

# HIV in breastmilk killed by flash-heating, new study finds

22 May 2007



Materials used for the demonstration included cow's milk, a locally purchased glass jar, a locally purchased aluminum pan, and a small charcoal stove that is commonly used for cooking. The temperature probes used in the test are not required in actual practice. Credit: UC Berkeley

A simple method of flash-heating breast milk infected with HIV successfully inactivated the free-floating virus, according to a new study led by researchers at the Berkeley and Davis campuses of the University of California.

Notably, the technique - heating a glass jar of expressed breast milk in a pan of water over a flame or single burner - can be easily applied in the homes of mothers in resource-poor communities.

The findings, to appear in the July 1 print issue of the *Journal of the Acquired Immune Deficiency Syndromes*, but now available online, provide hope that mothers with HIV in developing nations will soon be able to more safely feed their babies.

"We conducted this research to help HIV-positive mothers and their infants who do not have safe alternatives to breastfeeding," said Kiersten Israel-Ballard, a doctoral candidate at UC Berkeley's

School of Public Health and lead author of the study. "HIV can be transmitted to the baby via breastfeeding. But for infants in developing countries where infant mortality is already so high from diarrhea and other illnesses, they can't afford to lose the antibodies, other anti-infective agents and the optimal nutrition found in breast milk. This study shows that an easy-to-implement heating method can kill the HIV in breast milk."

This line of research began when HIV-positive women in Zimbabwe asked how they could make their milk safe for their babies. Israel-Ballard conducted a study there that indicated that HIV-positive women wanted to attempt the flash-heating method. The World Health Organization (WHO) recommends heat treating HIV-infected breast milk, but there has been little research into a simple method that a mom in a developing country could use.

Studies by this research team have shown that flash-heating breast milk can kill bacteria while retaining most of the milk's nutritional and antimicrobial properties, as well as a majority of its important antibodies.

"Many people in this field were skeptical that this would work," said Barbara Abrams, UC Berkeley professor of epidemiology and maternal and child health, and senior author on the study. "We wanted to be sure that there was scientific evidence that flash-heated milk was truly free of HIV, nutritious and immunologically beneficial. This study was done in response to the concerns of the mothers in Zimbabwe, and in addition provides evidence that field studies are warranted."

Banks that collect, store and dispense human milk already pasteurize milk, but the method they commonly use requires thermometers and timers that may be hard to obtain in resource-poor communities.

Flash-heating is a type of pasteurization that brings the milk to a higher temperature for a shorter period of time, a method known to better protect the anti-infective and nutritional properties of breast milk than the one typically used in human milk banks. Moreover, the low-tech materials used for this study are readily available in local communities in the developing world, and the heating method can be easily incorporated into a mother's normal daily routine.

Of the 700,000 children who become infected with HIV each year, an estimated 40 percent contract the virus from prolonged breastfeeding. WHO recommends that HIV-positive mothers avoid breastfeeding when safe feeding alternatives are available.

But in regions of the world where mothers cannot afford the cost of infant formula, water is contaminated, or other socio-cultural conditions make replacement feeding difficult, WHO recommends exclusively breastfeeding for up to six months.

"The risks and benefits of heating HIV-contaminated breast milk are different for women in developing countries than for women in the United States," said Dr. Caroline Chantry, a pediatrician and infant nutrition researcher with UC Davis Children's Hospital, and co-author of the paper. "Here we have access to safe water and formula, so it makes less sense for HIV-positive mothers in developed countries to take the risks associated with feeding babies their breast milk."

Studies indicate that when babies are breastfed exclusively, there is a 3 to 4 percent risk of HIV transmission. However, when babies are given formula or other foods in addition to breast milk, there is a significant three- to four-fold increase in the risk of HIV transmission, possibly because allergens and contaminants in solid foods and formula can compromise the epithelial lining of a baby's digestive tract, making it easier for viruses to pass through.

For this reason, WHO guidelines have recommended that after six months of exclusively breastfeeding, HIV-positive mothers wean their

babies as soon as other foods are available. Even then, while weaning may decrease the risk of HIV transmission, studies have shown that it increases the risk of malnutrition, diarrhea and other diseases that can lead to infant mortality.

"Early cessation of breastfeeding has been tried in several recent studies, and the results suggest that stopping breastfeeding early increased the risk of infant illness, growth failure and death, and actually outweighed the risk of transmitting HIV through breast milk," said Abrams. "This has been a desperate dilemma for mothers in developing countries. Our method of flash-heating breast milk could be particularly important at the time the mother stops nursing. Roughly 300,000 infants contract HIV from breastfeeding each year. Even if only a small proportion of HIV-positive mothers in resource-poor countries can successfully express and flash-treat their milk, this simple, inexpensive and potentially sustainable method could still save thousands of babies from HIV infection while providing most of the health benefits of human milk."

This study reflects results from the first stage of research, headed by Abrams, into the effects of flash-heating breast milk. Chantry will head the next stage of field trials, which involve moving this technique out of the lab and into the homes of women in Africa. The researchers are seeking funding to assess the flash-heating method's feasibility for babies in local communities in developing countries.

"Clinical trials are urgently needed to substantiate that mothers can express, flash-heat and store their milk safely, and to test the impact of this method on actual HIV transmission," said Chantry. "What is important about this study is that women have the right to an informed choice. It's amazing to me that in our paternalistic society, people so often readily dismiss the possibility that women would be willing to express and heat their milk to prevent their babies from getting infected with HIV."

Of the 98 samples of breast milk collected from 84 HIV-positive women in Durban, South Africa, only 30 had detectable levels of HIV before heating. Not all breast milk from HIV-positive mothers contains

HIV naturally. Milk had been hand expressed into clean, locally purchased glass food jars provided by the researchers. Source: UC Berkeley

For each sample of HIV-infected milk, researchers set aside 50 milliliters in the original collection jars and used the remainder as unheated controls. The uncovered jars were placed in a 1-quart pan filled with 450 milliliters of water. The water and milk were heated together over a single-burner butane stove. Once the water reached a rolling boil, the breast milk was immediately removed and allowed to cool.

The researchers checked the temperature of the milk at 15-second intervals and determined that the flash-heated milk reached a peak temperature of 163 degrees Fahrenheit (72.9 degrees Celsius), and typically stayed hotter than 132 degrees Fahrenheit (56 degrees Celsius) for more than six minutes.

Viral analysis of the flash-heated and unheated breast milk found that cell-free HIV had been inactivated in all of the heated samples.

The researchers note that they used a reverse transcriptase (RT) assay to test for an enzyme produced by viable HIV since traditional tests for HIV do not distinguish between dead and live viruses. The RT test, however, cannot detect HIV within cells, but preliminary data suggest that flash-heat inactivates cell-associated HIV as well.

"We hope this technique will not only provide HIV-free breast milk that is safe to consume, but that the milk also retains the antibodies and nutrition that will help keep their infants healthy," said Israel-Ballard. "Mothers in Africa have told us they will do anything to keep their babies alive, and this work is ultimately about providing them with viable options to do just that."

Other co-authors of the paper are Richard Donovan and Haynes Sheppard, virologists at the California Department of Health Services; Anna Coutsoydis, professor of pediatrics and child health at the University of KwaZulu-Natal in Durban, South Africa; and Lindiwe Sibeko, a Ph.D. student in nutrition at McGill University.

APA citation: HIV in breastmilk killed by flash-heating, new study finds (2007, May 22) retrieved 23 May 2022 from <https://medicalxpress.com/news/2007-05-hiv-breastmilk-flash-heating.html>

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