



Mother's Milk Cures Cancer?

Researchers Deliberate Over Whether to Publish

by

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Section I - "The Discovery"

The winter days had become too short. It always seemed like twilight in this country so close to the Arctic Circle. The sky remained grey even in the midday light. It was three o'clock, and the coffee break she had just taken had refreshed her somewhat. As she prepared to run the last samples of the day, she took her glasses off and rubbed her eyes, then rested her head in the palm of her cool hands for a few minutes. Somehow she just couldn't seem to shake the mid-December depression she was feeling. She could hear the students arguing in the laboratory next door. They seemed to be quite distracted from their usual afternoon daily lab meeting where the day's findings were discussed and plans were made for the next day's work. A sharp knock at her door jarred her into her formal posture reserved for colleagues and students.

"Dr. Svanborg?"

Maybe it was the new medication she was taking, but Catherine Svanborg just couldn't seem to focus. Or maybe it was the deadline coming up in two weeks for the NIH grant she was preparing. She would be spending Christmas alone again, as she gave way to the last-minute details involved in writing her yearly report of findings. Ever since joining Lund University as a research associate in 1990, she had been trying to build a reputation as a serious authority in immunology. Recognition in the form of a grant from a prestigious organization would place her in that category.

"Can this wait until tomorrow?" she asked.

The student replied that it couldn't wait — that she might find what was going on in the next room very disturbing. The student was one of Dr. Svanborg's most promising researchers. He had been working on the effects of various protein extracts of human breast milk on virally infected tissue cultures and was making good progress toward isolating factors that activated the immune response toward the retrovirus.

"Dr. Svanborg! Really, you must come look at this tissue culture of cancer cells I've got under the fluorescent microscope. Something very weird is happening, and we can't agree on what it is!"

In the next few minutes he showed her something that would send shivers of excitement through her body — like the time she received the letter announcing her election as a bona fide fellow to the Royal Academy of Science of Sweden.

Svanborg looked into the microscope. Did she actually see what she thought she was seeing? Another look confirmed that the cancer cells were indeed "committing suicide!" Without looking away, she drew

a lab stool under her to steady her trembling knees. For the next half-hour, she stared into the scope, and yes, something was causing the cancer cells to “explode” from within!

The news her student had brought seemed completely unrelated to the topic he was actually researching. He had been looking for how mother’s milk fights viruses in tissue culture. The virus is introduced into the cancer cells (or the culture) and treated with milk components to see if there is an increase of viral destruction. What he observed — the cancer cells “committing suicide” — wasn’t typical because normally they reproduce forever without dying, a kind of cell-line immortality. That immortality makes cancer cells a good medium for tissue culture. Normal human cells commit suicide every day. The process of cellular suicide is called *apoptosis*. What the graduate student found was a protein factor in the milk that induced the cultured cells to die.

Questions About Science

1. Why are cancer cells or abnormal cells used in tissue cultures even when researchers are not studying cancer? Explain how a cancer cell differs from a normal cell.
2. What is known about the life expectancy of most normal cells? Review the cell cycle and the mechanisms for regulating normal cell division. What happens when the regulatory mechanisms go awry in normal cell division?
3. What is the scientific name given to a cell’s committing suicide? Why would cells commit suicide normally?
4. Predict what would happen if normal cells did not commit suicide during fetal development.

Section II - “Response of the Scientific Community”

As good as this news sounded, Dr. Svanborg knew it would be extremely difficult to convince her science colleagues that the work of her student was for real. First of all, she normally worked with microorganisms that cause infectious diseases. Moreover, with only three undergraduate virology students and two doctoral students, her laboratory wasn't considered large by most standards. She knew her lab didn't qualify as a “high-profile, big science institute.” Examples of institutes with that level of prestige were the NCI, the National Cancer Institute, and NIH, the National Institutes of Health. So how would she go about explaining and reporting these recent findings to the scientific community and maintain her reputation?

Dr. Svanborg decided to call her trusted friend and colleague David Solomon, a cancer researcher at NCI, and share the discovery with him.

His response was immediate. “Cathy, don't do it! Don't risk being labeled an unreliable researcher by the scientific community!”

David continued, “You know that novel ideas in science always challenge the current paradigm, and acceptance is slow. Your work will not be taken seriously by the scientific community initially. And you are not at a stage in your career to take that kind of a risk.” His advice was to postpone reporting her findings until she had more evidence.

“You know,” he added, “if this work had come from a well-known lab like mine here at the NCI, you'd have reporters calling six days to Sunday wanting your story. You'd have scientists eager to collaborate, and grant money to do whatever you wanted. But it's coming from your small lab in a foreign country. It's like General Motors versus a mom-and-pop garage operation.”

Catherine was able to take his criticism in stride because he had been her ally for more than 25 years. As graduate students, they had worked together under an important researcher who used immunotherapy to treat cancer. Besides, she knew better than to risk her reputation by reporting a discovery without hard evidence to support her conclusions.

Questions About Science and Politics

1. What is meant by “big science” and “high-profile” research?
2. What and where is the National Cancer Institute? Where does the funding come from to support the work of the institute? Discuss how scientific research is funded in Sweden. How might funding be different there than in the U.S.?
3. Why did Dr. Solomon say that novel ideas in science always challenge the current paradigms? Isn't science supposed to be about new ideas? Try to justify what he meant by his statement.
4. What does the discovery of cancer-killing effects of breast milk while looking for effects of milk on viruses tell you about the process of science?

Section III - “The Research”

In her background research of the literature, Dr. Svanborg discovered a piece of evidence from 1995 that lent support to her hypothesis that human milk can protect against cancer. The study showed that the risk of childhood lymphoma is nine times higher in bottle-fed than breast-fed infants. She and her students wondered if there was some connection between the two situations.

Svanborg and her group began to analyze breast milk more thoroughly and eventually discovered that the actual component of breast milk that was killing cancer cells is a protein called alpha-lactalbumin (sometimes called *alpha-lac*). In January 1999, they finally released results demonstrating that in the acid environment of an infant’s stomach, the normal alpha-lac protein changed shape and transformed into a killer of cancer cells (or other potentially harmful cells, such as pneumonococcus bacteria). Her research group named the altered protein, *HAMLET*, for Human Alpha-lactalbumin Made Lethal to Tumor cells. By genetically altering bacterial cells, they were able to mass-produce the factor as is commonly done in the production of human insulin.

Now that they had produced *HAMLET* in sufficient quantities for research, it was ready to be tested in animals with tumors and then on human subjects with cancer. The team believed that the substance should not be toxic to animals because it was a naturally occurring protein in breast milk. If found to be useful in cancer treatment, it would represent a great advance over the toxic cancer drugs currently in use with their high risk of negative side effects.

Questions About Science

1. What are the contents of human breast milk and how does it differ from commercially available milk from cows and soybeans?
2. Discuss the immune components of breast milk.
3. How does the fact that infants raised on breast milk were nine times less susceptible than bottle-fed infants to lymphoma demonstrate that there may be a link between something in human milk and cancer-cell destruction? Could there be something other than the actual breast milk that lowered the rate of lymphoma in breast-fed children? How can a scientist be sure that the link is actually related to breast milk? Discuss how these links are actually substantiated by the scientific community.
4. How does protein shape relate to function? How might shape be altered other than changing pH of an environment?
5. How do researchers mass produce a protein such as *HAMLET* through genetic engineering?
6. Describe a mechanism whereby a protein actually causes cell death in tumor cells and bacteria.
7. What are the disadvantages of modern chemotherapy in curing cancer? Why would a naturally occurring protein be a great advance in treating cancer?

Section IV - “From the Lab to the Pharmacy”

To produce the quantities of material needed for animal research, Dr. Svanborg’s research group used genetically engineered *HAMLET* factor in bacterial cells. The methods they used were similar to the way insulin is produced for mass marketing. Once a protein has been isolated, a copy of the DNA can be made and inserted into a plasmid. Plasmids are vectors of the gene of interest that are placed into bacterial cells. Once a line of bacterial cells with the transformed plasmid is reproducing successfully, they are grown in large vats like the ones used in microbrewing beer. The protein product is extracted from the vats and tested first on animals. If the animal tests go well, human testing can then begin.

Human testing normally is done in three stages. The first stage is performed on animals to test for safety and merit. Then a limited number of people will be used to see if tumor cells are killed in humans. The final test is conducted with a large group study involving many trials and controls. This type of testing may take several years before final approval of the substance is granted for pharmaceutical use.

If the alpha-lac (*HAMLET*) factor can kill cancer cells in humans, then it will not be long before the pharmaceutical companies will get involved, but they must be convinced that the work is worth their attention. Often, naturally occurring drug products are labeled “orphan drugs” and are not marketed to the general public. Would this alpha-lac component of human breast milk be treated as such?

All in all, Dr. Svanborg was happy with the progress they had made. “When we started doing research here in this little town in this little country on the edge of the known world,” she mused to herself, “few people were aware of it. Now that this enormous opportunity has come to us, we want the world to know it.”

Questions About Science and Economics

1. Why would a scientist like Dr. Svanborg be reluctant to publish too soon an idea that breast milk fights cancer?
2. Why is testing on humans done in three stages? Why can’t the process be hurried up if it is known that a substance can kill cancer cells and ultimately cure many people with a dreaded disease? What is the procedure for clinical testing of a potential new therapeutic agent in the U.S. and in other countries if it is categorized as an “orphan”?
3. Why might drug companies be reluctant to support research on *HAMLET*? How might the caution of drug companies actually delay scientific progress?
4. How would drug companies come to support a laboratory such as Dr. Svanborg’s?
5. Is the alpha-lac discovery patentable?
6. If Dr. Svanborg and a drug company were to team up, who would claim the rights to this treatment methodology?
7. If drug companies do not decide to pursue the development of the alpha-lac treatment, could or should cancer patients take matters into their own hands and attempt to purchase human breast milk directly from lactating women? What implications might that practice raise?

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