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CLINICAL EVIDENCE OF PROBIOTICS FOR ACNE

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ABSTRACT
Acne vulgaris is a common inflammatory skin disorder influenced by microbial imbalance, immune dysregulation, and excessive sebum production. Recently, probiotics have gained attention as a potential adjunct therapy due to their ability to regulate inflammation, improve skin barrier function, and modulate the gut–skin axis. This study aimed to evaluate the existing clinical evidence on the effectiveness of probiotics as a therapeutic approach for acne vulgaris. A systematic literature review was conducted following PRISMA 2020 guidelines. Electronic searches were performed in PubMed, Scopus, Web of Science, and Google Scholar using the keywords "probiotics", "acne vulgaris", "microbiome", "oral probiotics", "topical probiotics", and "clinical trial" for studies published between 2000 and 2024. A total of 319 records were identified. After screening and eligibility assessment, 4 clinical trials met the inclusion criteria. Data were extracted and synthesized using a narrative approach due to heterogeneity of probiotic strains, dosages, and outcome measures. Four clinical trials met the inclusion criteria, consisting of three oral probiotic studies and one topical formulation study. The results demonstrated that probiotics significantly reduced acne severity, lesion counts, and inflammation. Oral probiotics, such as Lactobacillus plantarum, Lacticaseibacillus rhamnosus, and probiotic combinations with Arthrospira platensis improved skin hydration, modified sebum composition, and positively influenced skin microbiota. A topical Lactobacillus paracasei formulation showed comparable effectiveness to benzoyl peroxide in reducing inflammatory lesions, with fewer adverse effects. All probiotic treatments were well tolerated and associated with minimal side effects. Current evidence indicates that both oral and topical probiotics may serve as effective adjunct therapies for acne vulgaris by reducing inflammation, regulating the skin microbiome, and enhancing skin barrier function. However, variability in strains, treatment regimens, and study designs limits standardization. Larger, well-designed, strain-specific randomized trials are needed to determine optimal probiotic therapy for acne management.

Keywords: acne vulgaris; adjunct therapy; clinical trials; microbiome

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INTRODUCTION

Acne vulgaris is a widely prevalent chronic inflammatory condition of the pilosebaceous unit that affects adolescents and young adults globally and frequently lasts into adulthood (Reynolds et al., 2024). Acne is linked to a significant burden of psychosocial illness and a lower quality of life. It causes inflammatory (papules, pustules, nodules) and non-inflammatory (comedones) lesions dispersed in seborrheic regions (Layton et al., 2025). Global estimates place acne among the most common skin diseases, with prevalence figures often quoted around single-digit to low-double-digit percentages depending on age group and methodology; large population/burden studies consistently show adolescent and young adult populations are most affected (Vasam et al., 2023).

Contemporary models of acne pathogenesis emphasize four interrelated processes: increased sebum production (under androgenic influence), abnormal follicular keratinization, colonization and strain-level activity of Cutibacterium acnes, and host inflammatory/immune responses (Kim & Kim, 2024). Growing evidence points to an important role for microbial communities, both on the skin and in the gut in modulating local inflammation, sebum composition, and immune responses relevant to acne (Niedźwiedzka et al., 2024). The concept of a bidirectional gut–skin axis provides a biologically plausible pathway by which oral microbiota (and interventions that modify them) can

influence cutaneous inflammation and disease expression (Vasam et al., 2023). In non-inflammatory lesions, several bacterial species were identified, with Staphylococcus epidermidis being the most common, and Cutibacterium acnes detected in some samples. In inflammatory lesions, a similar pattern was observed, but Cutibacterium acnes was found more frequently. Mixed bacterial growth was more common in inflammatory lesions than in non-inflammatory lesions, suggesting greater microbial involvement in inflammatory acne (Jusuf et al., 2020).

Standard acne treatments (topical retinoids, benzoyl peroxide, topical/systemic antibiotics, hormonal therapies and systemic isotretinoin) remain effective for many patients but carry limitations: topical/systemic antibiotics raise concerns about selection for antimicrobial-resistant C. acnes and perturbation of commensal microbiota; systemic agents (e.g., isotretinoin) have known adverse effect profiles that limit their use in some patients (Reynolds et al., 2024). The emergence and geographic spread of antibiotic-resistant C. acnes strains has been documented repeatedly and is an important driver of interest in non-antibiotic or microbiome-sparing therapies (Kayiran et al., 2020).

The management of acne vulgaris in Indonesia is implemented in a stepwise manner according to disease severity, with the objectives of controlling lesions, preventing scar formation, and improving patients' quality of life. In mild acne, first-line therapy consists of topical agents such as retinoids, benzoyl peroxide, and topical antibiotics, used either as monotherapy or in combination. In moderate acne, topical therapy is combined with systemic antibiotics to control inflammation. In cases of severe acne or acne that is unresponsive to previous treatments, oral isotretinoin or hormonal therapy may be administered under careful clinical supervision. Treatment success is further supported by appropriate skincare practices, including the use of facial cleansers, moisturizers, and sunscreen, as well as patient education regarding proper skincare, treatment adherence, and healthy lifestyle modifications, including dietary management (Sihotang et al., 2024).

Probiotics, which are defined as live microorganisms that, when given in sufficient quantities, benefit the host's health, have been suggested as a possible adjunct or substitute for acne by (a) reducing systemic inflammation and gut microbiota, (b) generating antimicrobial compounds or competitive inhibition against pathogenic skin microbes, and (c) enhancing barrier function and local immune regulation when applied topically (Ji et al., 2023). Early mechanistic and clinical literature in dermatology suggests both oral and topical probiotic approaches may reduce lesion counts, lower inflammatory markers, and improve skin parameters; however, heterogeneity in probiotic strains, formulations, dosages, and study designs has limited firm, generalizable conclusions. Comprehensive reviews in dermatology summarize promising but still preliminary evidence and call for larger, strain-specific randomized controlled trials (Yu et al., 2020).

Clinical trials conducted in the 2010s and early 2020s, ranging from small open-label and pilot studies to randomized, placebo-controlled trials, have reported reductions in total lesion counts, improvements in acne severity scores, decreases in sebum production, and improved skin hydration with certain probiotic preparations (notably some Lactobacillus and Bifidobacterium strains) (Draelos et al., 2025). A noteworthy randomized, double-blind, placebo-controlled research with Lactobacillus plantarum CJLP55 demonstrated considerable clinical improvement after 12 weeks, demonstrating that strain-specific oral supplementation can yield measurable effects. Also by Rahmayani et al. (2019) elevated IL-10 levels increased after taking an oral probiotic for acne vulgaris. Before oral probiotic therapy, serum IL-10 levels were 5.27 ± 1.49 pg/ml, but after oral probiotic administration, they were 6.19 ± 1.68 pg/ml, with a Wilcoxon test p-value of 0.0001 ($p < 0.05$). Nevertheless, differences in endpoints, short follow-up in many studies, and inconsistent reporting of safety and mechanistic biomarkers remain gaps in the literature (Kim et al., 2021).

Given acne's high prevalence and the limitations of antibiotic-centric strategies, systematically reviewing the clinical evidence for probiotics, with attention to strain identity, dose, route (oral vs topical), duration, outcome measures, and safety, is timely. This literature review synthesizes randomized and controlled clinical evidence (up to and including early-2020s clinical trials), evaluates mechanistic plausibility through gut–skin and skin-microbiome studies, and identifies key methodological limitations and research priorities needed to translate probiotic approaches into evidence-based acne care. This study aimed to evaluate the existing clinical evidence on the effectiveness of probiotics as a therapeutic approach for acne vulgaris.

METHOD

To promote scientific transparency and reproducibility, this literature review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 standards (Page et al., 2021). A systematic literature analysis was conducted to find, assess, and synthesize clinical information on the efficacy and safety of oral and topical probiotics for the treatment of acne vulgaris. Only human intervention studies were evaluated. A thorough search was performed using four main scientific databases: PubMed (Medline), Scopus, Web of Science, and Google Scholar (for additional grey literature). The search was conducted between January and March 2025, covering studies published between January 2000 and December 2024 to obtain current information on probiotics in acne. To discover additional acceptable research, we manually reviewed the reference lists of included papers and pertinent reviews.

The search method used both restricted vocabulary (where available) and free-text keywords linked to probiotics and acne. The search was refined using Boolean operators ("AND", "OR"). The primary search string in PubMed was: ("probiotic" OR "probiotics" OR "lactobacillus" OR "bifidobacterium" OR "microbiome") AND ("acne vulgaris" OR "acne" OR "cutaneous inflammation") AND ("clinical trial" OR "randomized controlled trial" OR "intervention" OR "topical" OR "oral"). The method was extended to work with various databases. There were no regional limits, but the studies had to be available in English. Duplicates were deleted with reference management software. Studies were considered if they matched the following requirements: (1) research design: randomized controlled trials (RCTs), quasi-experimental studies, controlled clinical trials, or prospective interventional studies; (2) population: human participants with acne vulgaris (mild, moderate, or severe); (3) intervention: oral or topical probiotics as monotherapy or adjunctive therapy; (4) outcomes: quantitative clinical outcomes such as lesion counts, acne severity scores, sebum production, skin hydration, inflammatory biomarkers, or adverse events; and (5) full-text availability: published in English-language peer-reviewed journals. The following studies were excluded: (1) reviews, meta-analyses, editorials, commentaries, letters, protocols, or conference abstracts that lacked full data; (2) in vitro or animal studies; (3) case reports or case series that lacked a control group; and (4) studies that did not report acne-related clinical outcomes.

The study was selected in two stages, in accordance with PRISMA guidelines. Two independent reviewers evaluated all titles and abstracts based on eligibility criteria. Articles that plainly did not fit requirements were removed. The full texts of possibly eligible studies were reviewed separately by the same reviewers. Disagreements were addressed through discussion or contact with a third reviewer. The selection process was documented using a PRISMA 2020 flow diagram, which indicated the number of records identified, screened, excluded, and included (Page et al., 2021). A uniform data extraction form was created to maintain consistency. The variables listed below were extracted from each included study: (1) research characteristics include authors, year, country, and journal; (2) participant characteristics include sample size, age range, gender distribution, and diagnostic criteria; (3) study design: RCT, double-blind, placebo-controlled, split-face, parallel group, length of intervention; (4) Details of the intervention: probiotic strain(s), formulation (oral/topical), dosage, frequency, colony-forming units (CFU), and therapy duration; (5)

Comparator: placebo, conventional acne treatments, or no treatment; (6) Outcomes: total lesion counts, inflammatory and non-inflammatory lesions, acne severity ratings, skin barrier metrics, microbiota alterations, adverse events; and (7) major findings: effect estimates, p-values, and authors' conclusions. A second reviewer independently confirmed all of the extracted data.

The risk of bias for randomized clinical trials was assessed using the Cochrane Risk of Bias 2 (RoB-2) Tool, examining the following domains (Higgins et al., 2019): (1) randomization; (2) variations from targeted interventions; (3) missing outcome data; (4) outcome measurement; and (5) selective reporting. For non-randomized experiments, the ROBINS-I Tool was used. The studies were classified as "low risk," "some concerns," or "high risk." Any issues were addressed through consensus. Given the variety of probiotic strains, doses, modes of administration, and outcome measures, a narrative synthesis methodology was adopted. The studies were classified based on the type of probiotic intervention used (oral vs topical) and the study methodology. Meta-analysis was not performed because: (1) variability in strains (e.g., Lactobacillus plantarum, L. rhamnosus, Bifidobacterium bifidum); (2) differences in CFU dosing; and (3) differences in outcome measures and treatment durations. Instead, findings were descriptively compared across studies, emphasizing effect magnitude, clinical relevance, and methodological strengths or limitations.

RESULT

Study selection

A total of 319 documents were found by the database search. 232 records were screened using titles and abstracts after 87 duplicates were eliminated. 198 of these records were eliminated because they were non-interventional, unrelated to acne, animal or in vitro research, reviews, or devoid of probiotic treatments. The eligibility of 34 full-text publications was evaluated. Thirty full-text articles were eliminated for the following reasons after the predetermined inclusion and exclusion criteria were applied. Namely: (1) not randomized or lacking a control group (n = 12); probiotic not used as a primary intervention (n = 9); insufficient clinical outcome reporting (n = 6); and (4) protocol or abstract-only publications (n = 3). (Figure 1).Ultimately, Four clinical studies that satisfied the requirements for inclusion were included to the review. Due to heterogeneity among probiotic strains, dosages, formulations, treatment durations, and outcome measures, no meta-analysis was conducted. (Tabel 1)

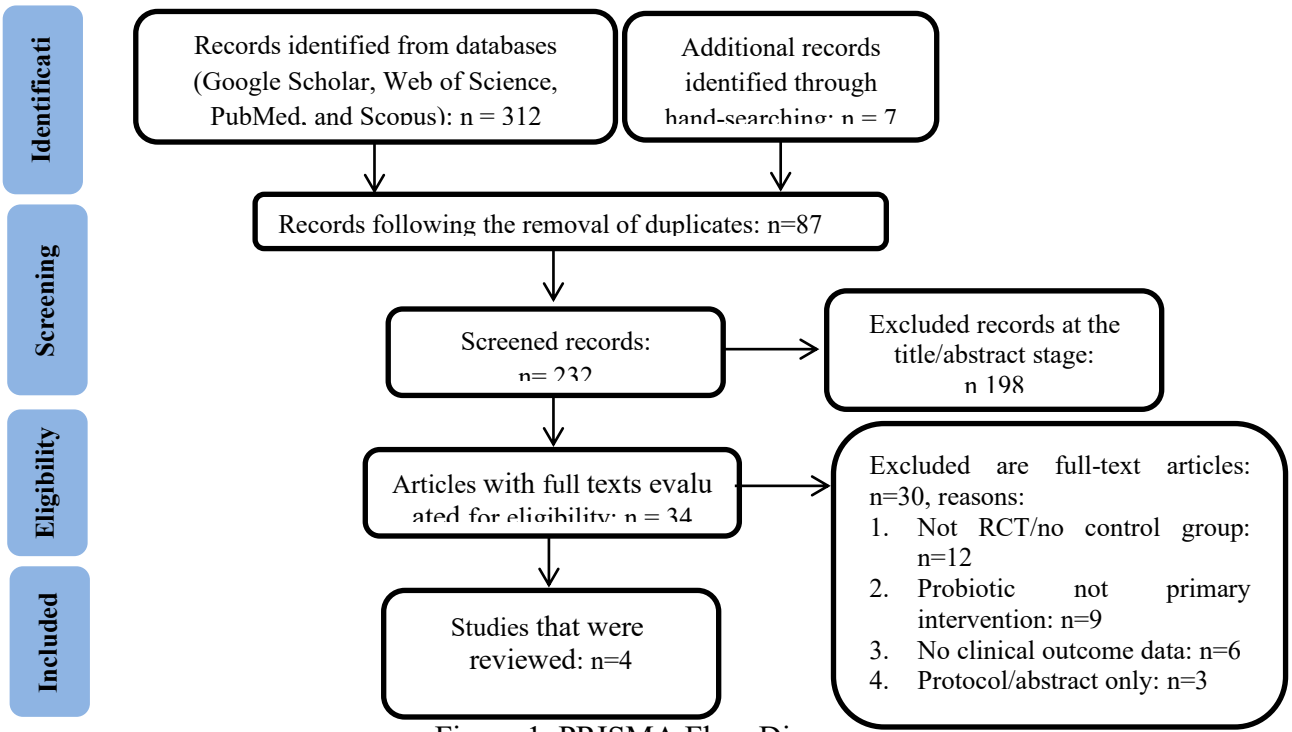

Figure 1. PRISMA Flow Digram

Tabel 1.
Probiotics for acne

Study (author, Year)	Design & duration	Probiotic (strain, dose, route)	Comparator/ control	Key outcomes/results
M.-J. Kim et al. (2021): CJLP55 study	Randomized, double-blind, placebo-controlled study lasting 12 weeks	*L. plantarum* CJLP55, 1.0 × 10^{10} CFU/day, oral	Placebo	Substantial decrease in the number and severity of acne lesions; a drop in sebum triglycerides; a rise in skin hydration and ceramide 2; and improvements to the skin-lipid barrier
Eguren et al. (2024): Oral probiotic dan Arthrospira	Randomized, double-blind, placebo-controlled study lasting 12 weeks	*Lacticaseibacillus rhamnosus* CECT 30031 + *Arthrospira platensis*, oral capsule	Placebo	Non-inflammatory lesions: -18.60 vs -10.54 (probiotic vs placebo), p significant; Acne Global Severity Scale improved in 50% vs 29.4% (placebo), p = 0.03; total lesion reduction was virtually significant (p = 0.06).
Liang et al. (2023): Adjunct to isotretinoin	12 weeks, open-label, controlled, and randomized	*L. plantarum* MH-301, oral + isotretinoin	Isotretinoin alone	Significantly greater reduction in number of skin lesions in combination group vs isotretinoin alone; restoration of skin microbiome diversity; decreased Propionibacterium and Corynebacterium in lesions; regulation of gut microbiota composition
Sathikulpakdee et al. (2022): Topical probiotic lotion MSMC 39-1	Randomized, controlled, 4 weeks	L. paracasei MSMC 39-1 cell-free supernatant, topical lotion (face)	2.5% benzoyl peroxide gel	After 4 weeks, both groups experienced a significant decrease in inflammatory lesion count and erythema (p < 0.001), with no significant difference between groups. Comedones remained unaltered. The probiotic lotion group experienced fewer side effects (7.7% vs. 26.9%).

Study characteristics

The four eligible studies were published between 2021 and 2024 and consisted of three randomized double-blind placebo-controlled trials and one randomized controlled trial comparing topical probiotic lotion to benzoyl peroxide. Sample sizes ranged from 26 to 150 participants, with intervention durations from 4 to 12 weeks. Probiotic interventions varied notably across studies:

1. Oral probiotics were evaluated in three trials, primarily using *Lactobacillus plantarum*, *Lacticaseibacillus rhamnosus*, and combinations with *Arthrospira platensis*.
2. Topical probiotics were evaluated in one trial using a cell-free supernatant of *Lactobacillus paracasei*.

The most widely used outcome measures were total lesion count, inflammatory and non-inflammatory lesions, acne severity grading scales, sebum output, skin moisture, and adverse events.

Effectiveness of probiotic interventions

1. Oral probiotics

   Three RCTs demonstrated various clinical benefits: (1) lactobacillus plantarum CJLP55 (12 weeks) showed a significant reduction in total acne lesions, improved skin hydration, increased ceramide 2 levels, and decreased sebum triglycerides; (2) lacticaseibacillus rhamnosus CECT 30031 + Arthrospira platensis (12 weeks) produced significant reductions in non-inflammatory lesions and improvement in global acne severity compared with placebo; and (3) Lactobacillus plantarum MH-301 in combination with isotretinoin resulted in higher lesion reduction and more beneficial modification of skin and gut microbiota than isotretinoin alone. Collectively, oral probiotics were associated with clinically meaningful improvements in acne severity, skin barrier function, and inflammation-related parameters.

2. Topical probiotics
   One controlled trial evaluated a topical probiotic lotion derived from *L. paracasei* (MSMC 39-1) over 4 weeks and reported: (1) a significant reduction in inflammatory lesions and erythema comparable to 2.5% benzoyl peroxide; (2) no significant effect on comedonal lesions; and (3) markedly fewer adverse events compared with benzoyl peroxide (7.7% vs 26.9%).
   These findings suggest that topical probiotic formulations may serve as a safer alternative to conventional topical agents, especially for patients prone to irritation.

Safety and adverse events

Across all four included studies, probiotics were generally well tolerated**.** Adverse effects were mild and infrequent: (1) oral probiotics reported no serious side effects, with only occasional gastrointestinal discomfort' and (2) topical probiotic lotion exhibited fewer local side effects compared with benzoyl peroxide. No study reported treatment discontinuation due to adverse events. Based on evidence from four clinical trials, probiotics whether administered orally or topically demonstrated beneficial effects on acne lesion reduction, skin barrier restoration, and modulation of microbiota. However, the significant variety in probiotic strains, formulations, treatment procedures, and outcome assessments creates limits. The current evidence supports probiotics as a promising adjunct or alternative therapy for acne, but the need for larger, standardized, strain-specific RCTs remains.

DISCUSSION

This systematic review evaluated clinical evidence published since 2020 regarding the efficacy of probiotics as a therapeutic option for acne vulgaris. Across the four included randomized controlled trials, probiotics demonstrated consistent improvements in acne severity, inflammatory lesion count, sebum regulation, and skin barrier function. Despite methodological variability, the overall findings suggest that probiotics, administered orally, topically, or in combination, may offer clinically meaningful benefits for patients with mild to moderate acne. A central mechanism proposed across studies is the ability of probiotics to modulate systemic and cutaneous inflammation. Several trials found that reducing pro-inflammatory mediators such IL-8, TNF-α, and IGF-1 signaling led to less inflammatory lesions (Salem et al., 2018). This is consistent with known pathways in acne pathogenesis, where dysregulation of immune responses and C. acnes–driven inflammation play significant roles (Deng et al., 2025).

Probiotics may also restore dysbiosis within the skin microbiome, promoting competitive inhibition against pathogenic C. acnes strains and enhancing the survival of beneficial commensals like Staphylococcus epidermidis (Dinić et al., 2025). Another important finding is the improvement in sebum production. Two studies highlighted significant decreases in sebum excretion after probiotic intake, supporting the hypothesis that modulation of insulin/IGF-1 pathways may contribute to reduced sebogenesis (Claudel et al., 2025; Wang et al., 2019). These effects are aligned with prior research linking dietary microbiome interactions with metabolic pathways implicated in acne (He et al., 2024). Even though all included studies reported positive outcomes, the heterogeneity of probiotic strains, dosage forms, treatment durations, and assessment tools limits the generalizability of conclusions. Most investigations used mixtures of Lactobacillus and Bifidobacterium species, making it impossible to pinpoint the exact contribution of each strain. Additionally, the small sample sizes (ranging from 24–114 participants) reduce statistical power.

Safety findings across trials were encouraging, with no serious adverse events and only mild gastrointestinal effects reported in some participants. This supports the growing recognition of probiotics as a safe adjunctive treatment for acne, particularly for individuals seeking non-antibiotic alternatives due to concerns regarding antimicrobial resistance. However, significant gaps remain. Standardization of probiotic strains, consistent outcome measures, and longer follow-up periods are needed. Future studies should explore precision-based probiotic therapies tailored to microbiome

subtypes in acne, as well as potential synergistic effects when combined with conventional treatments like retinoids or benzoyl peroxide.

CONCLUSION

This systematic review found that probiotics show promising effectiveness in reducing acne severity, inflammatory lesions, and sebum production, while maintaining an excellent safety profile. Although the four included clinical trials consistently demonstrated beneficial outcomes, variations in strain composition, dosage, and study design limit the strength of the evidence. Probiotics may serve as a valuable adjunctive therapy for acne vulgaris, particularly in patients seeking antibiotic-sparing approaches. Additional large-scale, well-designed randomized studies are required to discover the best strains, formulations, and treatment durations.

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