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Lactation, mastitis, and probiotics

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ABSTRACT

Exclusive breastfeeding during the first six months of life, and prolonged with complementary feeding until 2 years of age or more, is the best nutritional approach in the first stage of life. Mastitis is a pathology that can jeopardize the continuity of breastfeeding. Different methods have been proposed for the prevention and treatment of mastitis, including probiotics. This narrative review aims to describe the problem of mastitis during lactation and the role of probiotics in its prevention. Mastitis should not be confused with the physiological phenomenon known as milk coming in. In persistent pain, timely medical consultation is key to avoiding complications. The administration of specific probiotics in the perinatal period has shown efficacy in reducing the incidence of mastitis.

Keywords: *microbiota; lactation; mastitis; probiotics.*

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INTRODUCTION

Breastfeeding is the best nutritional approach in early infancy, and mastitis is a pathology that can jeopardize its continuity. There needs to be consensus or updated diagnostic and treatment guidelines. Different methods, including probiotics, have been proposed to prevent and treat mastitis. This narrative review aims to describe the problem of mastitis during lactation and the role of probiotics in its prevention.

IMPORTANCE OF BREASTFEEDING FOR THE CONSTITUTION OF THE NEWBORN'S MICROBIOTA

The World Health Organization promotes exclusive breastfeeding for the first six months of life and recommends extending it until 2 years of age or until the family decides to do so. In the world, breastfeeding (BF) can prevent the death of more than 800 000 children and 20 000 mothers, saving 300 billion dollars in health costs.[1]

The first 1000 days are considered critical and a window of opportunity in nutrition. Breastfeeding promotes neurodevelopment and the formation of an optimal microbiota and immunity. Human milk (HM) is the ideal food to meet these goals. Due to the importance of HM and BF for the unequaled bond between mother, child, and family, it is necessary to reinforce educational aspects and health policies to promote and favor it.[2]

It is recommended to initiate breastfeeding during the first hour (golden hour) after birth. Skin-to-skin contact (SSC) facilitates the initiation and maintenance of breastfeeding and favors the colonization of the newborn with the maternal microbiota to benefit their own; it also reduces the risk of postpartum maternal depression.[3]

Breastfeeding prevents viral or bacterial infections, diarrhea, anemia, obesity, diabetes, cardiovascular diseases, oncological diseases, sudden death, and breast cancer, as it provides bioactive substances and microorganisms with prebiotic and probiotic effects, respectively.[4] In preterm infants, BF prevents necrotizing enterocolitis, sepsis, and retinopathy with level A evidence.[5]

The composition of HM is dynamic, which does not occur in other foods. Its composition varies according to the time of day and genetic, environmental, and dietary factors. HM contains immunoglobulins, lactoferrin, cytokines, lymphocytes, hormones, antioxidants, oligosaccharides, and long-chain polyunsaturated fatty acids. HM also offers a high iron bioavailability since the calcium:phosphorus ratio (2:1) favors absorption. It also provides an adequate supply of long-chain fatty acids crucial for brain development and neurodevelopment. Historically, it was considered that the intrauterine environment was sterile so that colonization would begin after birth. However, exposure to a microbial environment starts before birth, as bacterial DNA and debris are detected in the placenta, umbilical cord, and amniotic fluid.[2] There is estimated to be a transfer of maternal-infant microbiota via the HM (*Figure 1*). Certain microorganisms from the mother's intestine would be selected by dendritic cells of the lamina propria to be transported, viable, via blood or lymphoid circulation, to be released in the mammary gland and from there to the HM, as was recently demonstrated for a strain of *Bifidobacterium breve*.[7]

MASTITIS DURING LACTATION

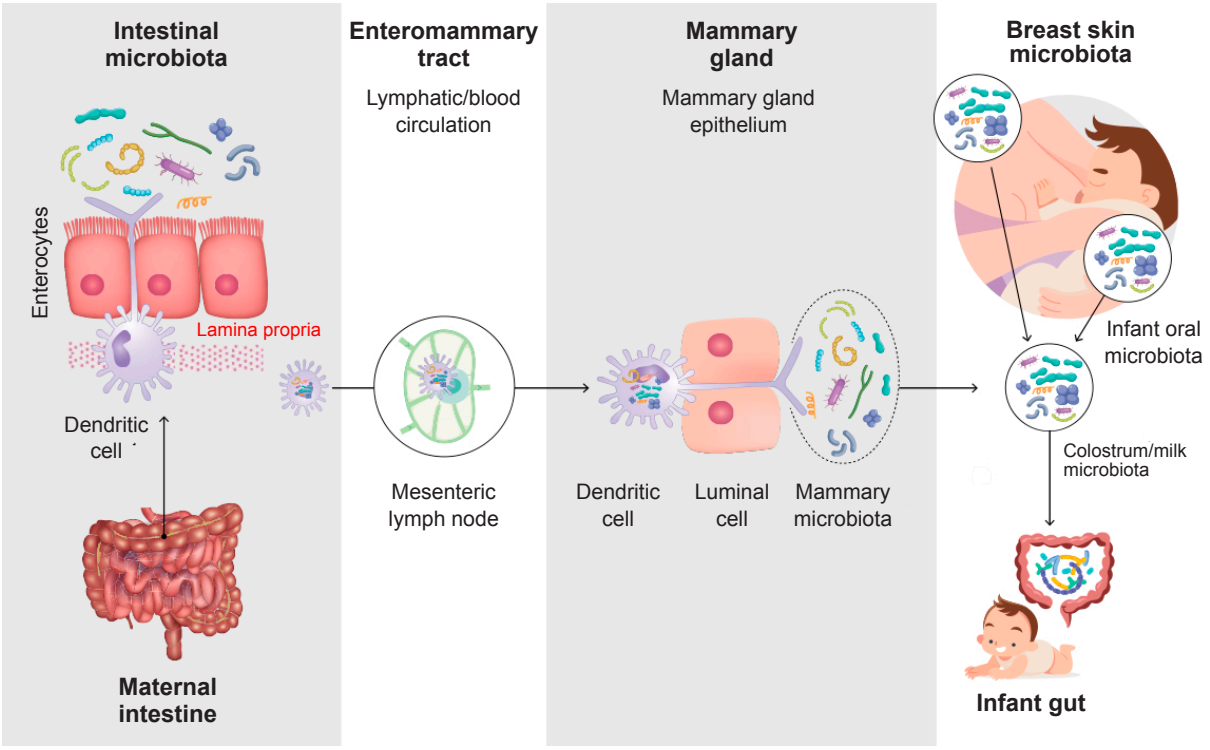
Mastitis is breast inflammation that may or may not be accompanied by infection. It is a multifactorial dysbiosis with an alteration in the mammary microbiota. It is one of the causes of breastfeeding interruption, with a variable incidence due to variability in its definition and the absence of representative samples, mostly based on diagnoses referred by women who could have differences in the perception of symptoms. In a review of 2024, the incidence rate of mastitis in countries such as the USA, UK, Australia, Denmark, Turkey, Finland, and New Zealand combined was estimated to be approximately 13.45%.[8,9] Mastitis is classified as acute, subacute, and chronic (*Table 1*) and, according to its etiology, as infectious or non-infectious.[8,10,11]

Abscess is the most frequent complication, and its leading causes are milk stasis due to compression and/or obstruction of the lactiferous ducts with increased parenchymal pressure or decreased alveolar contraction and ductal dilatation, generating bacterial overgrowth, pain, and decreased milk synthesis.[12] Lactational mastitis is the most common presentation of mastitis, occurring according to Wilson in 1 in 4 breastfeeding women, being more frequent in the second and third week.[8] Abscess is more frequent in the first six weeks.[8,13,14]

Mastitis should not be confused with milk stasis, nor should it be confused with engorgement.

Lactational mastitis usually presents as a painful, warm, erythematous, unilateral lump

Figure 1. Proposed mechanism for vertical microbial transmission between mother and infant



The dendritic cells of the lamina propria of the maternal intestine would pass their cytoplasmic projections (dendrites) through the basolateral zone of the enterocytes of the intestinal epithelium to capture microorganisms from the intestinal lumen. These microorganisms would be transferred intact inside the dendritic cells via blood/lymphatic circulation to the mammary gland, where they would be released and would go on to constitute the microbiota of human milk, to pass from there to the infant's intestine (adapted from Fernandez et al. 2013[6]).

that may develop into an abscess. Systemic manifestations are fever, osteoarticular pain, and chills. Diagnosis is clinical and complemented by ultrasound, which provides orientation, guides puncture and drainage of collections, and allows evaluation of the therapeutic response.

The most frequent microorganisms associated with mastitis are *Staphylococcus* and *Streptococcus*. Treatment includes antibiotics (amoxicillin, erythromycin, clindamycin), anti-inflammatory drugs, local physical measures and a suitable bra, and adequate nutrition, hydration, and rest. Suspending lactation is unnecessary; even continuing lactation may be beneficial for a rapid response to treatment (*Table 1*).

Acute mastitis not associated with lactation is infrequent and generally occurs in immunosuppressed women, where mixed microbiota and anaerobes can be isolated. It should not be confused with chronic relapsing galactophoritis, which is frequent in smokers. Treatment is with broad-spectrum antibiotics and anti-inflammatory drugs.[14] Subclinical mastitis is a common and asymptomatic inflammatory condition of the lactating breast, with consequences on milk composition, characterized by a subjective sensation of decreased production associated with long feedings and low weight gain of the infant (incidence of 2-66%). Subacute mastitis is described as a clinical picture of stabbing pain in the breast, cramps, burning sensation, and decreased milk production (*Table 1*).[10,11,15]

Idiopathic granulomatous mastitis is a chronic mastitis that presents abruptly in young women as an ill-defined, painful, and rapidly growing tumor accompanied by erythema, abscesses, fistulas, and/or ulcers. Numerous papers report a strong association with *Corynebacterium*, especially *C. kroppenstedtii*. Images are not pathognomonic; the diagnosis is histological, and tuberculosis must always be ruled out. Treatment

Table 1. Characteristics of the different types of mastitis, diagnoses and proposed treatments (adapted from[8,9,11,16])

Variable		Type of mastitis			
		Acute	Subclinical	Subacute	Chronic (granulomatous)
Symptoms	Local	Erythema Increase in size of the breast Induration	Decreased milk secretion	Stabbing pain Cramping Burning sensation	Pain Lumpiness Erythema
		Decreased milk secretion Abscess	Areas of induration	Decreased milk secretion Areas of induration	Fistula Ulcer Abscess
	Systemic	Fever Arthralgias Myalgias Chills	No	No	Erythema nodosum (10-20% of cases)
Main etiological agents		*Staphylococcus aureus*	*Staphylococcus epidermis* *Streptococcus mitis* *Streptococcus salivarius* *Rohita* spp. *Corynebacterium*		*Corynebacterium* *Corynebacterium kroppenstedtii* (mastitis granulomatosa quística) *Actinomyces*
Diagnosis		Clinical	Clinical Na/K IL-8 IgA Lactoferrina	Clinical	Histological biopsy
Images		Ultrasound			Ultrasound
Medical treatment		Antibiotics Analgesia Probiotics*	Probiotics*	Probiotics*	Antibiotics MPD MTX Probiotics*
Surgery		Yes (abscess drainage)			Yes (complications and selected cases)

**Evidence por a recommendation is not yet available.*
MPD: meprednisone; MTX: methotrexate; IL-8: interleukin-8; IgA: immunoglobulin A.

is with antibiotics and immunosuppressants. Recurrences vary between 6% and 30%.[16]

The gut is a fundamental organ for health and disease. During the first years of life, events in the gut contribute to programming, shaping, and fine-tuning distant organs, with lifelong consequences. In this context, the maternal gut plays a key role in programming the mammary gland to meet the growing infant's nutritional, microbiological, immunological, and neuroendocrine needs through the gut-mammary gland axis.[17]

APPROACH TO MASTITIS FROM THE CHILDCARE PERSPECTIVE

During the first postpartum days, it is common for the breast to be engorged, plethoric with edema in the areolar area (lactogenesis II), a physiological and expected fact, commonly called breast milk coming-in. It is crucial to differentiate it from mastitis. The breast may appear indurated to the naked eye, and there may be milk stasis; the mother may report local pain, but not systemic, usually bilateral pain, without a specific area. This situation can cause difficulty in breastfeeding, cause cracks, and, without proper care and management, can lead to premature weaning.[18] When congestive breasts are present, manual expression should be performed to drain the areola before latch-on. After feeding, a massage should be performed, and a cold pad should be applied.[19] Warning signs are characteristic erythema, generalized pain, back pain (occasionally), fatigue, or fever greater than or equal to 38 °C.

Mastitis may appear within the first weeks of the puerperium. It means an inflammation of the breast tissue, which may or may not result from an infectious process.[20] The mother first goes to her physician or a certified lactation consultant, referring pain or some hardness in a specific area. As a first step, she will be instructed not to stop breastfeeding from that breast. The baby could reject the affected breast since the milk has more sodium. With this condition, a separation between the cells of the alveolus is generated again, as it happens during the first days with the colostrum, which modifies the taste. In such cases, it is advisable to use a manual or mechanical breast pump. If the baby latches on regularly, the mother should palpate the breast after each feeding and

drain any hardness she may perceive. Finally, a local cold pad should be applied, and control should be performed within 24 hours with alarm guidelines. We can find other treatments, such as cabbage leaf placement, acupuncture, or ultrasound. These last two are not the most common, and there is no sufficient scientific evidence to indicate them.

If the breast is sore with characteristic erythema and fever, or if the symptoms do not subside after 24 hours, it is suggested that the patient go to the doctor or a hospital ward for appropriate antibiotic treatment.[21] If no improvement is observed after 48 hours, the antibiotic should be rotated for another. It is essential to be able to perform a culture of human milk to determine the nature of the infection and prescribe the appropriate treatment. Unfortunately, it is impossible to determine the nature of the infection, an indication that is not routinely performed.

Occasionally, mastitis may not have as many symptoms, so continue manually draining the breast after feeding and reevaluate in 24 hours.

When these situations are not treated correctly, they can lead to a breast abscess that is difficult to manage, and, in these circumstances of discomfort, breastfeeding is more likely to be discontinued.

Another complication during lactation can be tamponade, which is ductal inflammation and narrowing that causes an indurated area without associated systemic symptoms or erythema. The patient only reports local symptoms and pain, which should be resolved to avoid further complications. *Figure 2* summarizes the flow of decisions and actions for an indurated breast.

THE ROLE OF PROBIOTICS IN MASTITIS PREVENTION

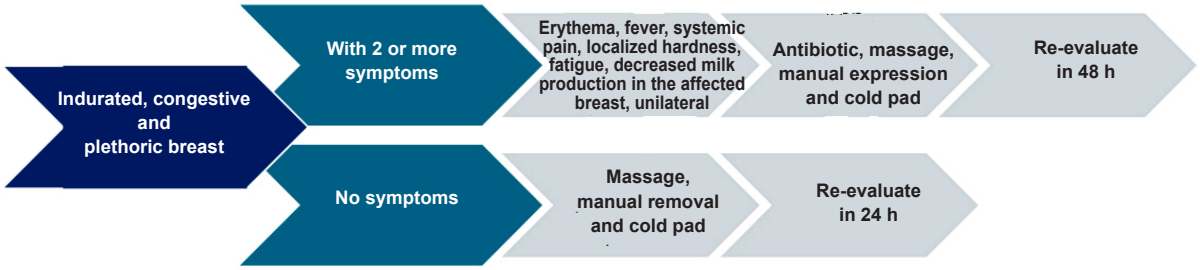
Probiotics are live microorganisms that benefit the host's health when administered adequately.[22] Because mastitis involves an inflammatory process, and specific probiotic strains demonstrate anti-inflammatory capacity, probiotics have been considered in the approach to this condition. *Ligilactobacillus salivarius* PS2 (current name of *Lactobacillus salivarius* PS2) was studied in two interventions.

In the first intervention, it was administered from 30 weeks of gestation until delivery, and the occurrence of mastitis was assessed during the first three months after delivery. In the placebo group, 44 of 108 women (41%) developed mastitis, whereas the percentage of women with mastitis in the probiotic group (25%, n = 14) was significantly lower. When mastitis occurred, milk bacterial counts in the probiotic group were significantly lower than in the placebo group.[23]

In a second study,[24] the intervention began at week 35 of pregnancy and was continued until week 12 postpartum. The primary outcome was that women in the probiotic group were 58% less likely to suffer mastitis.

Although the papers do not address the mechanisms of action by which the beneficial effects were observed, the hypothesis could be that the anti-inflammatory response exerted at the intestinal level could have reached the mammary gland. Two systematic review papers with meta-analysis,[20,25] (one conducted by the Cochrane organization) address the oral administration of probiotics to mothers to prevent mastitis. The strains evaluated in these studies were *L. salivarius* CECT5713, *L. gasseri* CECT5714, *L. fermentum* CECT5716, and *L. salivarius* PS2, in concentration ranges from 1×10^9 CFU/day to 1×10^{10} CFU/day and administration periods from 3 to 16 weeks. The systematic review with meta-analysis published in 2022 concludes that oral probiotics during pregnancy can reduce the incidence of mastitis. After oral administration

Figure 2. Decision flow diagram in the presence of indurated breast during lactation



of probiotics, the bacterial count in the milk of mothers with mastitis decreased significantly, indicating that probiotics are beneficial in reducing the incidence rate of mastitis during lactation and some related symptoms.[23]

The Cochrane Review studied different interventions to prevent mastitis after delivery, such as antibiotics, massage, and probiotics, among other treatments.[20] The strains included were *L. fermentum* CECT5716, *L. salivarius* PS2, and an unidentified strain of *L. fermentum*. This work concluded that probiotics may reduce the risk of mastitis more than placebo, but it is uncertain whether they reduce the risk of breast pain or nipple injury.

CONCLUSIONS

Human milk is the best food for infants, and mastitis should not be a reason to discontinue breasfeeding. Mastitis should not be confused with the physiological phenomena associated with lactogenesis II (commonly referred to as milk coming in). Before the persistence of pain, timely medical consultation is key to avoid complications. The administration of specific probiotic strains in late pregnancy and during early lactation has shown efficacy in reducing the incidence of mastitis in the context of clinical studies. It may be helpful in a comprehensive approach to mastitis. ■

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