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ANIMAL BIOTECHNOLOGY:
Knowledge Gap Breeds Distrust

A recent national study of public knowledge about biotechnology, genetic engineering, and genetic modification by Rutgers University found that the majority of Americans claim to know "very little" (55%) or "nothing at all" (22%) about biotechnology. While this may not be totally unexpected, what is significant is that the majority of people interviewed also disapprove of animal biotechnology, including those claiming to know "nothing at all" about the topic. In other words, we don't know much about it, but if we did we're quite sure we wouldn't like it.

This knowledge gap and related discomfort is particularly evident with animal biotechnology. The public experience with animal biotechnology often starts and ends with Dolly, the first mammal cloned from an adult cell. The hype that surrounded Dolly rapidly became entangled with the debate over human cloning, and perhaps failed to spell out the potential importance of animal cloning and biotechnology. Animals occupy a special place in our culture and are often considered to be an important member of the family. It is therefore perhaps not surprising that the self-reported majority, who know little to nothing about biotechnology, disapprove of the relatively recent science which engages in the sinister-sounding "genetic modification" of animals.

In addition to being our companions and providing our milk and often our dinner; animals also occupy a special place on our evolutionary tree. We share a large number of genes and biochemical pathways with animals, and many of the organs in our bodies function identically to those found in other mammals. This biological similarity means that animal biotechnology has a unique potential for life-saving applications in human medicine. Behind Dolly and many of the current efforts in animal biotechnology lies the need not just for healthier farm animals and better foods, but also for more available organs for transplantation and more effective medicines.

Thousands of critically-ill people die each year waiting for a suitable organ or tissue donation for transplantation. Pigs offer a potential source of suitably-sized organs for transplantation into humans. But organ transplantation from pigs is currently not feasible because human antibodies react to molecules present on the cell surface of pig tissue, causing tissue rejection. Scientists have used a genetic modification technique to "knock out" the pig genes that produce these cell-surface molecules, and have produced cloned pigs that do not have these rejection-causing molecules on the surface of their cells. Further research to evaluate the survival of transplanted organs from these pigs is underway to evaluate the potential of this technology as a solution for the worldwide shortage of organs and cells for transplantation.

Biotechnology also is responsible for a large increase in the number of approved medicines called "protein drugs," and for an even larger increase in the number of protein therapeutics now being used in clinical trials. Many human therapeutics, such as monoclonal antibodies used to treat cancer, require correct configuration and animal-specific modifications to be effective.

This means that the production of many human protein drugs cannot be carried out in bacteria or plants, but rather is confined to the cells of mammals. Mammalian cell culture, however, is very expensive and low yields limit the amount and number of different proteins that can be developed.

Consequently, researchers are attempting to address this problem by producing therapeutic proteins in the milk of domestic farm animals. The major function of the milk-producing mammary gland is to produce proteins. Transgenic animals – that is animals carrying an additional segment of DNA encoding the therapeutic protein – produce this one additional protein in their milk. These animals and their milk are not intended to enter the food supply, but rather to produce these potentially life-saving proteins in their milk. With hundreds of protein therapeutics currently in clinical trials, transgenic animals may become an important source of these protein drugs as they become available to the patient.

While animal biotechnology holds great promise, it is not without its problems. Although transgenic animals have the potential to produce medicines, no drug produced this way has yet reached the market. This is not a reflection of problems with the science, but rather with the long time frames involved in the production of transgenic animals. The total time from introducing a new gene into a female goat until that goat gives birth and begin producing milk is about 18 months. The time frame is even longer for cattle. Cloning livestock, a technique for producing exact replicas of a certain animal from a single cell, is also a timely process with low success rates. Researchers are actively investigating the reasons for this low efficiency.

The final and probably most important obstacle facing animal biotechnology is public acceptance. Some people oppose the use of animals for any purpose, others are concerned with the genetic manipulation of animals, and yet others are specifically concerned with the use of animal biotechnology for the production of food. Reasons for this opposition include varying personal beliefs, animal welfare, food safety, and ethical concerns. But what is perhaps most troubling is that some people are opposed to the technology even though they acknowledge having little or no knowledge of the topic. It would be unfortunate if the balance of public opinion was formed in the absence of relevant, factual information.