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Comprehensive Review of Probiotic Use Along with Antibiotics

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Abstract

Live microbes, known as probiotics, are beneficial to health when consumed in sufficient quantities, particularly when maintaining the intestinal microbiota balance. From Metchnikoff's "Theory of Longevity," probiotics have been recognized for improving intestinal and general well-being. Perfect probiotic strains, such as Lactobacillus, Bifidobacterium, and Saccharomyces boulardii, show high practicality, resistance to stomach causticity, and immunomodulatory properties. Amid anti-

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microbial treatment, probiotics offer assistance in reestablishing the intestinal flora, decreasing the hazard of antibiotic-associated diarrhea and Clostridium difficile infections. They work by recharging advantageous microbes, creating antimicrobial substances, and fortifying the intestine boundaries. Psychobiotics, a specialized lesson of probiotics, has shown promise in supporting mental well-being. In addition to probiotics, prebiotics—non-digestible nourishment components like inulin and pectin- support advantageous microorganisms, supporting absorption, improving supplement absorption, and possibly preventing conditions such as inflammatory bowel disease and colon cancer. Probiotics and prebiotics are broadly accessible in different shapes, including advantageous nourishments, dietary supplements, and pharmaceuticals. This audit looks at their part in anti-microbial treatment, their components of activity, and broader well-being benefits. Expanding mindfulness among healthcare experts can optimize probiotic utilization, make strides toward persistent results, and support anti-microbial stewardship.

Keywords: Antibiotic-Associated Diarrhea, Antibiotics Gut Microbiota, Microbial Balance, Pharmacy Education, Probiotics.

1. INTRODUCTION

Probiotics that are advantageous to the human body when administered correctly have garnered substantial attention in the context of restorative and open well-being. The World Health Organization defines probiotics as "live microorganisms that, when administered in sufficient quantities, provide the host with a health benefit" (Sharma et al., 2019). Metchnikoff's "Theory of Longevity" hypothesis proposed that the replacement of the current intestinal microbiota with healthy bacteria from yogurt could enhance well-being while delaying maturation, which led to the concept of controlling specific microorganisms by reducing body weight to improve intestinal health (Markowitz & Śliżewska, 2017). The ideal probiotic arrangement is believed to possess tall cell practicality, which encompasses the capacity to withstand pH and acids, remain within the digestive system even if the probiotic strain is unable to colonize the intestine, adhere to the intestinal epithelium, associate and communicate with the safe cells associated with the intestine, influence local metabolic activity, be safe to handle, and not have any harmful effects. These bacteria, which are referred to as "good microscopic organisms," are predominantly present in aged foods such as sauerkraut, kefir, and yogurt. (Nguyen et al., 2007) also stated that they can be utilized as nutritional supplements in capsules, tablets, or powders. These beneficial microbes are frequently strains of yeast species, such as Saccharomyces boulardii, or microscopic organisms, such as Lactobacillus and Bifidobacterium. The most critical function of probiotics in antimicrobial therapy is to restore the equilibrium of the intestinal microbiota, which the administration of antibiotics may disrupt. Psychobiotics are a prevalent family of probiotics that have been demonstrated to enhance the mental well-being of individuals with neurological or psychiatric disorders (Kechagia et al., 2013). By recharging beneficial microscopic organisms within the intestine, producing antimicrobial substances, improving the function of the gut's epithelial barrier, and adjusting the immune response, probiotics strengthen

the lining of the digestive tracts and prevent pathogens from attacking the circulatory system. The transition may result in health disruptions if the individual becomes frustrated. Subsequently, the consumption of probiotics corrects intestinal dysbiosis and restores the normal microbial population (Bonifait et al., 2009). Research has demonstrated that certain probiotic strains can assist in reducing the incidence and severity of diarrhea induced by antibiotics, alleviating the effects of uncomfortable gastrointestinal influences, and reducing the risk of Clostridium difficile infections while taking antibiotics. Probiotics may also abbreviate the duration of symptoms and expedite the restoration of the intestinal microbiota to its pre-treatment state. Probiotics have the potential to enhance overall health by fostering healthy microbiota, which could improve the efficacy of antimicrobial therapy and advance silent outcomes, both before and after antimicrobial use (Nelwan et al., 2024).

Prebiotics are also indispensable for the preservation of a healthy digestive environment, in addition to probiotics. Prebiotics are indigestible nutritional components that probiotic microorganisms consume. By incorporating a variety of foods into their caloric intake, individuals can guarantee that they consume a variety of prebiotics that promote the growth of a variety of probiotic bacteria (Sawan et al., 2024). Prebiotics, such as inulin and pectin, appear to have supplementary health benefits, such as preventing colon cancer, reducing the frequency and duration of loose faeces, and relieving intestinal tract congestion symptoms and inflammation. Furthermore, it has been asserted that they prevent obesity, enhance the bioavailability and assimilation of minerals, and reduce the risk factors for cardiovascular diseases. Probiotics and prebiotics are commercially available in a variety of forms, such as dietary supplements (nutrition supplements and wholesome supplements), claim-to-fame supplements (newborn child detailing), pharmaceutical arrangements, animal feed, and healthy food and beverages (dairy, non-dairy, breakfast cereal, prepared foods, aged meat products, and dry-food probiotics) (Wang et al., 2024).

2. MESH TERMS

- Probiotic: Lactobacillus, Bifidobacterium, Streptococcus, Bacillus
- Adjunct to antibiotics
- Pharmacy students' knowledge
- Cost-effectiveness
- Therapeutic efficacy

3. PRISMA -FLOW CHART

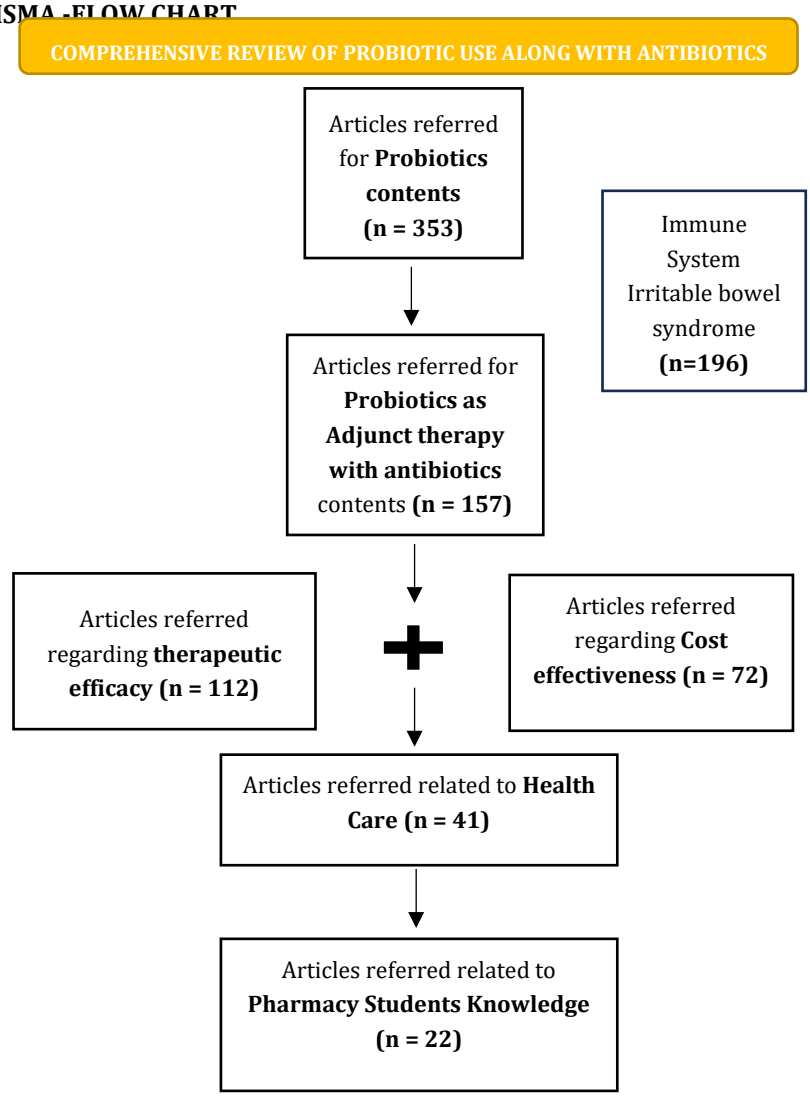

Fig. 1. Comprehensive Review of Probiotic use Along with Antibiotics

(Nelwan EJ et al., 2024) did a meta-analysis from 2012 to 2024 to find out how well probiotics work as extra medicine for treating several infectious diseases, including Helicobacter pylori infections, infectious diarrhea, urinary tract infections (UTIs), upper respiratory tract infections (URTIs), and HIV. There is evidence that probiotics can help H. Pylori eradication, when used with regular antibiotics, may lessen the intensity and length of infectious diarrhea and urinary tract infections. More than that, probiotics were linked to fewer upper respiratory tract infections and less use of medicines, but it's still not clear what effect they have on HIV. Both single-strain

and multi-strain probiotics were found to be helpful, but the effects were different based on the type of strain, the combination of strains, and the dosage. Even though probiotics might be helpful, more studies are needed to find the best way to treat different infections.

(Sawan HM et al., 2024) did a study using a self-administered poll that they came up with after reading a lot of other research. Questions and demographic information about the subjects were used to find out what pharmacists knew, how they felt, and what they did when giving antibiotics and probiotics. It was done with SPSS Version 26, which is the Statistical Package for the Social Sciences. We used Pearson correlations and one-way ANOVA to figure out how important information, attitudes, and practices were. A p-value of less than 0.05 was considered statistically significant. About 75% of the 333 people who answered (n=250) showed that they knew much about human gut bacteria. Around the same number of people had either moderate (n=164, 49.2%) or high (n=166, 49.8%) knowledge about how gut bacteria affect health. On the other hand, almost two-thirds (n=197, 59.2%) had an average understanding of how gut bacteria can cause sickness. Most of the people who took part (n=239, or 71.8%) had some experience with drugs, probiotics, and the human microbiome. On the other hand, more than fifty per cent of the volunteers (n=179, or 53.8% of the total) seemed to like these topics. A strong link was found between how well pharmacists knew about the human microbiome and how they felt about antibiotics and probiotics ($r=0.306$, $p < 0.01$) and how they used them ($r=0.331$, $p < 0.01$).

(Wang J et al., 2024) did a study on the knowledge, attitudes, and practices (KAP) of parents. The study showed how important parents are in shaping their children's immune systems. It took an online poll of 2,369 parents from 19 cities in China that they made themselves. The KAP questionnaire mostly looked at immunology, gut flora, and probiotics, which include prebiotics, probiotics, and symbiotics. It also included questions about the safety of babies. After the COVID-19 pandemic, most parents (97.90%) put their children's health first, and 40.40 per cent said they were feeling more anxious. The health problems that were mentioned most often were diarrhea (78.80%), colds (75.70%), weeping at night (73.80%), regurgitation (71.70%), and holding on to food (66.50%). Knowledge scores about immunity and intestinal bacteria were linked to practice and attitude scores in a good way.

(Sanmith T D et al., 2024) gave strong proof that probiotic supplements and foods like curd that are high in probiotics can help people who are taking the selective serotonin reuptake inhibitor (SSRI) antidepressant escitalopram. The research shows that people who use probiotic therapies for four weeks might see a slightly higher improvement in their health. Additionally, even though antidepressants work, they often have very bad side effects that cause many patients to stop taking them. When combined with curd, probiotics may help people take fewer antidepressants and have fewer side effects because their gut health improves. This could have big benefits for society as a whole. This study gives us useful information, but we need to do more to find out what the long-term effects of probiotic treatments are in a larger and more

diverse group of patients. More studies should be done to find out how other probiotic strains, their combinations, and their unique ways of working affect things.

A study by (Dierickx TH et al., 2024) looked at a randomized, double-blind, placebo-controlled clinical trial that ran from February 1, 2018, to May 31, 2021. 350 kids were treated with broad-spectrum antibiotics in both inpatient and outpatient situations as part of the trial. The follow-up time went on for one more month after the intervention. From September 1, 2022, to February 28, 2023, feces samples and statistics were looked at. Children between the ages of 3 months and 18 years who signed up within 24 hours of starting broad-spectrum systemic antibiotics were eligible. Out of the 646 eligible patients who were called, 350 agreed to take part in the trial. Neither during nor after antibiotic treatment did the tested probiotic mix have any noticeable or long-lasting effects on the microbiota. More study is needed to fully understand how probiotics affect the microbiome and how they might help lower antibiotic-associated dysbiosis and related problems, like antibiotic-associated diarrhea.

(Danic M et al., 2024) did a cross-sectional study to find out how well first- and last-year medicine and pharmacy students understood intestinal microbiota and probiotics. An anonymous form was used for the study. A negative binomial regression model was used to look into what factors could be used to predict knowledge scores. Two hundred and sixty-three students, mostly in their last year (55.5%) but also some in their first year (44.58%). The results showed that 53.2% of the students had fair knowledge, 34.2% had bad knowledge, and only 12.5% had great knowledge. Scores were greatly affected by the school year and how much information the student thought they had, but not by long-term illnesses, previous schooling, or lifestyle choices. Most people who use probiotics do so because they are taking antibiotics (75.4%) or because they are having problems with their digestion (69.9%). However, some students forgot to think about how to choose the strain and how it might mix with food and medicine. Also, most of the students thought that what they had learned in college about the subject wasn't enough.

(Abbas MO et al., 2024) sent an online poll that pharmacists in the United Arab Emirates could fill out on their own time. The information was gathered by going to pharmacies in person and asking the pharmacists to fill out a questionnaire. The study of 407 pharmacist answers showed that 30% did not know enough about the cardiovascular benefits of probiotics, and 16.7% did not know much about less common dosage forms like chewing gum. The use of probiotics was greatly limited by their high cost (86.5%) and false beliefs about their main purpose in maintaining digestive health (79.1%). There was a strong link ($p < 0.05$) between knowledge, demographics, and pharmacy characteristics. The results show how important it is for pharmacists to keep learning and growing. This will help them promote probiotics and teach patients about their overall health benefits.

The researchers (Zavisic G et al., 2023) did a study to find out what people knew and thought about probiotics. The results made a lot of important points clear, like

how interested most of the people were in learning more about probiotics. More than 40% of those who answered said they threw away leftover probiotics in regular trash. Another thing that almost half of the people who answered thought that probiotics didn't have any bad effects. Only 6% knew that eating probiotics might make bacteria resistant to antibiotics. These data show how important it is to put together bigger education campaigns to make more people aware of the possible link between using probiotics and the spread of antibiotic resistance.

(Al-Yami AM et al., 2022) are currently working on finding new species of Lactobacillus in places that haven't been explored before. Scientists have been inspired to look for new probiotic strains in unusual places, like non-dairy fermented objects and inanimate environments, even though probiotics usually live in a variety of places. This is because of new ways to do research. Plant-derived probiotics may be an option for people who can't handle lactose. These probiotics may have antibacterial properties that could work with or instead of chemical antibiotics. Lactobacillus species can be taken out of organic sources that have been fermented or not fermented, as well as from environmental samples. Lactobacilli have unique habitat traits and are very flexible, which means that new probiotic types could be found and extracted from unusual sources.

(A study by El-Sayed AI et al., 2022) looked at Lactobacillus acidophilus SAM1 and Lactiplantibacillus plantarum SAM2, two probiotics that were found in human breast milk and cottage cheese, and how they worked as probiotics and as enzymes. Aside from Escherichia coli, both strains were effective at killing the pathogens that were being studied. Even though they were exposed to low pH, high levels of bile, and pancreatin, their growth slowed down as the levels of phenol rose. Both strains were able to break down blood, but they also grouped with Staphylococcus aureus and Candida albicans. Antibiotics could not kill Lactobacillus acidophilus SAM1, but vancomycin and cefoxitin did. On the other hand, Lactiplantibacillus plantarum SAM2 was resistant to all of the antibiotics that were tried. The main source of carbon was glucose, which led to ideal growth by stopping catabolite activity. The Lactobacillus acidophilus SAM1 bacteria made lipase, and the Lactiplantibacillus plantarum SAM2 bacteria made amylase and protease.

(Kumar V et al., 2022) did a study that showed how probiotics are being used more and more in pharmaceutical formulations and the making of functional foods because they are good for you. To get the most probiotic biomass for the least amount of money, it is important to use the best production methods and nutrition medium. Growing things like substrate composition, pH, and incubation duration can be made better to boost biomass output. For economic industrial productivity to happen, a growth medium that is also cost-effective needs to be created. Cheese whey and corn steep liquor, which are waste products from the food business, can be used to make probiotic biomass. Using these industrial wastes improves the biomass yield and lowers the cost of production. This study emphasizes how important it is to improve bacterial media for biomass production and talks about problems that come up in this area.

(Lee CH et al., 2021) did a study to look into how well probiotics work as a treatment for asthma in people. The study looked at 80 people who were identified with pneumonia at Naval Pohang Hospital in Pohang, Korea, between May 2016 and January 2017. The people who took part were randomly put into either the control or probiotic groups, depending on which group they were in. Even though everyone showed clinical progress, 22.6% of them said they had problems with their bowel movements because of the pneumonia treatment. The people in the probiotic group had fevers that lasted a lot less time and were generally in better health. The Bristol Stool Scale ($P = 0.009$) showed that the probiotic group had significantly better stool traits. Also, after two weeks of treatment, serum hs-CRP levels dropped greatly in the probiotic group ($P = 0.015$), and all of the people in this group reached values that were within the normal range. The probiotic group had more regulatory T cells (Tregs) and fewer Th17 cells compared to Tregs after two weeks of treatment, as shown by flow cytometry analysis ($P = 0.007$ for Tregs and $P = 0.037$ for Th17 cells). In this study, probiotics were shown to help pneumonia patients' symptoms and keep levels of inflammation biomarkers stable. Probiotics may have helped the body get better from infection and inflammation at first because they change the immune system by increasing the amount of Tregs cells and decreasing the ratio of Th17 cells to Tregs cells.

(Ranjha MM et al., 2021) emphasized how important probiotics are for oral and digestive health. This has been known since the early 1900s. These good bacteria are linked to living longer and are still being studied because they are good for your health. Because they can control cytokines and chemokines, which have anti-inflammatory qualities, probiotics can help treat chronic inflammatory and gastrointestinal disorders. They improve nutrition by making it easier to digest food, absorb nutrients, control cholesterol, and make the pancreas work. Probiotics are also important for human health because they improve the barrier in the gut and change how the immune system works.

A cross-sectional poll was done by (Ayyash M et al., 2021) to find out what the Jordanian people knew and thought about probiotics. People who took part in the study were asked to fill out an electronic form, and 508 people agreed to do so. 64.0% of the people who took part ($n = 325$) said they were ready to eat probiotics. However, only 17.1% ($n = 90$) correctly identified probiotics as living bacteria, and only 55.0% ($n = 279$) thought they were safe to eat. Also, 75% ($n = 381$) of those who answered thought that community pharmacists could not make people more aware of probiotics. The regression analysis showed that people who made more money (>500 JD/month) and had medical degrees knew a lot more about probiotics than their peers ($P < 0.001$). The study found that doctors and pharmacists could help the public learn more about probiotics by telling their patients about them.

(Hasosah M. et al., 2021) did a cross-sectional study at pediatric hospitals in Saudi Arabia to find out what pediatric providers (PPs) knew and did about probiotics. From January to March 2020, an anonymous national poll was sent to 550 pediatric

residents (PRs), pediatric specialists (PSs), pediatric consultants (PCs), and pediatric gastroenterologists (PGs). Eighty-two per cent of them filled it out. A total of 57.7% of those who answered know what probiotics are. Significant differences were found in how much people knew about probiotics ($P < 0.05$), with PRs knowing the least and PGs knowing the most. Most of the time (63.3%), Lactobacillus acidophilus was given as a probiotic. The least often prescribed probiotic was Mycobacterium avium (8.6%). Most PRs and PSs were correct when they said that probiotics lower the chance of diarrhea caused by antibiotics (74.9% and 80.2%, respectively). Despite this, there were no major differences found between the two groups in this case.

4. DISCUSSION

Effectiveness as an Adjunct to Antibiotics: Probiotics, especially strains of Lactobacillus and Bifidobacterium, aid in reestablishing the equilibrium of the gut microbiota that has been upset by antibiotic treatment. Studies indicate that probiotics can reduce antibiotic-associated diarrhea (AAD), lower the risk of Clostridium difficile infections, and enhance Helicobacter pylori eradication rates. While single-strain and multi-strain probiotics show promise, optimal strain selection and dosage require further research.

Knowledge and Awareness Among Healthcare Professionals: Surveys among pharmacy students and pharmacists reveal moderate knowledge about probiotics. However, gaps exist in strain selection, drug interactions, and lesser-known health benefits. Educational programs should emphasize the role of probiotics beyond gut health, including their effects on immunity and mental well-being (psych biotics).

5. CONCLUSION

Probiotics, specifically Lactobacillus, Bifidobacterium, and Saccharomyces boulardii, are fundamental for protecting the integrity of the intestine flora, particularly when taking anti-microbials. They can boost the safety framework, reduce loose bowels brought on by anti-microbial, and improve mental well-being. When probiotics and prebiotics work together, assimilation, supplement assimilation, and standard well-being progress. Even though some considerations have appeared viable, more investigation is required to optimize strains, dosages, and applications. Maximizing the benefits of probiotics and making strides towards open well-being results can be accomplished by increasing information among patients and healthcare providers.

6. REFERENCES

Abbas, M. O., Ahmed, H., Hamid, E., Padayachee, D., Abdulbadia, M. T., Khalid, S., ... & Abdul Rasool, B. K. (2024). Pharmacists' Knowledge, Perception, and Prescribing Practice of Probiotics in the UAE: a Cross-Sectional Study. *Antibiotics, 13*(10), 967.

Al-Yami, A. M., Al-Mousa, A. T., Al-Otaibi, S. A., & Khalifa, A. Y. (2022). Lactobacillus species as probiotics: isolation sources and health benefits. *J. Pure Appl. Microbiol, 16*(4), 1761-1770.

Bonifait, L., Chandad, F., & Grenier, D. (2009). Probiotics for oral health: myth or reality? Journal of the Canadian Dental Association, 75(8).

Dierikx, T. H., Malinowska, A. M., Łukasik, J., Besseling-Van Der Vaart, I., Belzer, C., Szajewska, H., ... & Multispecies Probiotic in AAD Study Group. (2024). Probiotics and antibiotic-induced microbial aberrations in children: a secondary analysis of a randomized clinical trial. JAMA Network Open, 7(7), e2418129-e2418129.

El-Sayed, A. I., El-Borai, A. M., Akl, S. H., El-Aassar, S. A., & Abdel-Latif, M. S. (2022). Identification of Lactobacillus strains from human mother milk and cottage cheese revealed potential probiotic properties with enzymatic activity. Scientific Reports, 12(1), 22522.

Kechagia, M., Basoulis, D., Konstantopoulou, S., Dimitriadi, D., Gyftopoulou, K., Skarmoutsou, N., & Fakiri, E. M. (2013). Health benefits of probiotics: a review. International Scholarly Research Notices, 2013(1), 481651.

Kumar, V., Naik, B., Kumar, A., Khanduri, N., Rustagi, S., & Kumar, S. (2022). Probiotics media: Significance, challenges, and future perspective-a mini-review. Food Production, Processing, and Nutrition, 4(1), 17.

Markowiak, P., & Śliżewska, K. (2017). Effects of probiotics, prebiotics, and synbiotics on human health. Nutrients, 9(9), 1021.

Nelwan, E. J., Herdiman, A., Kalaij, A. G. I., Lauditta, R. K., Yusuf, S. M., & Suarthana, E. (2024). Role of probiotic as adjuvant in treating various infections: a systematic review and meta-analysis. BMC Infectious Diseases, 24(1), 505.

Nguyen, T. D. T., Kang, J. H., & Lee, M. S. (2007). Characterization of Lactobacillus plantarum PH04, a potential probiotic bacterium with cholesterol-lowering effects. International Journal of Food Microbiology, 113(3), 358-361.

Patait, M. R., Saraf, K. V., & Wakchaure, P. M. (2022). Assessment of knowledge and awareness of probiotics among the dental post-graduate students questionnaire study. Journal of Indian Academy of Oral Medicine and Radiology, 34(1), 68-75.

Sanmith, T. D., Chourasiya, J., & Patel, N. (2024). Comparing the efficacy of probiotic nutraceuticals and probiotic food (curd) in combination with antidepressants for depression. Archives of Medicine and Health Sciences, 12(2), 176-180.

Sawan, H. M., Shroukh, W., Abutaima, R., Al Omari, S. M., Abdel-Qader, D. H., & Binsuwaidan, R. (2024). Impact of Jordanian pharmacists' knowledge of the human microbiome: Has the practice of dispensing antibiotics and probiotics been affected? A cross-sectional study. Infection and Drug Resistance, 5203-5214.

Sharma, R., Gupta, S., Gupta, D., & Kushwaha, P. K. (2019). Awareness and knowledge about probiotics among college students. J Pure Appl Microbiol, 13(4), 2201-2208.

Wang, J., Liu, N., Chen, Y., You, J., Yang, Y., Jin, Y., ... & Zhou, J. (2024). Knowledge, attitude, and practice of Chinese parents with infants (aged 0–3 years) toward immunity, gut microbiota, and biotics: a comprehensive study. Frontiers in Immunology, 15, 1396087.

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