

RELIGA, Aleksandra, STARZYK, Agnieszka, CHARZEWSKI, Piotr and WRONA, Julia. Dietary and Probiotic Influences on Acne: A Comprehensive Review. *Quality in Sport*. 2025;39:58378. eISSN 2450-3118.

<https://doi.org/10.12775/QS.2025.39.58378>

<https://apcz.umk.pl/QS/article/view/58378>

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.

Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).

Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.

Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

© The Authors 2025;

This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland

Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author (s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non commercial license Share alike. (<http://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited.

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 30.01.2025. Revised: 02.03.2025. Accepted: 06.03.2025 Published: 07.03.2025.

Dietary and Probiotic Influences on Acne: A Comprehensive Review

Aleksandra Religa^{1*}, Agnieszka Starzyk^{1*}, Piotr Charzewski^{2*}, Julia Wrona^{3*}

1. Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland

2. Kozminski University, Jagiellońska 57, 03-301 Warsaw, Poland

3. Collegium Medicum, Jan Kochanowski University of Kielce, ul. Żeromskiego 5, 25-369 Kielce

* Corresponding author

Aleksandra Religa

olareliga4@gmail.com

ORCID: <https://orcid.org/0009-0004-9340-1221>

Piotr Charzewski

charzewskip@gmail.com;

ORCID: <https://orcid.org/0009-0007-5170-3899>

Agnieszka Starzyk

astarz.st@gmail.com

ORCID: <https://orcid.org/0009-0002-8696-4187>

Julia Wrona

julkawrona@wp.pl

ORCID: <https://orcid.org/0009-0005-5785-0449>

ABSTRACT

Introduction: Acne vulgaris remains a common dermatological disorder among adolescents and adults, posing persistent therapeutic challenges despite continued advancements in treatment. This review synthesizes research conducted between 2014 and 2021, focusing on the contributions of diet, probiotic supplementation, and the gut-brain axis to acne pathogenesis and management. An examination of studies from databases such as PubMed and Scopus indicates that high consumption of carbohydrates and dairy products is associated with increased acne severity, whereas diets rich in omega-3 fatty acids and characterized by a low glycemic index may confer protective effects. Furthermore, probiotics—particularly *Lactobacillus* and *Bifidobacterium* strains—exhibit immunomodulatory capacities that may attenuate systemic inflammation and enhance skin barrier function, thereby improving acne outcomes. The gut-brain axis underscores the systemic interconnections between gut health and cutaneous conditions, suggesting that targeted probiotic modulation of this axis could positively influence acne severity. Collectively, these findings emphasize the importance of an integrative strategy for acne management, incorporating both dietary interventions and probiotic supplementation, and underscore the necessity of further research to optimize therapeutic efficacy and promote better patient quality of life.

Materials and Methods: A systematic literature search of peer-reviewed studies published between 2014 and 2021 was conducted using Google Scholar, PubMed, Web of Science, and Scopus. Keywords included “acne,” “diet,” “probiotics,” “skin microbiome,” and “gut-skin axis.” Studies investigating the role of diet, probiotics, and the gut-brain axis in acne and skin health were selected. Collected data were organized according to dietary factors, probiotic strains, and mechanisms of action, with particular attention to clinical outcomes, inflammatory markers, and microbiome balance. This structured approach provided a comprehensive basis for evaluating integrative strategies in acne therapy.

Results: The findings indicate that regular intake of omega-3 fatty acids and adherence to low-glycemic-index (GI) or low-glycemic-load (GL) diets are associated with reduced acne severity, whereas elevated omega-6:omega-3 ratios and milk consumption may exacerbate the condition. Diet also influences the efficacy of antibiotic treatments, with certain minerals chelating tetracyclines and reducing their absorption. Moreover, probiotic interventions—particularly those involving *Lactobacillus* and *Bifidobacterium* strains—show promise in modulating inflammation and improving skin barrier function, potentially mitigating acne. Lastly, the gut-brain-skin axis emerges as a critical factor in acne pathogenesis, suggesting that strategies to optimize gut microbiota—through dietary adjustments, probiotics, and other interventions—may offer novel therapeutic avenues.

Conclusions: A diet low in glycemic index and high in omega-3 fatty acids, augmented by probiotic supplementation (e.g., *Bifidobacterium* and *Lactobacillus* strains), appears to confer significant benefits in reducing acne-related inflammation. Further investigations are warranted to formalize these findings into clinical guidelines and enhance therapeutic outcomes.

Keywords: Acne Vulgaris, Diet, High Glycemic Load, Dairy Consumption, Microbiome Balance, Holistic Treatment

INTRODUCTION

Acne vulgaris affects millions worldwide, especially in the group of young adults, where the prevalence of the disease ranges from 35% to even 90% [1,2]. Despite the increasing choice of treatment methods still remains a persistent disease. The need for a holistic approach to acne therapy is increasingly emphasized. Recent studies pay attention to the importance of diet, supplementation and gut health on acne development and treatment outcomes [3-5]. The diet of modern civilization, characterized by the consumption of large amounts of carbohydrates and dairy products, has been linked to increased acne severity, while diets rich in omega-3 fatty acids and low in glycemic index offer potential protective effects [12,13].

Also, probiotics recently have gained interest. Their known immunomodulatory properties contribute to reducing systemic inflammation, and maintaining skin microbiome balance. The gut brain axis- two way biochemical singalization between gastrointestinal tract and central nervous system is affected by probiotics and in that way confirms the complex relationship between the digestive system and other organs, including the skin. This article aims to demonstrate the connection between the mentioned factors and the course of the disease, thus highlighting the need for a holistic approach to acne therapy, which includes dietary recommendations and appropriate supplementation [21,22].

MATERIALS AND METHODS

This article synthesizes findings from various peer-reviewed articles and studies published between 2014 and 2021, focusing on the impact of diet and probiotics in acne therapy [2].

Search datebases such as Google Scholar, PubMed, Web of Science, and Scopus were used to find relevant articles. Keywords used during the searches included "dermatology," "microbiology," "skin microbiome," "bacterial infections," "gut-brain axis" "probiotics," and "antimicrobial resistance."such as PubMed and Scopus, employing keywords like "acne," "diet," "probiotics," and "gut-skin axis."Studies included those that focusing on the study of the impact of diet, the role of probiotics in therapy, and the gut-brain axis and their relationship with skin health.The collected data were categorized based on dietary factors, probiotic strains, and their mechanisms of action. Emphasis was placed on clinical outcomes, inflammatory markers, and microbiome balance. The collected data were grouped based on dietary factors, probiotics, and their mechanisms of action. This methodical approach enabled a comprehensive evaluation of current research findings, providing a solid foundation for understanding potential integrative strategies in acne treatment [23].

RESULTS

State of Knowledge

Acne vulgaris is a prevalent dermatological condition with significant psychological implications due to its visibility and chronic nature [18]. Peak incidence occurs in adolescents, but adult cases, especially in women, are growing.

Acne vulgaris affects 80–100% of individuals aged 11–30. While 85% of cases are mild, 15%

present severe forms, often leaving scars and hyperpigmentation. Adult acne is increasingly common, particularly in women over 25. The pathogenesis involves four main interacting factors:

1. **Increased Sebum Production:** Androgens (like testosterone and insulin-like growth factor 1) stimulate sebum production. Higher sebum levels create a favorable environment for the other factors to contribute to acne development [17].
2. **Abnormal Hyperkeratinization:** The pilosebaceous follicle's normal shedding process is disrupted. Dead skin cells accumulate, forming a plug (comedone) that obstructs the follicle [20].
3. **Cutibacterium acnes (C. acnes) Overgrowth:** This anaerobic bacterium thrives in the oily, clogged environment of the follicle. It produces lipases, breaking down sebum into fatty acids that trigger inflammation [23].
4. **Inflammation:** The body's immune response to *C. acnes* and the accumulated sebum causes inflammation, resulting in papules, pustules, nodules, and cysts. Epigenetic factors, specifically DNA methylation, may also influence this inflammatory process [23].

Clinical presentation can be very different. The initial observable symptom is excessive corneocyte production and accumulation, leading to comedone formation (blocked pores). Increased sebum flow compromises the lipid layer, impacting keratinization and increasing permeability, making the follicle more susceptible to inflammation [16-20]. Possible clinical presentations:

Non-inflammatory lesions:

- Open comedones (blackheads): The follicle is open, allowing the sebum and dead cells to oxidize and darken, appearing as black spots.
- Closed comedones (whiteheads): The follicle is closed, trapping sebum and dead cells beneath the surface as small, white bumps.

Inflammatory lesions:

- Papules: Small, inflamed, red bumps without pus.
- Pustules: Small, inflamed, red bumps containing pus.

- **Nodules:** Larger, deeper, and more painful inflammatory lesions extending into the dermis.
- **Cysts:** Large, deep, fluid-filled lesions that cause significant pain and often lead to scarring.

Diagnosis is largely clinical, relying on the presence of characteristic lesions [16,20]. The differential diagnosis includes rosacea, perioral dermatitis, folliculitis, and certain systemic conditions [16,20]. The following diseases should be taken into account in the differential diagnosis:

- **Rosacea:** Distinguishing features include flushing, telangiectasia (visible blood vessels), and the absence of comedones (blackheads and whiteheads), typically affecting the central face
- **Perioral dermatitis:** A papulopustular rash around the mouth, often triggered by topical steroids
- **Folliculitis:** Inflammation of hair follicles
- **Drug eruptions:** Acne-like breakouts caused by medications
- **Other Conditions:** conditions like syphilis, pityriasis lichenoides chronica, lupus vulgaris, and acneiform eruptions linked to endocrine issues, highlighting the importance of considering these possibilities

The review of the selected studies reveals several key findings:

Diet and Acne: Regular consumption of **omega 3 fatty acid**, that can be found in products such as linseed (also linseed oil), chia seeds, soy and walnuts, contribute to reduction of acne [6]. Omega 3 acids are group of fatty acids can't be produced in human body, so they have to be delivered from food intake. Omega 3 fatty acid regulate the skin's oil production, improve hydration. What is important not only the total amount of omega 3 acids are important but also **the imbalance between omega-6 and omega-3 fatty acids** is thought to play a significant role in the development of acne [14]. When omega-6 to omega-3 ratio is too high in can contribute to excess inflammation, which may worsen the severity of acne. Also **low GI and low GL** –diets have similar effect. Several studies show that milk may worsen the severity of acne. Milk can contribute to worsening the course of the disease via whey proteins and casein which activate insulinotropic and IGF-1 pathways. That explain why other dairy products such as butter or cheese have not demonstrated the same associations with acne.

More researches are needed to prove the effects of vegetarian, vegan and ketogenic diets on acne [8].

Also diet has an impact on efficiency of antibiotics used in treatment of acne such as tetracycline. Food rich in calcium, magnesium, zinc, iron, and aluminum can chelate the tetracyclines and contribute to poor absorption and loss of efficacy. Studies show that the presence of any food in the stomach can reduce absorption of doxycycline by nearly 20%. What is very interesting is the fact that populations with paleolithic diet – without sugar, grains, dairy protein, and has low basal insulin levels and don't suffer from acne.

Probiotic Efficacy: Probiotics affect one of the pathogenic factors – *P. acnes*. Strains of *Lactobacillus* and *Bifidobacterium*, likely play a role in modulating the immune response and reducing inflammation, which improves the skin barrier and hydration, thereby contributing to acne reduction [9-13]. Calming down the inflammation and improving skin hydration can improve treatment results. Not only oral probiotics can be used. Also topical probiotics can be helpful especially stress-induced acne. Role of stress in pathogenesis of acne is well known. Stress contributes to release of a chemical called substance P, which stimulates sebocytes to produce higher levels of proinflammatory cytokines -, IL-1, IL -6, TNF –alpha. *Lactobacillus paracasei* and *Bifidobacterium longum* in topical substances may improve inflammatory skin conditions by inhibiting substance P. Potential mechanisms of how probiotics affect acne are reducing local and systemic inflammation and oxidative stress. Probiotics also inhibit growth of *P. acnes*, contribute to maintaining of skin barrier, regulate production of sebum and affect the gut- brain axis [7-10].

Gut-Brain-Skin Axis:

Human gut microbiota (GM) includes different kinds of microorganisms that are crucial for well-being and survival of the organism [21,22]. The gut, skin, and brain are not isolated systems. Dysbiosis (microbial imbalance) in one location can impact the other, and vice-versa. Changes in either gut or skin microbiota can trigger or exacerbate skin conditions. Foods and the intestinal microbiota significantly influence the development of diseases in all three. Modulating the gut microbiota through diet, probiotics, and lifestyle changes offers potential for preventing and treating these conditions. The gut microbiome plays a crucial role in shaping the immune system. This influence extends to the skin, as demonstrated by the impacts of gut dysbiosis on skin inflammation and immune responses [9]. The gut produces

various molecules (hormones, SCFAs, neurotransmitters) that circulate systemically and affect skin homeostasis. Studies demonstrate a connection between gut health and skin condition through the gut-brain axis. Probiotics, as part of this axis, contribute to reducing inflammation and also influence the course of other diseases that may affect acne progression. As inflammation is one of the pathogenic factors of acne the composition of an individual's microbiota may affect to many diseases including acne [13]. It was reported that the yeast *Saccharomyces cerevisiae* could improve both acne vulgaris and constipation. But further researches are needed. The loss in SCCA (Short-chain carboxylic acids)-producing bacteria is remarkable because of anti-inflammatory effects of SCCA [22]. Understanding the gut-skin axis has significant implications for therapeutic approaches. Modulating the gut microbiome (e.g., through probiotics, prebiotics, dietary changes) may offer a valuable strategy for treating or preventing various skin conditions [7].

CONCLUSIONS

The impact of diet and probiotics on acne progression highlights the need for a holistic approach to acne therapy [11]. Evidence suggests that low-glycemic index diets, rich in omega-3 fatty acids, positively influence the course of the disease. Such a diet, combined with probiotic supplementation—particularly strains of *Bifidobacterium* and *Lactobacillus*—can significantly improve acne treatment outcomes by modulating inflammation, which plays a critical role in acne pathogenesis. The gut-brain axis further demonstrates the broader systemic influence of gut health on skin condition [5-10]. All these findings point to the importance of a holistic approach to acne treatment. Although the conclusions presented here are promising, further research is needed to develop guidelines that could enhance treatment effectiveness and improve the quality of life for acne patients [23].

Author's contribution:

Conceptualization: Aleksandra Religa

Methodology: Piotr Charzewski, Agnieszka Starzyk, Aleksandra Religa

Software: Piotr Charzewski

Check: Agnieszka Starzyk, Julia Wrona

Formal analysis: Piotr Charzewski, Agnieszka Starzyk, Aleksandra Religa, Julia Wrona

Investigation: Piotr Charzewski, Agnieszka Starzyk, Aleksandra Religa, Julia Wrona

Resources: Piotr Charzewski, Agnieszka Starzyk, Aleksandra Religa, Julia Wrona

Data curation: Julia Wrona

Writing-rough preparation: Julia Wrona, Aleksandra Religa

Writing-review and editing: Piotr Charzewski

Supervision: Piotr Charzewski, Agnieszka Starzyk

Project administration: Agnieszka Starzyk

All authors have read and agreed with the published version of the manuscript.

Founding Statement: The study did not receive funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflict of Interest Statement: The authors declare no conflicts of interest.

Acknowledgments: Not applicable.

Bibliography:

1. Biegaj, M. (2017). *Acne vulgaris and its treatment. Kosmetologia Estetyczna*, 6(2), 155-157.
2. Szepietowski, J., Kapińska-Mrowiecka, M., Kaszuba, A., Langner, A., Placek, W., Wolska, H., & Matusiak, Ł. (2012). Acne vulgaris: Pathogenesis and treatment. *Przegląd Dermatologiczny*, 99(6), 649-673.
3. Kober, M-M., & Bowe, W. P. (2015). The effect of probiotics on immune regulation, acne, and photoaging. *International Journal of Women's Dermatology*, 1(1), 85-89.
4. Porubsky, C. F., Glass, A. B., Comeau, V., Buckley, C., Goodman, M. B., & Kober, M.-M. (2018). The role of probiotics in acne and rosacea. In *Probiotics - Current Knowledge and Future Prospects*. IntechOpen.
5. Bowe, W. P., Patel, N. B., & Logan, A. C. (2014). Acne vulgaris, probiotics and the gut-brain-skin axis: from anecdote to translational medicine. *Beneficial Microbes*, 5(2), 185–199.
6. Baldwin, H., & Tan, J. (2020). Effects of diet on acne and its response to treatment. *American Journal of Clinical Dermatology*, 22, 55–65.

7. De Almeida, C. V., Antiga, E., & Lulli, M. (2023). Oral and topical probiotics and postbiotics in skincare and dermatological therapy: A concise review. *Microorganisms*, 11(6), 1420.
8. Alyoussef, A. (2024). The impact of consuming probiotics and following a vegetarian diet on the outcomes of acne. *Cureus*, 16(1), e51563.
9. Dessinioti, C., & Katsambas, A. (2024). The microbiome and acne: Perspectives for treatment. *Dermatologic Therapy*, 14, 31–44.
10. Bowe, W. P., & Logan, A. C. (2011). Acne vulgaris, probiotics and the gut-brain-skin axis – back to the future?. *Gut Pathogens*, 3(1), 1.
11. Kurkowska, N., & Musiał, C. (2021). Probiotics in the Care of Acne-Prone Skin: A Review of the Latest Scientific Reports. *Aesthetic Cosmetology and Medicine*, 10(2), 91–98.
12. 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. *Microorganisms*, 10(7), 1303.
13. Chilicka, K., Dzieńdziora-Urbińska, I., Szyguła, R., Asanova, B., & Nowicka, D. (2022). Microbiome and Probiotics in Acne Vulgaris—A Narrative Review. *Life*, 12(3), 422.
14. Cordain, L.; Lindeberg, S.; Hurtado, M.; Hill, K.; Eaton, S.B.; Brand-Miller, J. Acne vulgaris: A disease of Western civilization. *Arch. Dermatol.* 2002, 138, 1584–1590.
15. Roengritthidet, Katewadee, Nanticha Kamanamool, Montree Udompataikul, Salinee Rojhirunsa-kool, Saranya Khunkhet, and Silada Kanokrungeesee. 2021. “Association Between Diet and Acne Severity: A Cross-sectional Study in Thai Adolescents and Adults.” *Acta Dermato-Venereologica* 101
16. Linda K. Ogé, MD; Alan Broussard, MD; and Marilyn D. Marshall, MD Louisiana State University Health Sciences Center - University Hospital and Clinics, Lafayette, Louisiana Acne Vulgaris: Diagnosis and Treatment
17. D. Nowicka: *Dermatology. Illustrated Handbook for Cosmetologists*, Wyd. KosMeD, Wrocław 2014, 56-67.
18. Kinga Wilusz-Ludwiczak, Mirosława Kuchciak-Brancewicz, Aneta Czyż, Aleksandra Lesiak Forum Dermatologicum 2019, tom 5, nr 3, 92–95 Acne vulgaris as a inflammatory disease, not a bacterial dermatosis — case study
19. Etiopathogenesis and Clinical Picture of Acne Vulgaris."Derm Estet. 2006, 2, 67–71.

20. Dermatology. A Guide for Practicing Physicians.. Wyd. Czelej, lublin 2012, 101–107.
21. Ferraretto, A., Donetti, E., García-Mena, J., & Pacheco-López, G. (2023). Editorial: The gut-skin-brain axis in human health and disease. *Frontiers in Nutrition*, 10, 1155614.
22. De Pessemier, B., Grine, L., Debaere, M., Maes, A., Paetzold, B., & Callewaert, C. (2021). Gut–Skin Axis: Current knowledge of the interrelationship between microbial dysbiosis and skin conditions. *Microorganisms*, 9(2), 353.
23. Vasam, M., Korutla, S., & Bohara, R. A. (2023). Acne vulgaris: A review of the pathophysiology, treatment, and recent nanotechnology-based advances. *Biochemistry and Biophysics Reports*, 36, 101578.