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REVIEW ARTICLE

Application of vaginal probiotics in the prevention of dysbiosis and reduction of vaginal infections in Ecuador: bibliographic analysis

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ABSTRACT

Introduction: the balance of the vaginal microbiota is essential for female reproductive health, and its alteration favors recurrent infections.
Objective: to analyze the evidence on the use of vaginal probiotics in the prevention of dysbiosis and reduction of infections in Ecuadorian women.
Methods: a systematic review of the scientific literature was conducted across several databases. The search was carried out using an algorithm with keywords and Boolean operators, allowing the identification of relevant sources. Selected studies, after applying inclusion and exclusion criteria, were critically analyzed considering timeliness, methodological quality, and thematic relevance, and integrated into the final synthesis of the review.
Development: lactobacilli produce lactic and acetic acids that inhibit the growth of Candida and alter the morphology of Gardnerella vaginalis, reducing biofilms and restoring microbial balance. Studies show efficacy in preventing bacterial vaginosis and recurrent candidiasis, decreasing antimicrobial resistance. However, effectiveness varies depending on strain, route of administration, and ethnic factors. In Ecuador, the prevalence of vaginal infections is high, with Candida albicans and Gardnerella as the main agents. Probiotics emerge as a complementary alternative to conventional treatments, although randomized clinical trials are still required to recommend their routine use.
Conclusions: vaginal probiotics represent a promising strategy to prevent dysbiosis and recurrent infections, especially in high-prevalence contexts such as Ecuador. Their integration into clinical protocols could reduce complications and antimicrobial resistance, although further studies are needed to establish definitive recommendations.

Keywords: Dysbiosis; Infections; Microbiota; Probiotics; Vagina.

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INTRODUCTION

Vaginal dysbiosis is defined as an imbalance of the vaginal microbiome, characterized by a reduction in lactobacilli and a consequent overgrowth of *Streptococcus*, *Staphylococcus*, and/or Enterobacteriaceae, as well as increased susceptibility to vaginal candidiasis and trichomoniasis. Vaginal dysbiosis is a key factor that heightens the risk of vaginal infections.[1] The vaginal microbiota is crucial for maintaining vaginal health and protecting the host against disease. It classically comprises a diverse community of anaerobic and aerobic microorganisms, with *Lactobacillus* species being the most predominant. These bacteria help maintain an appropriate pH and play a decisive role in preventing urogenital diseases such as bacterial vaginosis (BV), yeast infections like vulvovaginal candidiasis (VVC), sexually transmitted infections (STIs), urinary tract infections, and even human immunodeficiency virus (HIV) infection.[2]

Vaginal infections have been linked to severe consequences for women's health, including infertility, preterm birth, pelvic inflammatory disease (PID), premature rupture of membranes, and spontaneous abortion.[3] Numerous studies have demonstrated a strong correlation between reduced lactobacilli proportions and overgrowth of pathogenic microorganisms leading to these complications. The frequent recurrence of infectious vaginal diseases and the rising bacterial resistance to antibiotics have driven the search for viable alternatives to prevent incidence and improve vaginal health.[4]

Prevalence of these infections varies widely. According to various studies in Ecuador, *Candida albicans* is the most common fungal pathogen (50 %),[5] with a reported 23,9 % prevalence of vulvovaginal candidiasis among pregnant women in Quito.(6) Regarding bacterial vaginosis, a study in Cuenca reported a prevalence of approximately 16,7 %.[7] Overall, in Ecuador, the prevalence of *Gardnerella vaginalis* is 60 %, *Candida* spp. 50 %, and *Trichomonas* 2–30 %.[5]

Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a health benefit to the host.[8,9] Recent in vitro studies have demonstrated that lactobacilli exhibit antibacterial activity against BV pathogens such as *Prevotella bivia*, *Atopobium vaginae*, and *Gardnerella vaginalis*.[10] Similarly, in VVC, the indiscriminate use of fluconazole has led to significant resistance, as its mechanism of action does not eradicate vaginal *Candida* but only inhibits its growth. However, recent animal model studies have shown the efficacy of both oral and intravaginal probiotic therapy in treating VVC.[11]

Currently, probiotic use in the prevention and management of infections has proven to be a valuable adjunct to first-line treatments for vaginal infections. While several studies report promising results, many emphasize that ethnic origin influences outcomes—most data come from developed countries. In Ecuador, the prevalence of vaginal infections among women of reproductive age and pregnant women remains high, representing a public health problem, as recurrences lead to complications and excessive healthcare costs.[12,13,14,15] This context motivated the present review, which aimed to analyze the evidence on the use of vaginal probiotics for the prevention of dysbiosis and reduction of infections in Ecuadorian women.

METHODS

This study was structured as a systematic literature review following the PRISMA 2020 guidelines to ensure transparency and reproducibility in the search and selection process. The search period was limited to 2019–2024 to capture the most recent evidence on vaginal probiotics for the prevention of dysbiosis and reduction of vaginal infections in women of reproductive age.

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High-impact scientific databases were consulted: PubMed/MEDLINE, Cochrane Library, Elsevier, and Scopus. Secondary references from selected articles were also reviewed to broaden coverage and reduce publication bias. Grey literature outside institutional repositories was excluded, prioritizing peer-reviewed, indexed studies.

The search strategy employed an algorithm combining keywords and Boolean operators. MeSH and DeCS terms such as "probiotics," "vaginal microbiota," "bacterial vaginosis," "Candida infections," and "dysbiosis" were combined using AND and OR operators to maximize sensitivity and specificity. Publications in Spanish and English were included to integrate evidence from diverse clinical and cultural contexts.

Inclusion criteria encompassed original articles, clinical trials, cohort studies, and systematic reviews published within the defined timeframe that directly addressed the use of vaginal probiotics for the prevention or treatment of dysbiosis and vaginal infections. Duplicates, articles without full access, irrelevant documents, publications prior to 2019, as well as letters, editorials, clinical practice guidelines, and theses were excluded.

The selection process occurred in several phases: initial title and abstract screening to exclude non-relevant studies, followed by full-text evaluation of potentially eligible articles. Initially, 85 records were identified; after removing duplicates and applying exclusion criteria, the sample was reduced to 32 articles; finally, 18 studies were included in the qualitative synthesis. The procedure was documented using a PRISMA flow diagram reflecting each selection stage.

Data extraction and analysis were performed systematically, collecting key variables such as author, publication year, methodological design, population characteristics, type of probiotic used, route of administration, clinical outcomes, and main findings. Information was organized into comparative matrices to facilitate interpretation. A qualitative synthesis was conducted, as methodological and outcome heterogeneity precluded formal meta-analysis. This approach enabled integration of available evidence and provided a critical, up-to-date overview of the role of vaginal probiotics in preventing dysbiosis and reducing vaginal infections in the Ecuadorian context.

DEVELOPMENT

The literature reports that dietary balance—limiting sugar intake and promoting dairy and vegetable consumption—significantly reduces the risk of vaginitis and provides substantial benefits in its treatment. High dietary fat intake (where 39 % of energy comes from fats), particularly total, saturated, and monounsaturated fats, may elevate vaginal pH, thereby increasing the likelihood of bacterial vaginosis. Consumption of functional foods and supplements containing probiotics and prebiotics exerts a positive impact on reducing genital inflammation.[15,16]

In bacterial vaginosis therapy, *Lactobacillus*-based probiotics administered orally or intravaginally have demonstrated significant efficacy in maintaining and preserving a healthy vaginal microbiota.[3] Numerous recent in vitro studies, such as that by Happel et al.,[10] have shown that various *Lactobacillus* strains produce acetic and lactic acids capable of altering *G. vaginalis* cell morphology, causing cell shrinkage or lysis. Additionally, they modify Na^+/K^+-ATPase activity, impairing ATP metabolism and subsequently inhibiting *G. vaginalis* growth and reproduction. These probiotics also drastically reduce *G. vaginalis* biofilm formation, particularly during early biofilm development.[3]

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The use of probiotics as adjunctive therapy may improve short-term bacterial cure rates and reduce recurrence frequency within one month; however, they are not a long-term solution. It is essential to carefully evaluate the pros and cons of probiotics in the treatment of bacterial vaginosis in non-pregnant women.[16,17]

Studies by Andrade et al.,[18] and Charlet R, et al.,[19] indicate that probiotic lactobacilli—administered either orally or intravaginally—can help maintain and even restore the vaginal microbiome to a healthy state. Moreover, literature reports that certain *Lactobacillus* strains, once isolated, have demonstrated significant antibacterial activity against BV pathogens—not only in specific populations but across strains isolated from women worldwide.

Another characteristic of lactobacilli is their ability to enhance pro-inflammatory cytokines. Increased production of IL-8, IL-1β, and human β-defensin 2 prevents future infections by *Gardnerella* and *Mobiluncus* by inhibiting their adhesion to vaginal epithelial cells, as noted by Li et al.[20]

Experiments by Basavaprabhu et al.,[21] have demonstrated the effectiveness of treatments using single or combined strains, administered either intravaginally or orally. Oral administration showed higher success rates in BV cases. Vaginal probiotics such as *L. rhamnosus* GR-1 and *L. reuteri* RC-14, when administered orally, resulted in improved vaginal flora.

However, a study by Bertuccini et al.,[12] found that *L. rhamnosus* GR-1 and *L. reuteri* RC-14 K, when isolated and used in patients of different ethnicities, showed reduced or no effect regardless of administration route—highlighting ethnicity as a determining factor in treatment response. Administration route also plays a critical role: comparisons between oral and intravaginal routes show that oral delivery is slower and may result in loss of probiotic strains essential for BV treatment.[12]

Role of probiotics in vulvovaginal candidiasis (VVC)

Vulvovaginal candidiasis ranks second in frequency among vaginal infections, after bacterial vaginosis, and is predominantly caused by the opportunistic fungus *Candida*. Data indicate that VVC affects a large proportion of sexually active women, with up to 75 % experiencing at least one episode in their lifetime, and 5–10 % suffering from recurrent VVC—defined as four or more episodes per year.[15,22]

Various *Candida* species are commensal yeasts, with a prevalence of 10–20 % in healthy women, forming part of the vaginal mucosal microflora. They can colonize the vulvovaginal mucosa asymptomatically in yeast form, but under certain conditions, *Candida* can transform into hyphae and cause acute infection. Imbalances between commensal *Candida* flora and the host vaginal environment—driven by behavioral and host-related factors—can predispose to VVC.[23] These factors include pregnancy, hyperglycemia, immunosuppression, antibiotic or glucocorticoid use, oral contraceptives, intrauterine devices, and genetic predispositions, which increase vulnerability to infection. Clinically, VVC is characterized by vaginal inflammation, pruritus, and white discharge. Women at highest risk include those with high estrogen levels or immunocompromise. Importantly, VVC is not considered a sexually transmitted infection.[24]

Candida can undergo morphological transformation from round, ovoid yeast cells to filamentous hyphae, enabling it to act as both a commensal colonizer and a pathogen.[25] In vitro co-culture studies of vaginal yeasts and lactobacilli suggest that lactobacilli can inhibit *Candida*'s yeast-to-hypha transition, reduce its vaginal presence, and compete for epithelial adhesion sites due to higher affinity, as proposed by Spaggiari et al.[26]

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Lactic acid produced by lactobacilli can limit *Candida* overgrowth and hyphal transformation by regulating the expression of *Candida* proteins such as agglutinin-like sequence protein (Als3) and hypha-associated proteins (HGC1, Ece1, Hwp1, Hyr1), as indicated by Chow et al.[27] Additionally, lactobacilli's ability to inhibit pathogenic hyphae formation may reduce *Candida*'s capacity to form biofilms.[25]

Lactobacillus-derived biosurfactants—such as iturin, lichenysin, and surfactin—have shown potential to limit *Candida* biofilm formation and prevent biomass expansion. Furthermore, lactobacilli can reduce *C. albicans* pathogenicity by enhancing local immune responses through cytokine modulation, as noted by Andrade et al.[18] Oleic and palmitic acids produced by *Lactobacillus johnsonii* can increase IL-10 expression and reduce TNF-α, IL-6, and IL-12 production in lipopolysaccharide-stimulated macrophages.[28]

However, not all *Lactobacillus* species are beneficial in treating vaginal infections. For example, women with positive candidiasis have shown increased prevalence of *Lactobacillus iners*, which may enhance *C. albicans* biofilm formation, promote hyphal growth, and upregulate hypha-associated genes such as *hwp1* and *ece1*, as reported by Sabbatini et al.[29]

Recent animal model studies have demonstrated the efficacy of both oral and intravaginal probiotic therapy in VVC treatment. In a murine model, biosurfactants from a vaginal *L. crispatus* strain reduced viable *C. albicans* counts and leukocyte influx.[3,11] Similarly, in a murine VVC model, prophylactic treatment with *L. casei*/pPG612.1-BLF increased vaginal IL-17 production, decreased IL-23 levels, and reduced *Candida* burden after five days of therapy.

This bibliographic review identified multiple studies reporting low cure rates for both bacterial and fungal vaginal infections. Many focus on lactobacilli—the most abundant agents in vaginal microbiota—due to their significant effects, including inhibition of pathogenic microbial proliferation, creation of barriers that impede biofilm formation, and maintenance of vaginal epithelial integrity and function.[2,30] Chee et al.,[22] conclude that *Lactobacillus* strains demonstrate potential health benefits through immunomodulation and restoration of healthy intestinal and vaginal microflora, suggesting investment in developing additional probiotic-based treatments to harness these advantages. Regarding fungal infections—predominantly caused by Wei G et al.,[31] demonstrate that lactobacilli probiotics reduce recurrence by regulating vaginal pH.

Despite promising in vitro and animal model results, significant heterogeneity exists among clinical trials regarding probiotic strains/combinations used and target populations (ethnicity, age, life stage, and methodologies).[3] There remain insufficient randomized studies to recommend routine daily probiotic use for preventing vaginal infections. Some trials, such as Sgibnev's,[32] suggest probiotics should be used alongside conventional treatments to prevent mixed-infection recurrence and enhance standard therapy effectiveness.

Bacterial, fungal, and mixed vaginal infections exhibit high prevalence in Ecuador, where probiotic use remains secondary. Socioeconomic factors and limited access to these products—which have proven adjunctive to conventional therapy—could significantly reduce recurrence rates among women of reproductive age and lower national healthcare costs associated with high metronidazole and fluconazole demand. Despite existing evidence, routine daily probiotic use as a preventive measure still requires further research on long-term health effects.

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CONCLUSION

The use of probiotics as a preventive method for bacterial, fungal, and mixed vaginal infections is not yet established. However, several studies confirm that specific lactobacilli strains—when combined with conventional treatments such as metronidazole (500 mg every 12 hours for seven days) and/or clotrimazole 5% (daily applicator for seven nights)—are effective in preventing recurrences. In Ecuador, the high prevalence of vaginal infections among women of reproductive age directly impacts household economies, particularly in rural areas where low income, lack of access to clean water, and other socioeconomic barriers prevail. Therefore, integrating probiotics into the national health system as a complementary therapy for affected women would be highly beneficial.

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