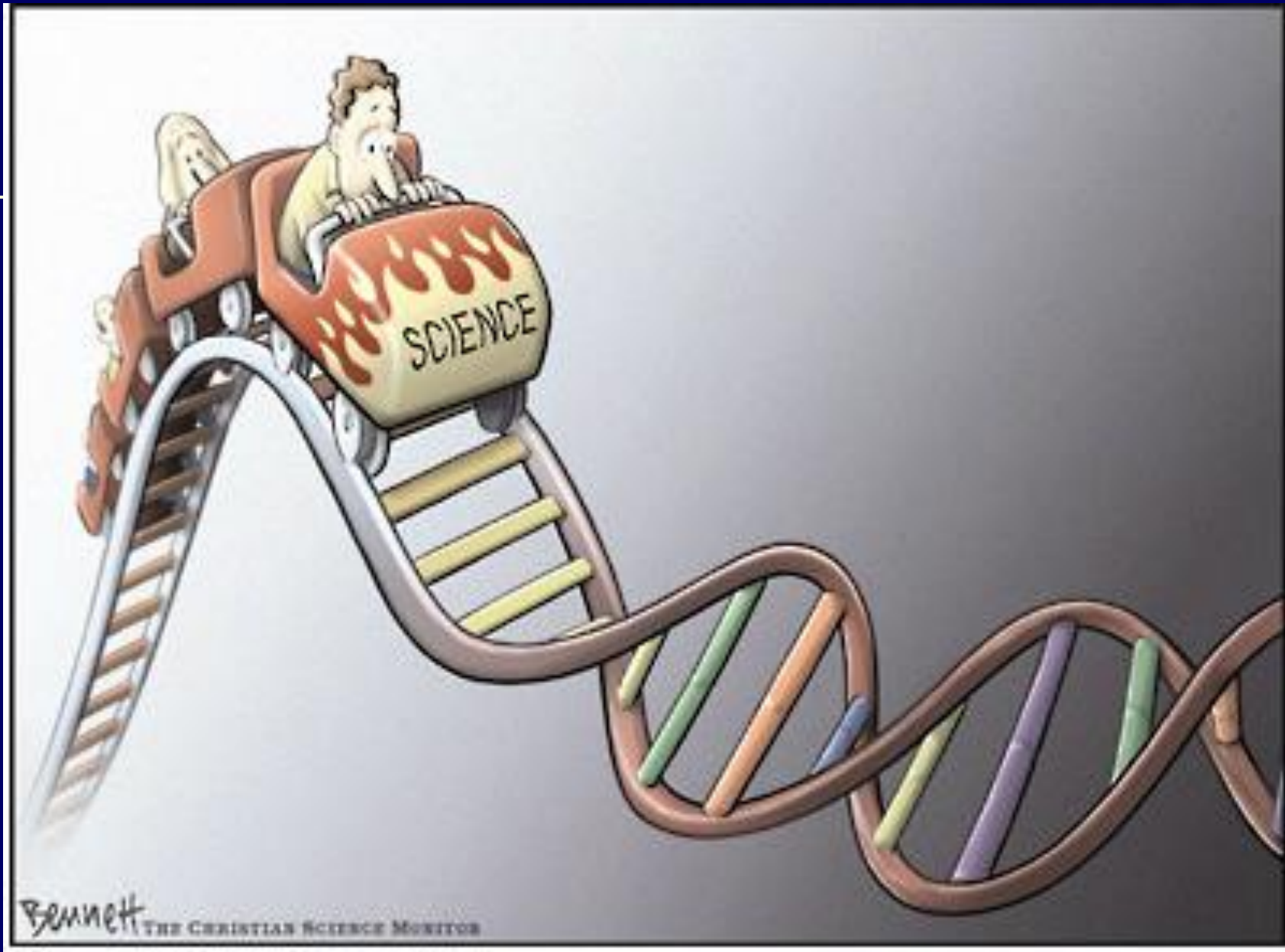
The term "clone" encompasses more than that specific subset, and it may in fact include animals that are currently being used in your supply chain. Estimates for the prevalence of these clones currently in the food supply are difficult to find as these animals are not specifically tracked in any way.



SUMMARY



- **Embryo split and embryo nuclear transfer clones have been in the food supply for over 20 years.**
- **Unlikely that clones will be produced in large numbers for commercial agricultural purposes.**
- **A voluntary moratorium on marketing products from adult SCNT clones and their progeny has been in effect for over 6 years despite the finding that clones and their progeny are as safe to eat as food from non-clones.**
- **Ethical and animal welfare concerns dominate the public discussion about cloned animals.**



Bennett
THE CHRISTIAN SCIENCE MONITOR