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# Mother's Milk

## Not what we thought

RESEARCH
OPINION

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The Two Pennies's Post - Facebook November 28th, 2025

In 2008, Katie Hinde stood in a California primate lab staring at hundreds of milk samples. Male babies got richer milk. Females got more volume. Science had missed half the conversation.

She was a postdoctoral researcher at the California National Primate Research Center, analyzing milk from rhesus macaque mothers. For months, she'd been measuring fat content, protein levels, mineral concentrations. The data showed something she hadn't expected: monkey mothers were producing completely different milk depending on whether they'd given birth to sons or daughters.

Sons received milk with higher concentrations of fat and protein—more energy per ounce. Daughters received more milk overall, with higher calcium levels. The biological recipe wasn't universal. It was customized.

Hinde ran the numbers again. The pattern held across dozens of mother-infant pairs. This wasn't random variation. This was systematic.
She thought about what she'd been taught in graduate school. Milk was nutrition. Calories, proteins, fats. A delivery system for energy. But if milk was just fuel, why would it differ based on the baby's sex? Why would mothers unconsciously adjust the formula?

The answer shifted everything: milk wasn't passive. It was a message.

Hinde had arrived at this question through an unusual path. She'd earned her bachelor's degree in anthropology from the University of Washington, then completed her PhD at UCLA in 2008. While most lactation research focused on dairy cattle or developing infant formulas, Hinde wanted to understand what milk actually did in primate mothers and babies.

At UC Davis, she had access to the largest primate research center in the United States. She could collect milk samples at different stages of lactation, track infant development, measure maternal characteristics. She could ask questions that had never been systematically studied.
Like: why do young mothers produce milk with more stress hormones?

Hinde discovered that first-time monkey mothers produced milk with fewer calories but higher concentrations of cortisol than experienced mothers. Babies who consumed this high-cortisol milk grew faster but were more nervous and less confident. The milk wasn't just feeding the baby's body—it was programming the baby's temperament.

Or: how does milk respond when babies get sick?

Working with researchers who studied infant illness, Hinde found that when babies developed infections, their mothers' milk changed within hours. The white blood cell count in the milk increased dramatically—from around 2,000 cells per milliliter to over 5,000 during acute illness. Macrophage counts quadrupled. The levels returned to normal once the baby recovered.

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The mechanism was remarkable: when a baby nurses, small amounts of the baby's saliva travel back through the nipple into the mother's breast tissue. That saliva contains information about the baby's immune status. If the baby is fighting an infection, the mother's body detects the antigens and begins producing specific antibodies, which then flow back to the baby through the milk.

It was a dialogue. The baby's body communicated its needs. The mother's body responded.

Hinde started documenting everything. She collected milk from over 250 rhesus macaque mothers across more than 700 sampling events. She measured cortisol, adiponectin, epidermal growth factor, transforming growth factors. She tracked which babies gained weight faster, which were more exploratory, which were more cautious.

She realized she was mapping a language that had been invisible.

In 2011, Hinde joined Harvard as an assistant professor. She began writing about her findings, but she also noticed something troubling: almost nobody was studying human breast milk with the same rigor applied to other biological systems. When she searched publication databases, she found twice as many studies on erectile dysfunction as on breast milk composition.

The world's first food—the substance that had nourished every human who ever lived—was scientifically neglected.
She started a blog: "Mammals Suck...Milk!" The title was deliberately provocative. Within a year, it had over a million views. Parents, clinicians, researchers started asking questions. What bioactive compounds are in human milk? How does milk from mothers of premature babies differ from milk produced for full-term infants? Can we use this knowledge to improve formulas or help babies in NICUs?

Hinde's research expanded. She studied how milk changes across the day (fat concentration peaks mid-morning). She investigated how foremilk differs from hindmilk (babies with bigger appetites who nurse longer get higher-fat milk at the end of feeding). She examined how maternal characteristics—age, parity, health status, social rank—shaped milk composition.

In 2013, she created March Mammal Madness, a science outreach event that became an annual tradition in hundreds of classrooms. In 2014, she co-authored "Building Babies." In 2016, she received the Ehrlich-Koldovsky Early Career Award from the International Society for Research in Human Milk and Lactation for making outstanding contributions to the field.

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### About Katie Hinde:

Katie Hinde is an associate professor of evolutionary biology at Arizona State University, where she directs the Comparative Lactation Lab studying mother's milk as food, medicine, and a behavioral signal in humans, monkeys, and other mammals.

Key Research Findings
Hinde's work shows milk composition varies by infant sex, with mothers producing more calcium-rich milk for daughters and fat/protein-rich milk for sons to match developmental needs. Milk hormones like cortisol influence infant temperament: higher levels correlate with faster weight gain, nervousness, and lower confidence, especially in offspring of younger or lower-ranking mothers. Human milk contains over 1,500 proteins and 200+ oligosaccharides that support digestion, immunity, and beneficial gut microbes while blocking pathogens.

Broader Impacts
Her studies across human populations reveal milk components differ by geography, diet, and culture, aiding personalized nutrition recommendations and better infant formulas. Hinde advocates for transdisciplinary research to translate findings into clinical support for breastfeeding and precision milk for vulnerable infants in NICUs. She communicates via TED talks, blogs like "Mammals Suck… Milk!", and media, highlighting gaps in milk science compared to other health topics

By 2017, when she delivered her TED talk, she could articulate what she'd discovered across a decade of research: breast milk is food, medicine, and signal. It builds the baby's body and fuels the baby's behavior. It carries bacteria that colonize the infant gut, hormones that influence metabolism, oligosaccharides that feed beneficial microbes, immune factors that protect against pathogens.

More than 200 varieties of oligosaccharides alone. The baby can't even digest them—they exist to nourish the right community of gut bacteria, preventing harmful pathogens from establishing.

The composition is as unique as a fingerprint. No two mothers produce identical milk. No two babies receive identical nutrition.
In 2020, Hinde appeared in the Netflix docuseries "Babies," explaining her findings to a mass audience. She'd moved to Arizona State University, where she now directs the Comparative Lactation Lab. Her research continues to reveal new dimensions of how milk shapes infant outcomes from the first hours of life through childhood.

She works on precision medicine applications—using knowledge of milk bioactives to help the most fragile infants in neonatal intensive care units. She consults on formula development, helping companies create products that better replicate the functional properties of human milk for mothers who face obstacles to breastfeeding.

The implications extend beyond individual families. Understanding milk informs public health policy, workplace lactation support, clinical recommendations. It reveals how maternal characteristics, environmental conditions, and infant needs interact in real time through a biological messaging system that's been evolving for 200 million years—longer than dinosaurs.

Katie Hinde didn't just study milk. She revealed that the most ancient form of nourishment was also the most sophisticated. What science had treated as simple nutrition was actually a dynamic, responsive communication between two bodies—a conversation that shapes human development one feeding at a time.

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Rhesus monkeys have been bottle-fed in laboratory settings notably in psychological and biomedical research. One famous example is Harry Harlow's maternal-separation experiments in which infant rhesus monkeys were separated from their mothers shortly after birth and given surrogate "mothers"—one made of wire holding a bottle for feeding, and another made of soft cloth without food. The monkeys would bottle-feed from the wire mother but preferred to spend most time clinging to the cloth mother for comfort, highlighting the importance of tactile contact over mere nourishment. These infant monkeys were thus bottle-fed artificially in the lab environment to study attachment behaviors.

Further research with bottle-fed rhesus monkeys has shown that the nutritional and immunological effects of bottle feeding versus breastfeeding can produce marked differences in their immune system development. For example, studies comparing breast-fed and formula-fed infant rhesus macaques found that bottle-fed infants had less diverse gut microbiota and different T cell immune profiles than breast-fed infants, with lasting effects months after weaning. This emphasizes how rhesus monkeys in labs being bottle-fed is part of controlled studies to understand both psychological and physiological development under different rearing conditions.

These experiments involve raising rhesus monkeys indoors in nursery settings with feeding bottles replacing natural breastfeeding, allowing researchers to control variables like nutrition and maternal contact to observe developmental outcomes. Such protocols are instrumental but ethically controversial due to separation from mothers and artificial rearing conditions.

Google & AI Research, Nov 2025

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The results show that mother's milk is dynamic. It changes, dependent on the sex of the offspring and even changes between the start and the end of the feeding session. This has enormous implications and leads us to ask previously overlooked questions.

1/ Why does the nutrient value change depending on the gender of the offspring?

2/ Why does the nutrient value further change during the feeding session of either gender?

3/ What are the implications of nutrients being the same for both genders?

4/ What are the implications of the nutrients being the same throughout the feeding session?

5/ Can any of the results be interpolated to the human feeding experience?

The (currently untested) results of these questions can lead us to examine a need for changes in infant formula. Perhaps current infant formula mimics 'late session, female offspring needs' rather than a variable need that is necessary.

Perhaps changes in human behavior since the advent of 'Baby Formula' can be attributed to a lack of understanding of infant needs, based on gender and duration of a feeding session...

1/ What benefits can be attributed to the current Formulae that are being marketed?

2/ What are the down-sides of the current baby Formulae?

3/ What benefits would be available to infants if a Gender Specific Formula was available?

4/ What benefits would be available to infants if a 'Time Graduated Formula' was available for each infant based on gender and need?

Once an educated round of studies has been completed, we may find that a complete change in the way formula is manufactured & delivered may result in a better health regime for humanity.

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### Formula Background

Baby formula in the modern, commercial sense dates back to the mid-19th century, with the first widely recognized formula created in the 1860s. It began to be introduced and sold as a product for infant feeding in Europe and then the United States soon after.

#### Early invention

The first commercial baby formula is generally credited to German chemist Justus von Liebig, who developed and patented an infant food around 1865–1867.

Liebig's product, often called "Liebig's Soluble Food for Babies" or "Liebig's Perfect Infant Food," was based on cow's milk mixed with wheat flour, malt flour, and potassium bicarbonate.

#### Market introduction

Liebig's formula was first marketed in Europe in the late 1860s and quickly gained popularity as an alternative to wet nursing and homemade mixtures.

By 1869, Liebig's infant food was being sold in the United States, making it one of the first commercial baby formulas introduced to the American market.

#### Further development

In the 1870s and 1880s, competing products such as Nestlé's Infant Food and evaporated-milk-based formulas appeared, helping to expand the use of manufactured infant foods.

Through the early 20th century, formulas evolved with changes in fat sources, added vitamins, and specialized versions (such as soy-based formulas in the late 1920s), moving closer to what is now considered modern infant formula