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BEYOND NUTRITION: IS BREAST MILK A NATURAL PAINKILLER? INSIGHTS FROM SCIENCE & AYURVEDA

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ABSTRACT: Background: Breast milk is known for its nutritional and immunological benefits, but its potential as a natural analgesic for infants is less explored. This review examines the analgesic properties of breast milk from both scientific and Ayurvedic perspectives. **Objectives:** To present modern scientific discoveries regarding breast milk's analgesic potential, explore Ayurvedic perspectives on its healing properties, establish connections between contemporary and traditional knowledge, and highlight potential applications in pain management for neonates and infants. **Methods:** A comprehensive literature review was conducted using scientific databases (PubMed, Google Scholar, ScienceDirect) and Ayurvedic sources (traditional texts, DHARA, ARP, ABIM). Keywords related to breast milk, analgesia, and Ayurveda were used to identify relevant studies and texts. **Results:** Scientific studies have identified bioactive compounds in breast milk with analgesic properties, including endogenous opioids, growth factors, and anti-inflammatory cytokines. Ayurvedic texts describe breast milk (Stanya) as possessing healing qualities beyond nutrition. Clinical studies demonstrate the efficacy of breastfeeding and expressed breast milk in reducing pain responses during medical procedures in neonates. **Conclusion:** The integration of scientific and Ayurvedic perspectives provides a comprehensive understanding of breast milk's analgesic effects. This knowledge may inform the development of natural pain relief strategies for infants and even adults, utilizing the therapeutic properties of breast milk.

INTRODUCTION: Pain is a universal human experience, but sadly, not one shared equally. As per the Haleon Global Pain Index Report (HPI 5), one-third of the world's population suffers from some form of pain every day [1]. While adults can communicate their pain in words and seek remedies for it, vulnerable populations such as neonates and infants remain largely voiceless in these statistics. They are often overlooked in conversations about effective pain management. However, for them, the stakes are just as high.

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Unmanaged pain in early life can lead to long-term consequences, including impaired growth and developmental delays [2]. Pharmacological solutions, such as NSAIDs, have been the primary approach to managing pain. However, in children, particularly infants, these come with notable safety concerns [3]. This has prompted a growing search for safer, more natural approaches, especially those that align with the delicate physiology of neonates. One such candidate, long known for its nutritional and immunological value, is breast milk.

Undoubtedly, breast milk is the gold standard of infant nutrition. It is rich in bioactive compounds that support immunity, growth, and development [4]. But there is more to this biological marvel than meets the eye. An emerging area of research is now shining a light on its analgesic potential. Compounds such as endorphins and anti-

inflammatory cytokines have been identified in breast milk [5, 6] and the presence of opioid receptors [7] in the infant's gut suggests a possible mechanism through which the analgesic effects of breast milk might be mediated. In short, breast milk might be doing more than nourishing. It could also be soothing.

Interestingly, this idea is not new. Long before the rise of molecular biology, Ayurveda, an ancient Indian system of medicine, recognized breast milk (Stanya) as a deeply healing substance. Ayurvedic texts have described Stanya (breast milk) as wholesome (Pathyam), suitable (Satmya), life-giving (Jeevaniya), and a homogenous elixir abundant in nutrients and curative properties [8, 9].

These facts position breast milk as a natural, readily available source of analgesics, offering a safe alternative to pharmacological agents. The purpose of this review is to provide a comprehensive exploration of the analgesic properties of breast milk from both scientific and Ayurvedic perspectives. The objectives of this paper are fourfold:

1. To present the modern scientific discoveries regarding the analgesic potential of breast milk.
2. To gain insights into the Ayurvedic perspectives on breast milk's healing properties.
3. To establish a connection between contemporary scientific knowledge and traditional Ayurvedic wisdom.
4. To highlight the potential applications and implications of utilizing breast milk as a natural pain reliever.

Through this integrated approach, this review will highlight the significance of considering both contemporary and traditional knowledge on breast milk in advancing pain management strategies for neonates and infants.

MATERIALS AND METHODS: To conduct this review and gain insights into the analgesic properties of breast milk, we searched and selected relevant scientific literature and Ayurvedic sources. The methodology involved a literature search using relevant keywords and medical subject headings (MeSH terms). We conducted print and electronic searches for scientific literature using reputable academic databases, including PubMed, Google Scholar, and ScienceDirect. These databases were selected to ensure broad coverage of peer-reviewed books, research articles, reviews, and clinical studies related to analgesic properties in breast milk.

For Ayurvedic sources, we used traditional Ayurvedic texts such as Charak Samhita, Sushruta Samhita, Ashtanga Hridaya, Ashtanga Samgraha, Kashyap Samhita and reputable Ayurvedic databases like Digital Helpline for Ayurveda Research Articles (DHARA), the AYUSH Research Portal (ARP), and the Annotated Bibliography of Indian Medicine (ABIM). These sources were identified through searches in databases specialising in Ayurvedic literature and consulting with experts in Ayurvedic medicine.

Some examples of the keywords used were Breast Milk, Human Milk, Breastfeeding, Analgesics, Pain Management, Endorphins, Cannabinoids, Bioactive Compounds, Infant, Newborn, Ayurveda, Stanya, Stanapana, *etc*.

RESULTS:

Biochemical Composition of Breast Milk: Breast milk is a complex and dynamic fluid produced by post-partum mothers. Its composition evolves from colostrum in the early days of a baby's life to mature milk in the later stages of infancy to suit the ever-evolving needs. It is a goldmine of bioactive compounds [10, 11] that provide nutrition and impart therapeutic benefits as described in **Table 1.**

TABLE 1: BIOACTIVE COMPOUNDS IN BREAST MILK

Component	Description	Function in Nursing Infants
Macronutrients [12, 13]		
Proteins	Casein and whey proteins (including lactoferrin, lysozyme, and secretory immunoglobulin A (sIgA))	Essential for growth and development; provides immune protection through antimicrobial and anti-inflammatory properties.
Fats	Triglycerides, phospholipids, cholesterol, and essential fatty acids	Provide energy; crucial for brain development and the formation of cell membranes and anti-inflammatory

	(omega-3 and omega-6)	compounds.
Carbohydrates	Lactose and Human Milk Oligosaccharides (HMOs)	Provide energy; promote healthy gut microbiota and aid in calcium absorption; support immune function by preventing pathogen adhesion to the gut.
Micronutrients		
Vitamins [11, 14]		
Vitamin A	Retinol and beta-carotene	Supports vision development, immune function, and skin health.
Vitamin D	Cholecalciferol	Essential for calcium absorption and bone development; supports immune function.
Vitamin E	Alpha-tocopherol	Acts as an antioxidant, protecting cells from oxidative damage; supports immune function.
Vitamin K	Phylloquinone	Necessary for blood clotting and bone health.
B Vitamins	Thiamine (B1), Riboflavin (B2), Niacin (B3), Pantothenic acid (B5), Pyridoxine (B6), Biotin (B7), Folate (B9), Cobalamin (B12)	Support energy production, brain development, and the formation of red blood cells; crucial for overall growth and neurological development.
Vitamin C	Ascorbic acid	Acts as an antioxidant; enhances iron absorption; supports immune function and collagen synthesis.
Minerals [15, 16]		
Calcium		Essential for bone and teeth development; involved in muscle function, nerve signalling, and blood clotting.
Phosphorus		Works with calcium for bone and teeth development; involved in energy metabolism.
Magnesium		Required for numerous biochemical reactions, including muscle and nerve function, blood glucose control, and protein synthesis.
Iron		Vital for the formation of haemoglobin and oxygen transport in the blood; supports cognitive development.
Zinc		Supports immune function, cell growth, and repair; important for enzyme function and DNA synthesis.
Selenium		Acts as an antioxidant, protecting cells from oxidative stress; supports thyroid function.
Copper		Involved in iron metabolism, energy production, and the formation of connective tissue and neurotransmitters.
Manganese		Important for bone formation, amino acid metabolism, and enzyme function.
Iodine		Essential for thyroid hormone production, which regulates metabolism, growth, and development.
Other Bioactive Compounds		
Endorphins [6]	Naturally occurring opioids	Help modulate pain and induce a sense of well-being by binding to opioid receptors in the brain.
Cannabinoids [17]	Endocannabinoids (e.g., 2-arachidonoylglycerol (2-AG))	Modulate pain, appetite, mood, and memory; interact with cannabinoid receptors in the nervous system.
Anti-inflammatory Cytokines [7, 19]	Interleukins, tumour necrosis factor (TNF)	Modulate the immune response; reduce inflammation and potentially alleviate pain.
Growth Factors [20]	Epidermal Growth Factor (EGF), Transforming Growth Factor-beta (TGF-β)	Support tissue repair and development; help in healing and mitigating pain from injuries or inflammation.
Hormones [21]	Oxytocin, prolactin	Support lactation; promote maternal-infant bonding; have calming effects, reducing stress and pain perception.
Antioxidants [22]	Vitamins C and E, selenium, glutathione	Protect cells from oxidative stress, which can contribute to pain and inflammation; support overall health.
Nucleotides [23]	Building blocks of DNA and RNA	Support growth and immune function; essential for cellular function and development; influence pain responses.

Analgesic Compounds in Breast Milk: From a vast list of all the bioactive compounds in breast milk, many exhibit potent analgesic properties. Among them, the most studied components are endogenous opioids, including beta-endorphins, enkephalins, and dynorphins [8, 24, 25].

These opioid peptides are believed to play a crucial role in reducing pain perception in infants during breastfeeding. As explained in **Table 2**, many bioactive compounds in breast milk have been investigated for their potential analgesic effects. These compounds may interact with the infant's developing nervous and immune systems, contributing to pain modulation and soothing effects.

TABLE 2: BIOACTIVE COMPOUNDS IN BREASTMILK WITH ANALGESIC EFFECTS

Compound	Mode of Action
Endorphins [17]	Endorphins, such as Beta-endorphins, Enkephalins, and Dynorphins, are endogenous opioids that bind to opioid receptors in the central nervous system, resulting in reduced pain perception and modulation of pain pathways.
Various Cytokines [5, 18]	Cytokines are a diverse group of signalling molecules that regulate immune reactions. They influence pain and analgesic pathways in the central and peripheral nervous systems.
Various Growth Factors [19, 20]	Growth factors such as Epidermal Growth Factor, Transforming Growth Factor, and Insulin-like Growth Factor, regulate cellular processes. They contribute to tissue repair and development.
Oxytocin [21]	Oxytocin, a neuropeptide, and neurotransmitter, modulates social bonding and trust in the brain. It contributes to the calming and analgesic effects on the recipient infant.
Serotonin [22, 23]	Serotonin, a neurotransmitter, regulates mood and behaviour in the central nervous system. It may influence pain perception and mood in the recipient infant.
GABAergic Compounds [24]	GABAergic compounds, including Gamma-Aminobutyric acid (GABA) and related compounds, act as inhibitory neurotransmitters in the brain. They may have calming and analgesic effects in the recipient infant.
Melatonin [25, 26]	Melatonin, a hormone, regulates sleep-wake cycles and has antioxidant and anti-inflammatory properties. It may contribute to pain relief in the recipient infant.
Various Fatty Acids [35, 36]	Various fatty acids, including Omega-3 and Omega-6 fatty acids, are essential components of breastmilk. They may have neuroprotective and anti-inflammatory effects in the recipient infant.
Lactoferrin [29, 30]	Lactoferrin, an iron-binding protein with antimicrobial properties, helps prevent bacterial growth. It may impact pain perception in the recipient infant.
Human Milk Oligosaccharides [12, 31]	Human milk oligosaccharides (HMOs) are complex carbohydrates with prebiotic properties. They inhibit pathogen attachment to the gut lining. They may influence pain perception in the recipient infant.

Mechanisms of Analgesic Action in Breast Milk: The mechanisms through which breast milk exerts its analgesic effects are not fully understood but are thought to involve multiple pathways. Opioid peptides, for instance, may bind to specific receptors in the infant's brain, triggering pain-inhibitory responses [32, 33]. Additionally, certain growth factors and cytokines may help regulate inflammatory processes and reduce pain signaling in the peripheral and central nervous systems [18, 20, 24, 26]. **Fig. 1** can shed some light on understanding the mechanisms of breast milk's analgesic effects.

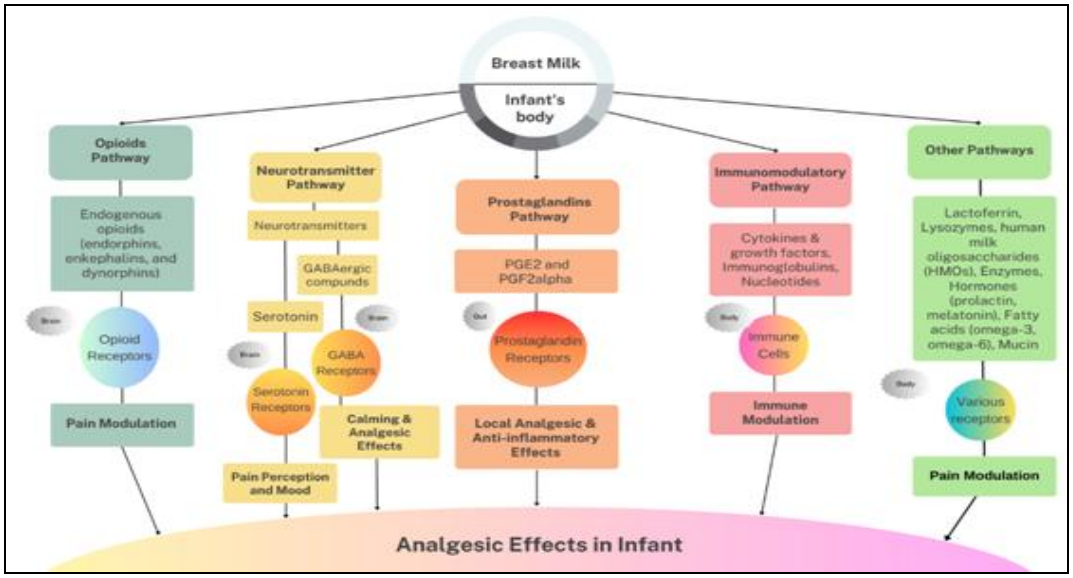

FIG. 1: MECHANISMS OF BREAST MILK ANALGESIC EFFECTS

Ayurvedic Perspectives on Analgesic Properties in Breast Milk: In Ayurveda, Stanya or breast milk holds a position of paramount importance due to its remarkable nourishing properties and potential to contribute to the overall well-being of infants. The emphasis on breastfeeding as a natural and optimal means of providing infants with essential nutrients, immunity-enhancing factors, and growth-promoting elements aligns with Ayurvedic principles of holistic health. Ayurvedic texts extol the therapeutic virtues of breast milk, attributing its healing potential to more than its basic nutritional composition. Termed as "Satmya," and "Pathya," breast milk is considered compatible with the baby's physiology, facilitating a harmonious relationship with the infant's body. This compatibility is believed to nurture and support the baby's well-being, extending beyond mere sustenance. The holistic perspective of Ayurveda considers various factors that influence the quality and efficacy of breast milk in promoting health. The mother's physical and mental state is recognized as pivotal, as her emotional well-being during breastfeeding can positively influence the nourishing properties of the milk [8]. The bond between mother and child established through breastfeeding creates a sense of security and comfort for the infant, potentially playing a role in pain alleviation during medical procedures. Ayurvedic teachings also introduce the "Avyahata Bala-Anga-Ayu-Aroga" concept concerning breast milk's vital life force energy [34]. This life force is believed to possess balancing and nurturing effects on the baby's physiological, psychological, and developmental aspects, potentially contributing to overall pain management and comfort.

Analysis of Properties of Stanya: The review of Ayurvedic texts and relevant literature on breastfeeding offers valuable insights into the ancient wisdom and traditional practices surrounding the analgesic effects of breast milk in neonates and infants. According to Acharya Bhavprakash, Stanya or breast milk is believed to have a calming and analgesic effect on infants, promoting comfort and reducing distress [35]. This aspect of breastfeeding-induced analgesia is consistent with modern scientific findings. Ayurvedic texts, such as Kashyap Samhita, Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, and Ashtanga Samgraha, contain detailed descriptions of breast milk's properties, qualities, and therapeutic applications. Stanya (breast milk) is described as possessing a unique combination of qualities (Gunas) and actions (Karmas), which contribute to its therapeutic efficacy as an analgesic for neonates, as described in **Table 3.**

TABLE 3: QUALITIES (GUNA) AND ACTIONS (KARMA) OF BREAST MILK (STANYA) IN AYURVEDA

Guna (Qualities)	Karma (Actions/Effects)	Role in Inducing Analgesic Effect in Neonates
Madhur (Sweet)[*]	Enhances palatability and acceptance	Provides satisfaction and comfort to the infant, thus relieving pain and promoting a sense of well-being.
Kashaya (Astringent)[*]	Helps maintain fluid balance and aids digestion	Aids in balancing the Doshas, particularly Pitta Dosha, helping to alleviate any heat-related discomfort or inflammation in the infant's body.
Laghu (Light)[*#]	Easily digestible and assimilable	Facilitates easy digestion, which can minimise the workload on the digestive system, promoting a smoother recovery from pain.
Snehan (Unctuousness)[*+]	Facilitates smooth functioning of physiological processes	Provides lubrication and moisture to the body, easing bodily functions and contributing to overall comfort during medical procedures.
Sheeta (Cooling)[*#]	Balances excess heat and soothes the baby	Help in pacifying excess heat or inflammation, providing relief from pain and discomfort caused by medical procedures.
Jeevaniya (Life-promoting)[*+]	Sustains life by providing essential nourishment	Provides essential nutrients and immunity, supporting the overall health and well-being of neonates, which aids in the body's natural healing process during medical procedures.
Brimhaniya (Nourishing)[+]	Supports healthy weight gain and overall growth	Enhances healthy weight gain and development, ensuring neonates are better equipped to endure medical procedures and recover more effectively.
Satmya & Pathya (Compatible) [*+]	Wholesome, highly compatible and easily digestible	Breast milk is naturally wholesome and compatible with the neonate's digestive system, reducing the risk of adverse

		reactions and providing a safe and effective analgesic remedy.
Deepan (Appetizer) [*#]	Stimulates appetite and healthy desire for food	Acts as a natural appetiser, stimulating the neonate's digestive fire, which can improve their metabolism and modulate the functioning of various bodily systems.
Shoolaghna (Pain-relieving)[#]	Provides pain relief and soothing properties	Natural pain reliever that offers comfort to neonates during medical procedures, thus helping to soothe and ease discomfort.
Abhighataghna (Trauma-alleivating)[$#]	Protects against infections and strengthens immunity	Alleviate trauma and aid in calming neonates during distressing situations, promoting a positive experience during medical interventions.
Vatahara (Pacifies Vata) [$#]	Pacifies Vata Dosha and promotes balance	Contributes to a sense of calmness, comfort, and relaxation in neonates, reducing their stress response during medical procedures.
Pittahara (Pacifies Pitta)[+$#]	Pacifies Pitta Dosha and reduces excess heat	Helps in maintaining a balanced body temperature, reducing heat-related discomfort during medical procedures.

[*] Charak Sutra 27/224, [+] Sushruta Sutra 45/47, [$] Ashtanga Hridaya Sutra 5/26, [#] Bhavprakash Purvakhanda 5/23

Evidence from Scientific Studies: Several studies have explored the analgesic effects of breastfeeding and expressed breast milk (EBM) in newborns during painful procedures. Carbajal (2003), in a randomized controlled trial (RCT), demonstrated that breastfeeding significantly reduced pain responses in term neonates undergoing minor invasive procedures [36]. This finding aligns with the work of Upadhyay *et al.* (2004), who conducted an RCT showing that feeding 5 ml of EBM before venepuncture was more effective in reducing pain compared to distilled water in term neonates [37].

Goswami *et al.* (2013) further substantiated these findings by showing that infants who were breastfed or given 25% dextrose exhibited significantly shorter crying durations and lower pain scores at 1 and 3 minutes following needle insertion during DPT vaccination, compared to a placebo group [38]. Similarly, Sahoo *et al.* (2013) confirmed that both 25% dextrose and breast milk effectively reduced behavioural and physiological pain responses in newborns during procedural pain [39]. Modarres *et al.* (2013) observed that breastfeeding provided effective pain relief during the administration of the hepatitis B vaccine [40]. Expanding on this, Hatami Bavarsad *et al.* (2018) conducted an RCT that demonstrated breastfeeding's ability to reduce pain severity during muscular injections of the hepatitis B vaccine, recommending that neonates be breastfed during painful interventions such as vaccinations [41]. Abinaya *et al.* (2018) reported that expressed breast milk significantly reduced pain perception and crying duration during venepuncture in neonates when compared to placebo [42]. Fitri *et al.* (2020), in an RCT, highlighted the analgesic potential of breast milk as a gustatory sensory stimulus, finding it comparable to sucrose in reducing pain intensity in neonates [43]. Lan *et al.* (2021) investigated the impact of multisensory interventions using breast milk during newborn screening procedures. Their study found that combining breast milk odour with its taste offered superior analgesic effects compared to breast milk odour alone during heel stick procedures [44]. Finally, Keir *et al.* (2022) conducted a multi-centre prospective cohort study on the effects of breastfeeding on hospitalization outcomes among late preterm infants, concluding that breastfeeding was associated with reduced pain responses and improved overall outcomes in this population [45].

DISCUSSION:

Controversies: While there is strong evidence supporting the analgesic properties of breast milk, some controversies and challenges remain in the research, such as:

Variability in Analgesic Efficacy: The analgesic effects of breast milk may vary depending on the composition of the milk, maternal factors, and the infant's age and health status.

Specificity of Effects: Some studies have questioned the specificity of breast milk's analgesic effects, as factors like the mother's emotional state and the comfort provided during breastfeeding may also contribute to pain reduction [46, 47]. Even Ayurvedic literature underscores that the mother's

overall well-being is of the essence when producing healthy breast milk. Despite these controversies, the research suggests that breast milk contains bioactive compounds with analgesic potential, offering a natural and nurturing approach to alleviating infant pain. However, further studies are needed to better understand the specific mechanisms of action and address the remaining uncertainties in this field.

Potential Applications & Implications of Utilising the Analgesic Properties of Breast Milk: Recognising breast milk's analgesic properties opens various potential applications and implications in neonatal care and pain management. Integrating this natural analgesic into medical practices can lead to safer and more effective pain relief strategies for infants during medical procedures. There could be various potential applications and implications of utilising breast milk's analgesic properties, drawing upon evidence from modern scientific research and Ayurvedic perspectives.

Non-Pharmacological Pain Management: Breast milk can serve as a safe and non-pharmacological approach to managing pain in neonates. Providing breast milk during medical procedures or post-surgery offers comfort and relief to infants, potentially reducing the need for conventional pain medications that may have side effects or interactions with other treatments. Implementing breast milk as a pain management strategy aligns with the growing emphasis on non-invasive and holistic approaches to neonatal care.

Enhancing Preterm Care: Premature infants often experience heightened sensitivity to pain and discomfort, making pain management a critical aspect of their care. Breast milk's analgesic properties may be vital in promoting comfort and easing pain in these fragile infants. Additionally, the nurturing touch during breastfeeding enhances the mother-infant bond, which is particularly important for the well-being and development of preterm babies.

Applications in Adult Pain Management: The exploration of breast milk's analgesic properties in neonatal care opens the door to potential research into natural pain relief therapies for adults. Numerous studies have examined the non-nutritional uses of breast milk, demonstrating its benefits in a wide range of conditions. These include its application for skin issues such as atopic eczema, diaper dermatitis, and perineal ulcers, as well as its effectiveness in alleviating nipple pain and promoting the healing of cracked or sore nipples. Breast milk has also been investigated for its role in treating neonatal conjunctivitis and in postnatal umbilical cord care [48, 49].

Interestingly, Ayurvedic compendiums have long described the analgesic effects and non-nutritional uses of breast milk in a variety of conditions, ranging from eye ailments to trauma.[9,35] The bioactive components in breast milk, such as endorphins and immune factors, may serve as the foundation for novel pain management approaches in adults, further highlighting its therapeutic potential beyond infant care.

CONCLUSION: The modern scientific perspective employs rigorous methods to explore breast milk's analgesic properties, identifying specific bioactive components responsible for pain relief in infants. On the other hand, the Ayurvedic perspective draws upon ancient wisdom, recognising breast milk's holistic nature and compatibility with the infant's body. Both perspectives acknowledge breast milk's natural analgesic effects on infants and emphasise the importance of breastfeeding in nurturing the emotional bond between mother and child. While modern science isolates specific bioactive components, Ayurveda considers that the interplay of various Gunas (properties) and Karma (actions) breast milk exhibits.

Combining these perspectives enriches our understanding of breast milk's analgesic potential, offering a comprehensive approach to neonatal care and pain management. In conclusion, combining modern scientific and Ayurvedic perspectives offers a comprehensive understanding of breast milk's analgesic properties. By acknowledging both evidence-based research and ancient wisdom, we gain valuable insights into the potential benefits of breastfeeding as a natural and nurturing approach to alleviate pain and promote well-being in neonates and infants. This knowledge may inspire further research and applications into developing

natural pain relief therapies for infants and adults, utilising the healing potential of breast milk components. Integrating breast milk's analgesic properties into neonatal care and pain management strategies requires collaboration between healthcare professionals, lactation consultants, and parents. As this approach gains recognition, healthcare providers should be educated on the evidence supporting breast milk's analgesic effects and its potential applications in various clinical settings. However, continued research and collaboration between modern medicine and traditional systems are essential to fully harnessing the benefits of breast milk's analgesic potential.

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