WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Role of Probiotics as Therapy for Acne in Adolescents

Amelia A. Badri[1], Ni Nyoman Ayu Dewi[2], Ida Ayu Ika Wahyuniari[3]

[1]Master of Biomedical Sciences, Anti-Aging Medicine, Faculty of Medicine, Udayana University, Denpasar, Indonesia. [2]Department of Biochemistry, [3]Department of Histology, Faculty of Medicine, Udayana University, Denpasar, Indonesia.

DOI : https://doi.org/10.55248/gengpi.6.0225.1002

A B S T R A C T

Acne is a common dermatological condition in adolescents, primarily influenced by hormonal changes, increased sebum production, and bacterial colonization, particularly Cutibacterium acnes (C. acnes). Recent research suggests that probiotics may offer a promising therapeutic approach by modulating skin microbiota, reducing inflammation, and enhancing the skin barrier. Probiotics such as Streptococcus salivarius, Lactococcus sp. HY449, and Streptococcus thermophiles have demonstrated antimicrobial activity against C. acnes through the production of bacteriocins and the promotion of ceramide synthesis, which strengthens the skin barrier and reduces irritation. Additionally, probiotics may regulate insulin-like growth factor-1 (IGF-1), a hormone implicated in acne development, particularly in individuals consuming high-glycemic diets. Clinical and in vitro studies indicate that topical and oral probiotics can help restore microbial balance, mitigate inflammation, and improve acne severity. This review explores the mechanisms by which probiotics influence acne pathophysiology and their potential role as a complementary or alternative therapy for adolescent acne management. Further research is needed to establish standardized probiotic strains, dosages, and treatment protocols for optimal therapeutic outcomes.

Keywords: Acne, Probiotics, Adolescents, Skin Microbiota, IGF-1

1. INTRODUCTION

More than 80% of teens and young adults suffer from acne (Mosaico *et al.,* 2022) Based on epidemiological studies, acne is most commonly experienced by adolescents after puberty, with boys more often affected, especially in more severe forms (Tan & Bhate, 2015; Zaenglein et al., 2016) The impact of acne vulgaris on psychology is very significant, characterized by an increased risk of experiencing insomnia, depression, anxiety, as well as impaired concentration and hyperactivity (Trivedi *et al*., 2018).

Acne vulgaris is a chronic inflammatory disease that is common in the pylobasea unit. This condition is usually characterized by the appearance of papules, pustules, or nodules, especially in the facial area, but can also be present on the upper arms, body, and back. Generally, this disorder is triggered during adolescence by *Cutibacterium acnes*, a species of bacteria that influences dehydroepiandrosterone levels(Sutaria AH, 2025).

Acne vulgaris is a chronic disease that requires long-term treatment to achieve optimal results. One of the main challenges in treatment is patient adherence, especially to topical therapies, due to side effects as well as long treatment durations. Non-compliance in undergoing therapy can lead to acne recurrence, patient dissatisfaction, and increased medical care costs (Sevimli Dikicier, 2019)

Many new therapies are proposed for acne pathogenesis including sebum-suppressing and anti-inflammatory phytochemicals and also laser therapy. However, research interest in probiotics has increased in the medical field in the last 20 years (Trivedi *et al.,* 2018) Several studies have proven the role of the microbiome in human health with a focus on oral and topical probiotics can be used in the prevention and treatment of skin diseases (Yu *et al.*, 2020), so in the near future, it is possible that therapy for P. acnes and acne vulgaris may include probiotics as the gold standard (Mosaico *et al.*, 2022).

2. LITERATURE REVIEW

2.1 Prevalence studies

Acne vulgaris has a prevalence of 9.4% and is included in the eight most common diseases in the world. About 85% of adolescents aged 12–15 years experience this condition and every year, the number of people with acne vulgaris continues to grow. According to a survey on the epidemiological characteristics of adolescent acne in Northeast China, the total prevalence of adolescent acne is 51.30% (52.74% in men, 49.65% in women) (Wang *et al*., 2022)

2.2 Factors that affect the onset of acne

The main factors that play a role in the development of acne include hyperkeratinization of follicles, colonization of microbes by *Propionibacterium acnes*, increased sebum production, and complex inflammatory mechanisms involving innate and acquired immunity. In 2014, Kistowska *et al*. reported that *P. acnes* triggers inflammation through IL-1β and NLRP3 inflammasome-driven pathways of myeloid cells. In addition, research shows that neuroendocrine regulation, diet, and genetic and non-genetic factors also contribute to the multifactorial process of acne pathogenesis (Zaenglein *et al*., 2016) . Androgens play an important role in the production and excretion of sebum. This further contributes to the formation of acne lesions. Moisturizers and cosmetics can also cause or worsen acne vulgaris cases (Gollnick *et al*., 2016). Acne vulgaris is closely related to diet. The three main food groups that can trigger acne include: 1) carbohydrates with a high glycemic index, 2) milk and its processed products, and 3) saturated fats, including trans fats and an unbalanced intake of omega-3 polyunsaturated fatty acids (PUFAs). Insulin signaling and insulin-like growth factor (IGF-1) triggered by diet are further amplified by increased IGF-1 levels during puberty, which then leads to nutrigenomic disturbances in the balance of the sebaceous glands (Melnik, 2015).

2.3 Probiotics

Probiotics are live microorganisms that provide benefits to their hosts when consumed in adequate amounts, with a high level of safety. Although initially widely researched for their impact on the digestive system, probiotics have a wider range of applications, as explained in the gut-skin-brain axis theory that has been put forward since 80 years ago. The most common types of bacteria used as probiotics are *Lactobacilli* (*L.)* and *Bifidobacteria*, but combinations with other microorganisms, such as Gram-positive cocci, bacilli, yeast, and *Escherichia coli*, have also been applied. Probiotic products are available in a variety of forms, including powders, tablets, beverages, and fermented dairy products (Fuchs-Tarlovsky *et al*., 2016; Gasbarrini *et al*., 2016). Topical probiotics have also been used to maintain healthy skin since the early 20th century, and in the last decade there has been a dramatic increase in commercially available topical probiotics (Gao *et al*., 2023).

3. RESULT

Effects of Probiotics on Acne Vulgaris

Skin barrier dysfunction is a common side effect of various acne medications, including topical retinoids and benzoyl peroxide. The use of these medications can cause irritation, burning sensation, and dryness, potentially reducing the patient's adherence to the acne treatment regimen (Kober & Bowe, 2015). Topical and oral antibiotics have long been the main treatment for acne. However, *Cutibacterium acnes* resistance to antibiotics continues to increase over time and is a global problem for patients with acne. Higher levels of resistance were reported in clindamycin (lincosamide) of 36–90% and erythromycin (macrolides) of 21–98%, compared to tetracyclines, which had lower resistance levels, at about 4–16% (Sardana *et al*., 2016)

Research shows a link between diet and skin condition. Consumption of foods high in fat and sugar can disrupt the balance between pathogenic and commensal microorganisms, which then triggers inflammation, including inflammation of the skin. In addition, stress also has an impact on the balance of the skin's microbiota, characterized by changes in the population of microorganisms such as *Lactobacillus* and *Bifidobacterium*, which are very sensitive to physiological changes in the body. Under stressful conditions, these microorganisms produce compounds that can trigger inflammatory signals in the body (Vaughn *et al.,* 2017)

In the 1960s, Dr. Robert H. Siver conducted the first clinical trial to assess the effects of probiotics on acne. He examined the effects of commercial oral probiotics (*Lactinex*, which contains *Lactobacillus acidophilus* and *Lactobacillus bulgaricus*) on 300 patients. Although the method used was unconventional—i.e. eight days of probiotic consumption, followed by a two-week pause before repeating—the results showed that 80% of patients experienced improvement, especially in inflammatory lesions (Bowe *et al*., 2014)

A study by Deng *et al*. (2018) showed that patients with acne had lower gut microbiota diversity as well as a higher *ratio of Bacteroidetes* to *Firmicutes*, a characteristic often associated with Western-style diets. In addition, research conducted by Yan *et al*. (2018) found that acne patients had reduced amounts of *Lactobacillus*, *Bifidobacterium*, *Butyricicoccus*, *Coprobacillus*, and *Allobaculum* compared to the control group. These findings provide new insights into the relationship between acne and changes in the composition of the intestinal flora. Manzhalii *et al.* (2016) A study of 57 patients with papulopustular acne vulgaris who underwent an intervention in the form of taking a probiotic supplement containing *Escherichia coli* Nissle every day for one month. The results showed that 89% of patients experienced significant improvement to total recovery of skin lesions. Two clinical trials have evaluated the effects of topical probiotics on acne. Two clinical trials have also been conducted, in the first clinical trial, a lotion containing *Enterococcus faecalis* was applied to the face for eight weeks, showing a 50% reduction in inflammatory lesions compared to the placebo group (Kang *et al.,* 2009)

4. DISCUSSION

Acne usually appears along with the development of puberty and increased sebum production. Therefore, this condition is more common in adolescents and is rarely found in prepubescent children. After passing adolescence, the prevalence of acne tends to decrease, although some adults still experience this problem. In fact, up to 43% of individuals who experience acne as a teenager continue to experience it until the age of 30–40 years (Sánchez-Pellicer *et al.,* 2022).

The balance of the skin microbiome is an important element in maintaining the skin's immune system. Imbalances in species composition, interactions between microorganisms, as well as their relationship with other parts of the body can trigger pathological changes that not only impact the skin. The dominant bacteria in the skin are commensal and, along with immune cells and keratinized skin cells that change every four weeks, play a role in maintaining the skin's immune barrier function. Dysbiosis, which is a disturbance of the balance of the normal microbiome, can be triggered by various internal and external stress factors. Efforts to overcome dysbiosis and restore the balance of the skin's microbiota include the use of probiotics and prebiotics. Some of the conditions related to skin microbiome disorders include acne, atopic dermatitis, and dandruff (Skowron *et al*., 2021). One of the most recognizable bacteria is *Cutibacterium acnes* (*C. acnes*), which begins to dominate from puberty and tends to develop in areas of the skin with high sebum production. Currently, *C. acnes* is considered to play an important role in maintaining the balance and function of the epidermis. Despite being an essential commensal bacteria, *C. acnes* can act as an opportunistic pathogen during puberty due to microbiota imbalances, contributing to the pathogenesis of inflammatory skin diseases such as acne vulgaris (Bolla *et al*., 2020)

A growing body of evidence suggests that probiotics can affect pathophysiological factors that play a role in the development of acne, potentially increasing patient adherence to treatment (Kober & Bowe, 2015). Probiotics directly inhibit the growth of *C. acnes* through the production of antimicrobial proteins. In vitro studies show that *Streptococcus salivarius* can suppress *C. acnes* by releasing inhibitory substances such as bacteriocin. Similarly, the strain *of Lactococcus sp. HY449* inhibits *C. acnes* through the secretion of bacteriocin. In addition, the topical use of probiotics can improve the skin's barrier function while increasing the production of antimicrobial peptides. For example, *Streptococcus thermophiles* have been shown to be able to increase ceramide synthesis, both in vitro and in vivo studies, when applied in cream form for one week. Ceramide not only plays a role in keeping the skin moisturized, but it also has antimicrobial properties against *C. acnes*, especially in certain forms of sphingolipids such as phytosphingosine, which help improve acne conditions. By increasing the production of ceramides, probiotics contribute to strengthening the skin's protective layer, which can help reduce irritation resulting from the use of topical agents. (Lee *et al*., 2019) In addition, insulin-like growth factor 1 (IGF-1) is thought to play a role in the development of acne. Consumption of foods high in milk and carbohydrates is associated with an increased risk of acne, possibly because it increases IGF-1 levels, in adolescents who are experiencing an increase in IGF-1, they will experience an even higher increase in IGF-1 levels (Melnik, 2015). However, the addition of *Lactobacillus* to fermented milk has been shown to lower IGF-1 levels by up to four times compared to unfermented skimmed milk. Therefore, probiotics have the potential to help treat acne by regulating IGF-1 levels (Lee *et al*., 2019).

5. CONCLUSIONS

Acne usually appears along with the development of puberty and increased sebum production. Therefore, this condition is more common in adolescents and is rarely found in prepubescent children. After passing adolescence, the prevalence of acne tends to decrease, although some adults still experience this problem. In fact, up to 43% of individuals who experience acne as a teenager continue to experience it until the age of 30–40 years (Sánchez-Pellicer et al., 2022).

The balance of the skin microbiome is an important element in maintaining the skin's immune system. Imbalances in species composition, interactions between microorganisms, as well as their relationship with other parts of the body can trigger pathological changes that not only impact the skin. The dominant bacteria in the skin are commensal and, along with immune cells and keratinized skin cells that change every four weeks, play a role in maintaining the skin's immune barrier function. Dysbiosis, which is a disturbance of the balance of the normal microbiome, can be triggered by various internal and external stress factors. Efforts to overcome dysbiosis and restore the balance of the skin's microbiota include the use of probiotics and prebiotics. Some of the conditions related to skin microbiome disorders include acne, atopic dermatitis, and dandruff (Skowron et al., 2021). One of the most recognizable bacteria is *Cutibacterium acnes* (*C. acnes*), which begins to dominate from puberty and tends to develop in areas of the skin with high sebum production. Currently, *C. acnes* is considered to play an important role in maintaining the balance and function of the epidermis. Despite being an essential commensal bacteria, *C. acnes* can act as an opportunistic pathogen during puberty due to microbiota imbalances, contributing to the pathogenesis of inflammatory skin diseases such as acne vulgaris (Bolla et al., 2020)

A growing body of evidence suggests that probiotics can affect pathophysiological factors that play a role in the development of acne, potentially increasing patient adherence to treatment (Kober & Bowe, 2015). Probiotics directly inhibit the growth of *C. acnes* through the production of antimicrobial proteins. In vitro studies show that *Streptococcus salivarius* can suppress *C. acnes* by releasing inhibitory substances such as bacteriocin. Similarly, the strain *of Lactococcus sp. HY449* inhibits *C. acnes* through the secretion of bacteriocin. In addition, the topical use of probiotics can improve the skin's barrier function while increasing the production of antimicrobial peptides. For example, *Streptococcus thermophiles* have been shown to be able to increase ceramide synthesis, both in vitro and in vivo studies, when applied in cream form for one week. Ceramide not only plays a role in keeping the skin moisturized, but it also has antimicrobial properties against *C. acnes*, especially in certain forms of sphingolipids such as phytosphingosine, which help improve acne conditions. By increasing the production of ceramides, probiotics contribute to strengthening the skin's protective layer, which cahelp reduce irritation resulting from the use of topical agents.(Lee et al., 2019) In addition, insulin-like growth factor 1 (IGF-1) is thought to play a role in the development of acne. Consumption of foods high in milk and carbohydrates is associated with an increased risk of acne, possibly because it increases IGF-1 levels, in adolescents who are experiencing an increase in IGF-1, they will experience an even higher increase in IGF-1 levels (Melnik, 2015) . However, the addition of *Lactobacillus* to fermented milk has been shown to lower IGF-1 levels by up to four times compared to unfermented skimmed milk. Therefore, probiotics have the potential to help treat acne by regulating IGF-1 levels (Lee et al., 2019).

REFERENCES

Bolla, B. S., Erdei, L., Urbán, E., Burián, K., Kemény, L., & Szabó, K. (2020). Cutibacterium acnes regulates the epidermal barrier properties of HPV-KER human immortalized keratinocyte cultures. Scientific Reports, 10(1). https://doi.org/10.1038/s41598-020-69677-6

Bowe, W. P., Patel, N. B., & Logan, A. C. (2014). Acne vulgaris, probiotics and the gut-brain-skin axis: From anecdote to translational medicine. In Beneficial Microbes (Vol. 5, Issue 2, pp. 185–199). Brill Wageningen Academic. https://doi.org/10.3920/BM2012.0060

Fuchs-Tarlovsky, V., Marquez-Barba, M. F., & Sriram, K. (2016). Probiotics in dermatologic practice. In Nutrition (Vol. 32, Issue 3, pp. 289–295). Elsevier Inc. https://doi.org/10.1016/j.nut.2015.09.001

Gao, T., Wang, X., Li, Y., & Ren, F. (2023). The Role of Probiotics in Skin Health and Related Gut–Skin Axis: A Review. In Nutrients (Vol. 15, Issue 14). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/nu15143123

Gasbarrini, G., Bonvicini, F., & Gramenzi, A. (2016). Probiotics History. Journal of Clinical Gastroenterology, 50, S116–S119. https://doi.org/10.1097/MCG.0000000000000697

Gollnick, H. P., Bettoli, V., Lambert, J., Araviiskaia, E., Binic, I., Dessinioti, C., Galadari, I., Ganceviciene, R., Ilter, N., Kaegi, M., Kemeny, L., López-Estebaranz, J. L., Massa, A., Oprica, C., Sinclair, W., Szepietowski, J. C., & Dréno, B. (2016). A consensus-based practical and daily guide for the treatment of acne patients. Journal of the European Academy of Dermatology and Venereology, 30(9), 1480–1490. https://doi.org/10.1111/jdv.13675

Kang, B. S., Seo, J. G., Lee, G. S., Kim, J. H., Kim, S. Y., Han, Y. W., Kang, H., Kim, H. O., Rhee, J. H., Chung, M. J., & Park, Y. M. (2009). Antimicrobial activity of enterocins from Enterococcus faecalis SL-5 against Propionibacterium acnes, the causative agent in acne vulgaris, and its therapeutic effect. Journal of Microbiology, 47(1), 101–109. https://doi.org/10.1007/s12275-008-0179-y

Kober, M. M., & Bowe, W. P. (2015). The effect of probiotics on immune regulation, acne, and photoaging. In International Journal of Women's Dermatology (Vol. 1, Issue 2, pp. 85–89). Elsevier Inc. https://doi.org/10.1016/j.ijwd.2015.02.001

Lee, Y. B., Byun, E. J., & Kim, H. S. (2019). Potential role of the microbiome in acne: A comprehensive review. In Journal of Clinical Medicine (Vol. 8, Issue 7). MDPI. https://doi.org/10.3390/jcm8070987

Melnik, B. C. (2015). Linking diet to acne metabolomics, inflammation, and comedogenesis: An update. In Clinical, Cosmetic and Investigational Dermatology (Vol. 8, pp. 371–388). Dove Medical Press Ltd. https://doi.org/10.2147/CCID.S69135

Mosaico, G., Artuso, G., Pinna, M., Denotti, G., Orrù, G., & Casu, C. (2022). Host Microbiota Balance in Teenagers with Gum Hypertrophy Concomitant with Acne Vulgaris: Role of Oral Hygiene Associated with Topical Probiotics. Microorganisms, 10(7). https://doi.org/10.3390/microorganisms10071344

Sánchez-Pellicer, P., Navarro-Moratalla, L., Núñez-Delegido, E., Ruzafa-Costas, B., Agüera-Santos, J., & Navarro-López, V. (2022). Acne, Microbiome, and Probiotics: The Gut–Skin Axis. In Microorganisms (Vol. 10, Issue 7). MDPI. https://doi.org/10.3390/microorganisms10071303

Sardana, K., Gupta, T., Kumar, B., Gautam, H. K., & Garg, V. K. (2016). A cross-sectional pilot study of antibiotic resistance in Propionibacterium acnes strains in Indian acne patients using 16s-RNA polymerase chain reaction: A comparison among treatment modalities including antibiotics, benzoyl peroxide, and isotretinoin. Indian Journal of Dermatology, 61(1), 45–52. https://doi.org/10.4103/0019-5154.174025

Sevimli Dikicier, B. (2019). Topical treatment of acne vulgaris: efficiency, side effects, and adherence rate. Journal of International Medical Research, 47(7), 2987–2992. https://doi.org/10.1177/0300060519847367

Skowron, K., Bauza ‐ kaszewska, J., Kraszewska, Z., Wiktorczyk ‐ kapischke, N., Grudlewska ‐ buda, K., Kwiecińska ‐ piróg, J., Wałecka ‐ zacharska, E., Radtke, L., & Gospodarek ‐ komkowska, E. (2021). Human skin microbiome: Impact of intrinsic and extrinsic factors on skin microbiota. In Microorganisms (Vol. 9, Issue 3, pp. 1–20). MDPI AG. https://doi.org/10.3390/microorganisms9030543

Sutaria AH. (2025). Acne Vulgaris. StatPearls [Internet]. Treasure Island (FL).

Tan, J. K. L., & Bhate, K. (2015). A global perspective on the epidemiology of acne. In British Journal of Dermatology (Vol. 172, Issue S1, pp. 3–12). https://doi.org/10.1111/bjd.13462

Trivedi, M. K., Bosanac, S. S., Sivamani, R. K., & Larsen, L. N. (2018). Emerging Therapies for Acne Vulgaris. In American Journal of Clinical Dermatology (Vol. 19, Issue 4, pp. 505–516). Springer International Publishing. https://doi.org/10.1007/s40257-018-0345-x

Vaughn, A. R., Notay, M., Clark, A. K., & Sivamani, R. K. (2017). Skin-gut axis: The relationship between intestinal bacteria and skin health. https://api.semanticscholar.org/CorpusID:90752338

Wang, Y., Xiao, S. X., Ren, J. W., & Zhang, Y. F. (2022). Analysis of the epidemiological burden of acne vulgaris in China based on the data of global burden of disease 2019. Frontiers in Medicine, 9. https://doi.org/10.3389/fmed.2022.939584

Zaenglein, A. L., Pathy, A. L., Schlosser, B. J., Alikhan, A., Baldwin, H. E., Berson, D. S., Bowe, W. P., Graber, E. M., Harper, J. C., Kang, S., Keri, J. E., Leyden, J. J., Reynolds, R. V., Silverberg, N. B., Stein Gold, L. F., Tollefson, M. M., Weiss, J. S., Dolan, N. C., Sagan, A. A., … Bhushan, R. (2016). Guidelines of care for the management of acne vulgaris. Journal of the American Academy of Dermatology, 74(5), 945-973.e33. https://doi.org/10.1016/j.jaad.2015.12.037