Transgenic Goat's Milk Offers Hope for Tackling Children's Intestinal Disease

August 4 2006

It's hard to improve on milk, but animal scientists at the University of California, Davis, have found that milk produced by transgenic goats, which carry the gene for an antibacterial enzyme found in human breast milk, altered the intestinal bacteria in young goats and pigs that were fed the milk.

The researchers hope these findings will one day lead to milk that protects infants and children against diarrheal illnesses, which each year kill more than 2 million children worldwide, according to the World Health Organization. The results of their study will be reported in the August issue of the international journal Transgenic Research.

"This goat's milk represents one of the first transgenic food products that has the potential to really benefit human health," said Professor Jim Murray, who led the study along with Professor Gary Anderson and animal scientist Elizabeth Maga. "The results of the study indicate that the protective, antibacterial characteristics of lysozyme-rich human breast milk are also present in milk produced by transgenic goats that carry the gene for lysozyme."

Lysozyme is a protein found in the tears, saliva and milk of all mammals. It is found at high levels in human breast milk, however goat's milk contains only 0.06 percent as much lysozyme as does human milk. Lysozyme inhibits the growth of bacteria by destroying the bacterial cell wall, causing the contents of the cell to leak out.

Because lysozyme limits the growth of bacteria that cause intestinal infections and diarrhea, and encourages the growth of beneficial intestinal bacteria, lysozyme is considered to be one of the main components of human milk that contribute to the health and well-being of breast-fed infants.

For more than a decade, UC Davis researchers have been looking for ways to enrich the milk of cows and goats with some of the beneficial compounds like lysozyme that are found in human breast milk. About eight years ago, they used gene-transfer technology to develop a line of transgenic dairy goats that carry the gene for human lysozyme and, consequently, produce human lysozyme in their milk.

In this study, the researchers fed pasteurized, lysozyme-rich milk produced by transgenic dairy goats to young goats and pigs. Pasteurized milk from non-transgenic goats was fed to the control group of pigs and goats.

The pigs were chosen because they have a digestive system similar to humans and are often used as a research model for humans. In this study, the pigs provide a glimpse of how such milk might impact people's digestive systems.

The kid goats were chosen for the other model in order to study the effect of the transgenic milk on ruminants -- animals like goats, sheep and cows -- which have multichambered stomachs.

In both animal models, the results of this study indicated that the milk from the transgenic goats was impacting the growth of digestive-tract bacteria -- although with opposite results.

The young pigs fed the lysozyme-rich milk from transgenic goats had lower levels of coliform bacteria in the small intestine, including fewer

Escherichia coli (E. coli), than did the control group of young pigs that were fed milk from non-transgenic goats. Some strains of E. coli can cause severe intestinal illness.

However, the kid goats fed lysozyme-rich goat's milk, had higher levels of coliform bacteria and roughly the same level of E. coli, compared to control group.

Both the kid goats and the young pigs were healthy and exhibited normal growth patterns.

"Although the effects were different in the goats than in the pigs, the study demonstrates clearly that the consumption of pasteurized goat's milk containing human lysozyme can impact the bacterial makeup of the digestive tract in these two distinct animal models," Maga said. "It is likely that the differences observed in the two species were due to the fact that goats, being ruminants, have a different digestive system and different collection of bacteria than do the pigs, which have only one stomach."

Maga and Murray suggested that larger, more in-depth studies are needed to examine other possible benefits of the lysozyme-rich milk from the transgenic goats.

"This study underscores the potential for using biotechnology to improve the healthfulness of the milk of dairy animals by introducing the beneficial properties of human milk into dairy animals," Murray said.

He and Maga note that this procedure could be used to produce lysozyme-rich powdered milk and eventually transgenic dairy goat herds for developing nations, where intestinal diseases threaten the lives of infants and children. They project that the potential for even more widespread benefit could be realized if this technology is applied to

dairy cattle, rather than goats, because the volume of milk available from cows would be much larger than from goats.

Source: UC Davis