International Journal of Medical and Pharmaceutical Sciences
Open access peer-reviewed Journal
Volume 2, Issue 6, Page 284-288.
https://doi.org/10.5281/zenodo.20735193

Review Article

Postbiotic- Enriched Topical Formulations for Skin Health: Opportunities and Challenges

Brundha U., Anamika Das, Zaiba Fathima, Vanitha K. S., Kirti Holebasappagol

Pharmacognosy Dept., Acharya & B. M. Reddy College of Pharmacy

Probiotics are live microbes that hang out in our bodies, keeping us healthy. These tiny guys work through different molecular tricks; they stop harmful bacteria from sticking around, boost our immune systems, ease inflammation, and keep our epithelial barriers strong. Plus, researchers found that probiotics release helpful compounds called postbiotics, which actually do a lot of the heavy lifting when it comes to benefits. Lactobacillus species, in particular, have gotten a lot of attention. Scientists love them because they pump out tons of useful metabolites. These metabolic goodies are awesome for skin too - they fight germs, tamp down inflammation, and protect the skin barrier. So, this review dives into where we get Lactobacillus postbiotics, how they work, what we can use them for in dermatology, as well as the tricky parts like keeping them stable and navigating all the rules and regulations.

Keywords: Lactobacillus-derived postbiotics, postbiotics, dermatology, cosmetic dermatology, probiotics, bioactive metabolites, skin microbiome.

INTRODUCTION

Human dermis acts as our primary shield and is teeming with a whole bunch of tiny organisms called the skin microbial ecosystem. This crew helps keep our skin balanced, controls how our immunological system behaves, and shields us from harmful germs. Messing with their balance can lead to issues like acne, eczema, psoriasis, and rosacea. Recent advances in micro biome research have highlighted the importance of maintaining a healthy skin microbial ecosystem as a strategy for preventing and managing skin diseases. Scientist digging into probiotics found these are great for bringing back balance and boosting overall well-being [1] . But there's a catch - using live microbes in products is tricky because of worries about preserving them properly and ensuring safety. Because of this, researchers are focusing more on postbiotics [2]. These are good-for-you substances left behind after microbes have finished their fermentation process, such as enzymes, organic acids, and cell fragments. So while we don't use living bugs, we still get to enjoy the benefits they provide through these postbiotic leftovers [3]. Traditionally, probiotics have been explored for their ability to promote microbial balance and support host health. However, the incorporation of live microorganisms into pharmaceutical and cosmetic products presents challenges related to stability, storage, and safety [2]. As a result, increasing attention has been directed toward postbiotics, which are preparations of non-viable microorganisms and their bioactive components that confer health benefits to the host. These substances include peptides, enzymes, organic acids, cell wall fragments, and other metabolites produced during microbial fermentation [3]. Among the various microbial genera, Lactobacillus species have emerged as an important source of postbiotic compounds with potential dermatological applications. Lactobacillus-derived postbiotics exhibit antimicrobial, anti-inflammatory, antioxidant, and skin barrier-enhancing properties, making them attractive candidates for both cosmetic and pharmaceutical formulations [4]. Unlike live probiotics, postbiotics

demonstrate improved formulation stability and compatibility with topical products, thereby offering practical advantages for commercial skincare development [5]. In recent years, Lactobacillus-derived postbiotics have been incorporated into a variety of dermatological products aimed at improving skin hydration, reducing inflammation, supporting wound healing, and managing acne-related conditions [6]. Despite growing commercial interest, further research is needed to establish standardized production methods, clarify mechanisms of action, and address regulatory considerations. Therefore, this review aims to discuss the sources, biological activities, cosmetic applications, pharmaceutical dermatology applications, stability concerns, Among the various microbial community, Lactobacilli stands out for their potential to produce postbiotic metabolites that could benefit skin health. These postbiotics from Lactobacillus have antimicrobial, anti-inflammatory, antioxidant properties, and can even help enhance the skin barrier. That makes them super interesting for both cosmetics and pharmaceuticals [4]. Unlike live probiotics, these postbiotic compounds are easier to use in products because they're more stable and work well in topical applications [5]. Recently, companies have added Lactobacilli-derived postbiotic substances to a bunch of skincare items to boost hydration, ease inflammation, aid in healing wounds, and deal with acne [6]. While there's lots of buzz and commercial interest in these products, we still need to do more research to figure out how to make these postbiotics consistently, understand exactly how they work, and handle any regulatory issues. So, this review is about talking through where these postbiotics come from, what they do, how we use them, and looking at the stability problems and regulatory stuff too [7].

Sources of Lactobacillus- Derived Post Biotics

Postbiotic compounds from lactobacillus originate from various lactobacilli species as a result of fermentation and metabolic activities. These guys make all sorts of useful compounds that keep doing their thing without any live bacteria around. Some common Lactobacilli types used are L. plantarum, L. rhamnosus, L. acidophilus, L. casei, L. paracasei, and L. fermentum. Scientists love studying them because of the great stuff they make that fights off germs, acts as antioxidants, calms down inflammation, and tweaks the immune system [8]. For example, L. plantarum gives us exopolysaccharides, antimicrobial peptides, and organic acids. Meanwhile, L. rhamnosus chugs out metabolites that are awesome for your immune system and skin. Also L. acidophilus is known for its bacteriocins and lactic acid which stop harmful bugs. On the other side, L. casei and L. paracasei pump out —things like peptides and enzymes—that aid in mending tissues and balancing microbes [9]. Lactobacilli- derived bioactive compound like fatty acid metabolites, organic acid metabolite, antimicrobial peptides, are getting lots of significance in dermatology. They strengthen the skin's barrier, fight inflammation [10], suppress the proliferation of pathogenic bacteria because these compounds offer enhanced stability and prolonged efficacy compared to live probiotics, they’re rising more in skin care and medical products [11].

Stability Issues

Integrity is important for developing and marketing postbiotic-infused stuff. Unlike probiotics, needs very specific storage to keep those little bugs alive, postbiotic metabolite are made up of dead cellular components and stuff they leave behind. Because of this, postbiotics can handle thermal condition, atmospheric oxygen and moisture much better [12]. Lactobacilli-derived bioactive metabolites stay fresh longer through all stages of production, shipping, and storage [13]. They don't need living bacteria to work, so heat and oxygen affect them less. That means products with postbiotics can sit on shelves for way longer than probiotics before declining in potency Although progress has been achieved, some issues may still pop up. Postbiotics consists of various metabolites including peptides, enzymes, organic acids, and exopolysaccharides – these can break down if stored for too long or influenced by high temperatures, moisture, or unfavorable conditions. Also, what’s in the formulation, the packaging, and how it’s processed all affect how well postbiotics work overtime [14]. Now, studies show that postbiotics tend to stay active across more storage conditions compared to live probiotics. Yet, how well each part holds up depends on its makeup and the environment. This means finding good formulation tricks, using smart packaging, and keeping a close eye on storage is necessary to make sure Lactobacillus-based

postbiotics work as promised in skin products for cosmetics and medicine [15].

Regulatory Outlook for Clinical And Cosmetic Applications

The rules for postbiotics, including compounds from Lactobacilli are still changing as it interests people. Postbiotics are different from medicines and there is no single set of rules that apply everywhere. This means that postbiotics are classified differently in regions [17]. In cosmetics postbiotics follow the rules as other cosmetic products.They are not treated as medicines. For instance in the European Union cosmetics are covered by a regulation that focuses on keeping products safe and telling consumers what is in them[16]. However this regulation does not specifically mention postbiotics. Postbiotics are usually listed as ingredients like ferments or microbial derivatives. This lack of classification causes confusion when labeling products and making claims especially if they claim to change the micro biome or have therapeutic effects like postbiotics do. The postbiotics field needs rules to help consumers and companies understand what they are. Postbiotics are still an area and regulations will likely change as more is learned about them and their use in products, like cosmetics [17]. In medicine and pharmacy postbiotics might be treated like drugs or biological products if they are meant to cure, stop or change how the body works. According to rules set by the European Medicines Agency things that have an effect affect the immune system or change how the body processes food might be called medicines. This means that postbiotics made from Lactobacillus that have shown they can help with health issues might need to be tested in clinics checked for safety and approved for sale like medicines [18]. A big problem is that there is no definition or rule for postbiotics that everyone agrees on. The International Scientific Association for Probiotics and Prebiotics has said that postbiotics are "a preparation of microorganisms and/or their components that confers a health benefit on the host"[18]. However, regulators have not fully agreed on this definition. This has led to classifications in the cosmetic, food and pharmaceutical industries. Overall postbiotics seem to have a lot of potential for skin and medical uses. Clearer rules are still needed [16]. In the future guidelines will need to be standardized. This will help ideas, ensure products are safe and make sure claims about Lactobacillus postbiotics are accurate, in both cosmetic and medical markets [19].

CONCLUSION:

This review mainly enlightens us with the potential and current data of postbiotics in dermatological care. There are several ways in which the postbiotics have proven to be significantly valuable in terms of modulation, stimulation and synthesis. Postbiotics, in comparison with the probiotics, have shown better stability and safety making them the perfect choice for dermatological formulation. Moreover, their chemical nature allows them to work in association with probiotics without causing any irregularities. The stability issues can be resolved with vigorous clinical trials. In order to do so, the regulatory aspects must also be covered. Since postbiotics are bioactive compounds, mainly, metabolic by-products, their research can bring about clinical advancement in medical field. Future studies must be done to study more about their mode of action and multifunctional roles. Based on the studies conducted, it can be established that the use of postbiotics in manufacturing medical and dermatological products can be of major profit and efficacy.

FUTURE PERSPECTIVE:

The market of biotics is still brewing. Though the prebiotics is well known to consumers, the postbiotics is yet unknown to many. Several research projects have been conducted on postbiotics since 2013. Gradually, it is coming to picture [20]. The market of postbiotics has huge potential to develop and attract many companies from various industries. The commercialization of postbiotics will be accelerated by involvement of such industries. Currently, countries like USA and Japan have a concentrated postbiotic market considered globally [21]. As discussed postbiotics edges ahead of prebiotics and probiotics because of its unique features like targeted regulation effect. Hence the application and regularity of postbiotics is beneficial for both consumer and provider [22]. Driven by the necessity of improved product and results, major enterprises are heading towards the research and development of these biomolecules to discover new formulations which shall be used for medicinal and cosmeceutical

products. It is of utmost importance that the postbiotics must be studied and experimented in large scale to generate more accurate trial data to support the efficacy of such biomolecules [23,24].

REFERENCES

1. Evolving advances in the cosmetic use of probiotics and postbiotics: health, regulatory and marketing aspects. Current Pharmaceutical Biotechnology. 2024 Aug 1;25(11):1349-61.
2. Cicenia A, Scirocco A, Carabotti M, Pallotta L, Marignani M, Severi C. Postbiotic activities of lactobacilli-derived factors. Journal of clinical gastroenterology. 2014 Nov 1;48: S18-22.
3. Vinderola G, Sanders ME, Salminen S, Szajewska H. Postbiotics: The concept and their use in healthy populations. Frontiers in Nutrition. 2022 Dec 9; 9:1002213.
4. Gao J, Li Y, Wan Y, Hu T, Liu L, Yang S, Gong Z, Zeng Q, Wei Y, Yang W, Zeng Z. A novel postbiotic from Lactobacillus rhamnosus GG with a beneficial effect on intestinal barrier function. Frontiers in microbiology. 2019 Mar 14; 10:477.
5. Mosca A, Abreu Y Abreu AT, Gwee KA, Ianiro G, Tack J, Nguyen TV, Hill C. The clinical evidence for postbiotics as microbial therapeutics. Gut microbes. 2022 Dec 31;14(1):2117508.
6. Sabahi S, Homayouni Rad A, Aghebati-Maleki L, Sangtarash N, Ozma MA, Karimi A, Hosseini H, Abbasi A. Postbiotics as the new frontier in food and pharmaceutical research. Critical reviews in food science and nutrition. 2023 Oct 14;63(26):8375-402.
7. Alipour M, Bonyad R, Ghasemi S, Khoshdooz P, Shafiee F, Hasannejad-Bibalan M. Probiotics and Postbiotics for Skin Care Cosmetics. Journal of Tropical Medicine. 2026;2026(1):3125037.
8. Prajapati N, Patel J, Singh S, Yadav VK, Joshi C, Patani A, Prajapati D, Sahoo DK, Patel A. Postbiotic production: harnessing the power of microbial metabolites for health applications. Frontiers in Microbiology. 2023 Dec 19; 14:1306192.
9. Teame T, Wang A, Xie M, Zhang Z, Yang Y, Ding Q, Gao C, Olsen RE, Ran C, Zhou Z. Paraprobiotics and postbiotics of probiotic Lactobacilli, their positive effects on the host and action mechanisms: A review. Frontiers in nutrition. 2020 Oct 22; 7:570344.
10. Nataraj BH, Ali SA, Behare PV, Yadav H. Postbiotics-parabiotics: The new horizons in microbial biotherapy and functional foods. Microbial cell factories. 2020 Aug 20;19(1):168.
11. Salminen S, Collado MC, Endo A, Hill C, Lebeer S, Quigley EM, Sanders ME, Shamir R, Swann JR, Szajewska H, Vinderola G. The International Scientific Association of Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of postbiotics. Nature reviews Gastroenterology & hepatology. 2021 Sep;18(9):649-67.
12. Scott E, De Paepe K, Van de Wiele T. Postbiotics and their health modulatory biomolecules. Biomolecules. 2022 Nov 4;12(11):1640.
13. Vinderola G, Sanders ME, Salminen S. The concept of postbiotics. Foods. 2022 Apr 8;11(8):1077.
14. Salminen S, Collado MC, Endo A, Hill C, Lebeer S, Quigley EM, Sanders ME, Shamir R, Swann JR, Szajewska H, Vinderola G. The International Scientific Association of Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of postbiotics. Nature reviews Gastroenterology & hepatology. 2021 Sep;18(9):649-67.
15. Zhong Y, Wang S, Di H, Deng Z, Liu J, Wang H. Gut health benefit and application of postbiotics in animal production. Journal of Animal Science and Biotechnology. 2022 Apr 8;13(1):38.
16. Aguilar-Toalá JE, Garcia-Varela R, Garcia HS, Mata-Haro V, González-Córdova AF, Vallejo-Cordoba B, Hernández-Mendoza A. Postbiotics: An evolving term within the functional foods field. Trends in food science & technology. 2018 May 1; 75:105-14.
17. Arora R, Kaur R, Babbar R, Dhingra S, Dhingra AK, Grewal AS. Evolving advances in the cosmetic use of probiotics and postbiotics: health, regulatory and marketing aspects. Current Pharmaceutical Biotechnology. 2024 Aug 1;25(11):1349-61.
18. Franco W. Postbiotics and parabiotics derived from bacteria and yeast: current trends and future perspectives. CyTA-Journal of Food. 2024 Dec 31;22(1):2425838.

19. Mishra B, et al. (2025). Commercial and regulatory frameworks for postbiotics: an industry-oriented scientific perspective.
20. Dahmouni S, Benabdelmoumene D, Bengharbi Z, Fodil MK, Umar KM, Qadi WS, Krache F, Waqar M, Tong X, Han R, Abu Bakar ZH. Postbiotics and paraprobiotics in food biochemistry mechanisms stability and nutritional applications. npj Science of Food. 2026 Apr 16.
21. Bing Liang, Dongming Xing; The Current and Future Perspectives of Postbiotics. 2023.
22. Salminen S, Collado MC, Endo A, Hill C, Lebeer S, Quigley EMM, et al. The International Scientific Association of Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of postbiotics. Nat Rev Gastroenterol Hepatol. 2021.
23. Mosca A, Abreu Y, Abreu AT, Gwee KA, Ianiro G, Tack J, Nguyen TVH, et al. The clinical evidence for postbiotics as microbial therapeutics. Gut Microbes. 2022.
24. Seyedeh, Sara Hashemi, Alireza Rafati, Shahin Roohinejad, Fatemeh Yaghoobi, Alireza Salehi; Postbiotics as Emerging Therapeutics for Skin Wound Healing and Dermatological Care: Clinical Trends and Mechanistic Insights. 2025.

Cite: Brundha U., Anamika Das, Zaiba Fathima, Vanitha K. S., Kirti Holebasappagol, Postbiotic- Enriched Topical Formulations for Skin Health: Opportunities and Challenges, Int. J. Med. Pharm. Sci., 2026, 2 (6), 284-288. https://doi.org/10.5281/zenodo.20735193