IJPSR (2025), Volume 16, Issue 8 **(Research Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 03 March 2025; received in revised form, 23 March 2025; accepted, 07 April 2025; published 01 August 2025

EVALUATION OF KNOWLEDGE AND PERCEPTION AMONG THE PHARMACY STUDENTS ON USE OF PROBIOTICS AS AN ADJUNCT THERAPY WITH ANTIBIOTICS

Jayalakshmi Venugopal *, Yashwanth Krishna, M. Rajesh Kumar, V. Gowtham, K. Naveen Raj and M. Vignesh

Department of Pharmacy Practice, KMCH College of Pharmacy, approved by PCI & Affiliated to The Tamil Nadu Dr. M. G. R Medical University, Chennai - 600032, Tamil Nadu, India.

Keywords:

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

Correspondence to Author:
Mrs. Jayalakshmi Venugopal

Assistant Professor,
Department of Pharmacy Practice,
KMCH College of Pharmacy,
approved by PCI & Affiliated to The Tamil Nadu Dr. M. G. R Medical University, Chennai - 600032, Tamil Nadu, India.

E-mail: jayalakshmi@kmchcop.ac.in

ABSTRACT: The use of antibiotics to treat infections requires treatment of microbial communities in the gut which causes antibiotic-associated diarrhea (AAD) as a side effect. The number of people using probiotics to manage these effects remains low because there is insufficient awareness of their proper usage. An investigation examines pharmacy student understanding and perceptions about the co-administration of probiotics with antibiotics by studying effectiveness together with timing variables and treatment costs and values. The survey at KMCH College of Pharmacy used structured questionnaire research methodology to evaluate students' comprehension of probiotic advantages and timing and financial details as well as probiotic-antibiotic interaction awareness throughout the two-month study period. Survey results demonstrated that more than three quarters of participants understood the effects of probiotics against antibiotic side effects, yet respondents exhibited gaps in their understanding about correct strain pick and appropriate timing and storage procedures. Students had varying understandings about how financial matters affected purchasing decisions for probiotics. Research has proven the benefits of probiotics for treatment success, yet a lack of consistent learning demonstrates a necessity to provide enhanced probiotic education. The spread of probiotics encountered resistance because students both misunderstood their benefits and had financial concerns. The data indicates that pharmacy students held favorable beliefs about probiotics even though their information about these products remained deficient. Educational programs about probiotics within pharmacy studies would enhance clinical advice while maximizing antibiotic treatments' effect on both digestive health and treatment success.

INTRODUCTION: Infection illnesses consistently represent the principal global reason for premature death and disability. Primary medical approaches to manage infections consist of vaccines together with curative therapies though new pandemic threats persist as major obstacles [1].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.16(8).2348-56

This article can be accessed online on www.ijpsr.com

DOI link: https://doi.org/10.13040/IJPSR.0975-8232.16(8).2348-56

Research indicates that probiotics demonstrate promise for medical treatment of human diseases through immune stimulation and pathogenic microorganism inhibition [2].

The Food and Agriculture Organization (FAO) together with the World Health Organization (WHO) define probiotics as live microorganisms that demonstrate health benefits in persons when taken through sufficient doses [3]. Research findings show that probiotics enhance immunity then inhibit pathogen colonization and minimize infections [4]. Some protective mechanisms of probiotics remain

unclear to science while public education levels about their advantages and proper usage stay low which results in insufficient consumption or misapplied usage [5]. Providing antibiotic treatments to combat infections ends up destroying beneficial gut microbiota leading to dysbiosis which creates several adverse health outcomes like obesity, asthma, Crohn's disease and type 1 diabetes [6].

Antibiotic-associated diarrhea (AAD) represents the most immediate side effect that results from antibiotic use making microbial balance intervention crucial [7]. The promising remedy offered by probiotics helps restore healthy intestinal microorganisms while stopping pathogen multiplication and bettering gut health [8]. One can obtain probiotics through food fermentation such as yogurt and also through supplements in forms including capsules and tablets and powder [9].

The human body contains three main probiotic strains including Lactobacillus and Bifidobacterium and Saccharomyces boulardii which restore beneficial bacteria while creating antimicrobial compounds and sustaining gut barriers and controlling immune function [10]. Monitoring research shows that psychobiotics demonstrate mental health advantages through their influence on the gut-brain axis [11].

Scientific research demonstrates how probiotics minimize AAD development and extend to treating both gastrointestinal symptoms and reducing Clostridium difficile infection risk [12]. Food ingredients known as prebiotics work to boost both the functionality of probiotics and enhance gastrointestinal health [13].

The modern scientific investigation of probiotics began when Élie Metchnikoff observed in early 20th-century that fermented dairy products produced health benefits [14]. The effects of probiotics become effective by rebalancing gut microbiota while modifying immune responses and blocking pathogenic microbes as well as strengthening gut barrier integrity and producing necessary nutrients particularly short-chain fatty acids (SCFAs) [15]. Numerous studies prove that incorporating probiotics with antibiotics improves therapy results by decreasing antibiotic-caused gut dysbiosis [16]. Two commonly effective probiotic strains for AAD prevention come from Lactobacillus rhamnosus GG and Saccharomyces boulardii which simultaneously fight C. difficile infection risk [17]. A probiotic's effectiveness relates to its particular strain effects and requires optimal time of administration and standardized formulation [18].

Studies demonstrate that co-administering antibiotic therapies with probiotics leads to improved clinical results together with higher cost-effectiveness through reduced treatment-related problems and accelerated recovery periods as well as reduced dependency on supplemental medications and potential limitations to antibiotic resistance [19]. The availability and reasonable cost of probiotics makes these microorganisms an effective and affordable method to improve antibiotic treatment and general human well-being [20].

The research evaluates the educational comprehension together with the perceptual understanding of pharmacy student populations about using probiotics along with antibiotics as therapeutic agents. The research examines both student understanding of probioitic-antibiotic coadministration and their evaluation of cost-efficiency related to antibiotic treatment. This research investigates and resolves missing information in pharmacy student understanding about probiotics in antibiotic therapy to provide conclusions on their awareness and attitudes toward antibiotic-probiotic combination therapy.

METHODOLOGY: The research lasted two months within the premises of KMCH College of Pharmacy where pharmacy students received evaluations about combining antibiotics with probiotics. The study utilized a structured questionnaire to investigate vital aspects of probiotic usage such as their advantages as well as timing patterns and financial considerations.

The questionnaire reached Pharmacy students from the institution and these students completed the survey through Google Forms. The data collection process concluded when the researchers analyzed the information to discover student patterns and assessment of probiotics during antibiotic treatment.

OBSERVATIONS AND RESULTS:

TABLE 1: RESPONSES FOR SUPPORTING GUT HEALTH DURING ANTIBIOTIC TREATMENT

Category	No. of Responses (n = 201)	Percentage (%)
Strongly Agree	55	27
Argree	100	50
Neutral	26	13
Disagree	17	8
Strongly Disagree	3	2

Most individuals maintain a positive perception about how fermented foods with fibres can help preserve gut health while receiving antibiotic medication.

TABLE 2: RESPONSES FOR PROBIOTICS ALONGSIDE ANTIBIOTICS TO SUPPORT GUT HEALTH

Category	No. of Responses (N = 201)	Percentage (%)
Strongly Agree	55	27
Argree	98	49
Neutral	33	16
Disagree	14	7
Strongly Disagree	1	1

Most participants endorse the recommendation to combine probiotics with antibiotics for strengthening gut health since few respondents show any opposition to this approach.

TABLE 3: RESPONSES FOR TAKING PROBIOTICS 2 TO 3 HOURS AFTER ANTIBIOTICS FOR BETTER GUT HEALTH

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	48	24
Argree	78	39
Neutral	59	29
Disagree	15	7
Strongly Disagree	1	1

Most participants see taking probiotics 2-3 hours after antibiotics consumption as a beneficial approach to improve gut health while no major disagreements were reported.

TABLE 4: RESPONSES FOR PROBIOTICS RESTORING GUT BALANCE AND REDUCE ANTIBIOTIC SIDE-EFFECTS

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	55	27
Argree	98	49
Neutral	35	17
Disagree	12	6
Strongly Disagree	1	1

A significant portion of respondents agree or strongly agree that probiotics restore gut balance and reduce side effects when combined with antibiotic treatment, with minimal disagreement

TABLE 5: RESPONSES FOR RECOMMENDING TAKING PROBIOTICS FOR ONE WEEK AFTER ANTIBIOTICS

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	46	23
Argree	86	43
Neutral	48	24
Disagree	16	8
Strongly Disagree	5	2

A substantial number of respondents agree or strongly agree that probiotics should be taken for up to one week after antibiotics to support gut health.

TABLE 6: RESPONSES FOR IMPROVING DIGESTION AND REDUCED SIDE-EFFECTS, SHOW PROBIOTICS ARE EFFECTIVE

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	58	29
Argree	98	49
Neutral	37	18
Disagree	7	3
Strongly Disagree	1	1

A notable majority of respondents agree or strongly agree that improved digestion and reduced side effects demonstrate the effectiveness of probiotics, with minimal disagreement.

TABLE 7: RESPONSES FOR REFRIGERATING PROBIOTICS MAINTAIN THEIR EFFECTIVENESS

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	44	22
Argree	81	40
Neutral	49	25
Disagree	22	11
Strongly Disagree	5	2

A clear majority of respondents agree or strongly agree that refrigerating probiotics helps maintain their effectiveness

TABLE 8: RESPONSES FOR PROBIOTICS INCREASE THE COST OF ANTIBIOTIC TREATMENT

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	40	20
Argree	85	42
Neutral	49	24
Disagree	24	12
Strongly Disagree	3	2

Most participants acknowledge that using probiotics adds expense to antibiotic treatment yet display a blend of neutral and opposing views to this assumption.

TABLE 9: RESPONSES FOR THE COST OF PROBIOTICS IS JUSTIFIED BY THEIR THERAPEUTIC EFFICACY

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	49	24
Argree	90	45
Neutral	42	21
Disagree	18	9
Strongly Disagree	2	1

The majority of survey participants believe that probiotics give value for their therapeutic worth a significant majority of respondents agree or strongly agree that completing the full prescribed course of antibiotics helps prevent resistance, with minimal disagreement.

TABLE 10: RESPONSES FOR COMPLETING THE FULL ANTIBIOTIC COURSE PREVENTS RESISTANCE

Category	No. of Responses (N=201)	Percentage (%)
Strongly Agree	67	34
Argree	80	40
Neutral	32	16
Disagree	17	8
Strongly Disagree	5	2

Graphical Representations of Study Findings: The research sought to determine pharmacy student knowledge and perception levels regarding probiotics as antibiotic adjunct therapy through graphical representation of collected data. Student responses regarding probiotic benefits exceeded 80 and reached 100 at various times in the "Agree" category which demonstrated that most students

recognized probiotics as effective tools for gut care and antibiotic side effect management. Responses in the "Neutral" category displayed noticeable changes between 30 to 60 indicating student uncertainty and limited knowledge about uses of probiotics when it comes to strain selection, dosage and timing medicine. The level of agreement surged between 30 and 50 "Strongly Agree" responses at the beginning but it peaked towards the survey conclusion demonstrating that students in these areas positively assessed probiotics. Students who fell under the "Disagree" category produced fewer than 30 responses throughout the study period but showed a slight increase before their numbers tapered off in the middle section of the dataset. This showed that only a minor percentage of students were doubtful about probiotic effectiveness levels. The responses within the "Strongly Disagree" segment remained consistently minimal because very few students expressed potent opposition towards using probiotics as treatment adjuncts. The collected data shows most pharmacy students see the importance of using probiotics with antibiotics but there is still some doubt about their actual practice.

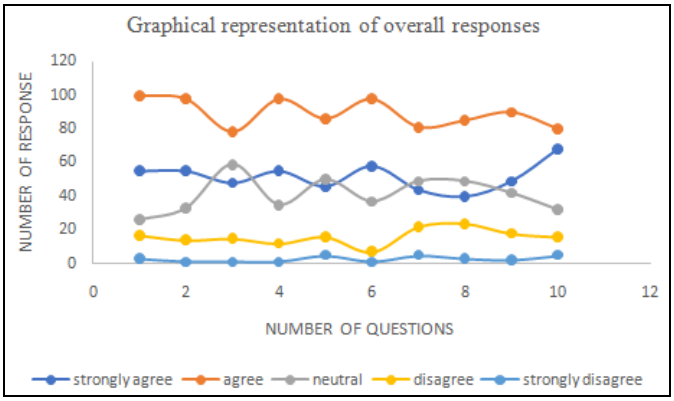

FIG. 1: GRAPHICAL REPRESENTATIONS OF STUDY FINDINGS

DISCUSSION: Probiotics have attracted much interest for the role attributed to them in mitigating side effects associated with antibiotics and improving intestinal health. The articles reviewed give sufficient evidence of the advantages and disadvantages of using probiotics alongside antibiotics. Probiotics are strongly noted to play an effective role in the restoration of gut microbiota balance while alleviating severity related to disruptions associated with antibiotics, as stated by Erni *et al.* (2024) [21]. However, parental awareness has been elaborated through Wanj *et al.* (2024) to impact infant gut health; hence interventions require dietary alterations aimed at preserving microbial homeostasis [22]. A good percentage of studies support the use of probiotics during antibiotic treatment. Metanalysis from several studies shows that administration of probiotics with antibiotics diminishes side effects linked with antibiotic administration yet boosts efficacy. Probiotic use is suggested to improve clinical outcomes in pneumonia patients treated with antibiotics, as per Chang H *et al* (2021) [23]. Probiotics have attracted much interest for the role attributed to them in mitigating side effects associated with antibiotics and improving intestinal health.

Probiotics should be administered 2-3 hours after the completion of antibiotic therapy. According to the work of Thomas H *et al.* in (2024), the effect that probiotics have on the composition of the microbiota is minimal and ephemeral. This implies that the ideal timing for administration is something that still requires further study. The other emphasizes the need to establish what constitutes the best probiotic treatment, especially with regard to duration following antibiotic therapy. All these studies support probiotics' ability to restore gut balance and reduce side effects [24]. The roles of probiotics in improving gut health, reducing gastrointestinal side effects, and regulating immune function have been reported by Sanmith *et al.* in (2024) and Muhammad *et al.* in (2021) [25, 26]. Probiotics are discussed in immunomodulatory roles restoring gut balance by Mazziotta *et al.* (2019) [27].

Probiotic stability studies indicate the existence of knowledge gaps among practitioners in the healthcare sector. According to Maram *et al.* (2024), there are gaps in the knowledge of pharmacists regarding probiotic formulations and that there is a need for additional professional education on the probiotic stability and storage conditions [28]. Likewise, Maja D *et al.* (2024) observed that medical and pharmacy students generally neglected some essential elements of probiotics use, like strain selection and food-drug interactions; thus, these students should be targeted by education. Cost is one of the important factors that follow the usage of probiotics [29]. Gordana Z *et al.* (2023) stated that misconceptions about

probiotics roles plus expensive costs become one of the obstacles on it's widely usage [30]. The same issue was tackled by Nicole T *et al* (2017), who emphasized that probiotics are cost-effective in preventing Clostridium difficile infections, thereby underlining their potential therapeutic value [31].

Literature and surveys demonstrate the highest awareness concerning antibiotic stewardship. According to Neha S *et al*. (2021), most dental practitioners are aware of the inappropriate use of antibiotics and its role in resistance development [32]. Correspondingly, Gordana Z *et al.* (2023) pointed out that educational programs are needed to raise awareness about probiotics and antibiotic resistance [30].

This study of ours probes into the knowledge, attitude, and awareness of pharmacy students regarding probiotics as an adjunct therapy to antibiotics. It was found that although students appreciated the role of probiotics in maintaining gut health and minimizing side effects associated with antibiotics, there were gaps in knowledge particularly in the timing, duration, and strain selection optimal thereof. These findings are in agreement with the current literature evaluating the knowledge of healthcare students and professionals about probiotics.

For instance, Maja D *et al.* (2024) conducted a cross-sectional study among first- and final-year medical and pharmacy students, which turned out that only 12.5% of students, have good knowledge of probiotics; the largest proportion had fair knowledge, 53.2% [29]. Our study found similar results: even though most students knew the benefits of probiotics, they were hesitant in areas like timing and duration of probiotic use. With this uncertainty, both studies point out the need for educational materials within university curricula to better enhance probiotics education among students. In the same vein, Maram *et al.* (2024) conducted a survey with pharmacists in the UAE reporting gaps in knowledge regarding probiotics' cardiovascular benefits (30%) and alternative dosage forms (16.7%). The other finding of their study was that the misperception about the primary role of probiotics and high cost formed two main barriers toward their utilization [28]. Probiotic knowledge was found to be the highest among paediatric gastroenterologists and lowest among paediatric residents in the study conducted by Mohammed H *et al.* in (2021). Their study also stated that most of the study participants were aware of probiotics' role in alleviating antibiotic-associated diarrhea [33]. Likewise, Yakoob R *et al.* have discussed these Bifidobacterium species as having increased commercial and clinical significance in probiotic products with functions specified for the reduction of serum cholesterol, lactose intolerance relief, and therapeutic intervention for inflammatory bowel diseases [34]. Our research does not target specific probiotic strains but does support their overall conclusion that probiotics are well accepted for gastrointestinal benefits. On the other hand, our research shows that a significant number of students did not know critical information such as strain-specific efficacy and food-drug interactions; thus, there is an urgent need for targeted education about probiotics in pharmacy curricula.

Somayeh S *et al.* (2018) analyzed probiotic antimicrobial properties and established that beneficial bacteria both stop the growth of pathogens and combine favorably with tetracycline yet demonstrate opposite effects to imipenem and chloramphenicol [35]. Research findings show pharmacy students need additional education on strain selection as well as antibiotic-probiotic interactions despite not studying this specific interaction.

The research findings support evidence which shows pharmacy students display favorable attitudes toward probiotics even though they have limited understanding of crucial aspects such as proper timing and length of usage combined with appropriate storage practices. Multiple studies confirm that educational institutions should provide better integration of probiotic subjects because current curriculums fail to deliver sufficient information. Students' perceptions remain influenced by economic problems and by misconceptions about probiotics function alongside inadequate formal learning on the subject. Future pharmacists require evidence-based training to make clinical recommendations about probiotics because they currently lack essential content knowledge.

Comparison between Natural and Synthetic Probiotics: Gut microbiota modulation by natural or synthetic probiotics is a key component of promotion of health and management of disease [36]. Most natural probiotics are strains of Lactobacillus and Bifidobacterium, which are widely known for gut health and the ability to reduce inflammation, as is considered in the article [37]. Nevertheless, the success of thioredoxin based therapies is greatly reliant on staying intact in gastrointestinal conditions and to integrate in successful in the host microbiome which results in variability in therapeutic outcome [38].

In India, traditional fermented foods serve as rich sources of natural probiotics, including Dahi (Curd) containing *Lactobacillus delbrueckiisub* sp. bulgaricus and Streptococcus thermophilus, which aid gut health and lactose digestion; Kanji, a fermented rice drink rich in Lactobacillus plantarum, known for its anti-inflammatory properties; Idli and Dosa, fermented rice-lentil batters containing Leuconostoc mesenteroides and Lactobacillus fermentum, which improve digestion and nutrient bioavailability; Gundruk and Sinki, fermented leafy vegetables from Northeast India that support gut microbiota; and Bhaturu, a Himachali fermented wheat product containing Lactobacillus species that contribute to gut and immune health [39]. In contrast, more targeted next generation probiotics (NGPs) sophistically engineered or selected to address, for example, inflammatory bowel disease, obesity, metabolic problems, neurodegenerative disease et cetera, offer greater stability, enhanced therapeutic precision, and individualized probiotic treatment that fit a person's respective microbiome [40, 41, 42].

The advances in synthetic biology now allow for the construction of engineered probiotics that produce bioactive compounds and their modulation of immune response are currently a promising method to use in precision medicine [43, 44]. Moreover, natural probiotics face challenges, as they may be strain to strain variable in efficacy, and there are multiple challenges related to NGPs that need to be met before safety and regulatory approval can be assured [45]. However, the research shows that probiotics have therapeutic potential against antibiotic related side effects, improve digestion and manage systemic diseases, such as cancer and type 2 diabetes. The progression of probiotic research is entailing the transitional shift of general use probiotics to precision engineered microbial therapies, which is a paradigmatic change to personal health in the disease era of personalized medicine. This process is also supported by recent evidence of the gut microbial metabolites' and engineered probiotics' roles in defining a therapeutic outcome and solving complex health problems.

CONCLUSION: The research shows how medical professionals recognize probiotics as powerful medication which supports antibiotic treatments by reducing antibiotic side effects while rebuilding gut microbiota ecosystems. A vast number of pharmacy students recognize the beneficial impact of probiotics regarding intestinal health and immune defense along with their ability to stop antibiotic side effects according to study results. The students lack sufficient knowledge about selecting proper strains and determining appropriate dosages together with proper times for their administration. Future pharmacists will gain the ability to prescribe evidence-based probiotics through intervention programs that fill existing knowledge deficits. The lack of awareness about storage requirements combined with patient perceptions of cost required more education which would support the logical adoption of probiotics in clinical settings. Improved professional skills in addressing probiotics together with better patient education results in positive therapeutic outcomes and enhanced antibiotic usage protection in health services.

ACKNOWLEDGEMENTS: Nil

Fundings: No fundings available

Ethical Approval Statement: Not applicable

Statement of Declaration: Not applicable

CONFLICTS OF INTERST: No conflict of interest.

REFERENCES:

1. Lewnard JA and Reingold AL: Emerging Challenges and Opportunities in Infectious Disease Epidemiology. Am J Epidemiol 2019; 188(5): 873-882. doi: 10.1093/aje/kwy264. PMID: 30877295; PMCID: PMC7109842.

2. Yan F and Polk DB: Probiotics and immune health. Curr Opin Gastroenterol 2011; 27(6): 496-501. doi: 10.1097/MOG.0b013e32834baa4d. PMID: 21897224; PMCID: PMC4006993.
3. Hill C, Guarner F and Reid G: The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. Nat Rev Gastroenterol Hepatol 2014; 11: 506–514. https://doi.org/10.1038/nrgastro.2014.66
4. Mazziotta C, Tognon M, Martini F, Torreggiani E and Rotondo JC: Probiotics Mechanism of Action on Immune Cells and Beneficial Effects on Human Health. Cells 2023; 12(1): 184. doi: 10.3390/cells12010184. PMID: 36611977; PMCID: PMC9818925.
5. Plaza-Díaz J, Ruiz-Ojeda FJ, Gil-Campos M and Gil A: Immune-Mediated Mechanisms of Action of Probiotics and Synbiotics in Treating Pediatric Intestinal Diseases. Nutrients 2018; 10(1): 42. https://doi.org/10.3390/nu10010042
6. Ramirez J, Guarner F, Bustos Fernandez L, Maruy A, Sdepanian VL and Cohen H: Antibiotics as Major Disruptors of Gut Microbiota. Front Cell Infect Microbiol 2020; 10: 572912. doi: 10.3389/fcimb.2020.572912. PMID: 33330122; PMCID: PMC7732679.
7. Varughese CA, Vakil NH and Phillips KM: Antibiotic-associated diarrhea: a refresher on causes and possible prevention with probiotics--continuing education article. J Pharm Pract 2013; 26(5): 476-82. doi: 10.1177/0897190013499523. PMID: 24064436.
8. Wang X, Zhang P and Zhang X: Probiotics Regulate Gut Microbiota: An Effective Method to Improve Immunity. Molecules 2021; 26(19): 6076. doi: 10.3390/molecules26196076. PMID: 34641619; PMCID: PMC8512487.
9. Leeuwendaal NK, Stanton C, O'Toole PW and Beresford TP: Fermented Foods, Health and the Gut Microbiome. Nutrients 2022; 14(7): 1527. doi: 10.3390/nu14071527. PMID: 35406140; PMCID: PMC9003261.
10. Geoffrey A. Preidis and James Versalovic: Targeting the human microbiome with antibiotics, probiotics and prebiotics. Gastroenterology Enters the Metagenomics Era Gastroenterology 2009; 136(6): 2015- ISSN 0016-5085,https://doi.org/10.1053/j.gastro.2009.01.072.
11. Ķimse L, Reinis A, Miķelsone-Jansone L, Gintere S and Krūmiņa A: A Narrative Review of Psychobiotics: Probiotics That Influence the Gut-Brain Axis. Medicina (Kaunas) 2024; 60(4): 601. doi: 10.3390/medicina 60040601. PMID: 38674247; PMCID: PMC11051712.
12. Al Sharaby A, Abugoukh TM, Ahmed W, Ahmed S and Elshaikh AO: Do Probiotics Prevent Clostridium difficile-Associated Diarrhea? Cureus 2022; 14(8): 27624. doi: 10.7759/cureus 27624. PMID: 36072190; PMCID: PMC9437377.
13. You S, Ma Y, Yan B, Pei W, Wu Q, Ding C and Huang C: The promotion mechanism of prebiotics for probiotics: A review. Front Nutr 2022; 9: 1000517. doi: 10.3389/fnut.2022.1000517. PMID: 36276830; PMCID: PMC9581195.
14. Ibrahim SA, Yeboah PJ, Ayivi RD, Eddin AS, Wijemanna ND, Paidari S and Bakhshayesh RV: A review and comparative perspective on health benefits of probiotic and fermented foods. Int J Food Sci Technol 2023; 58: 4948-4964. https://doi.org/10.1111/ijfs.16619
15. Hemarajata P and Versalovic J: Effects of probiotics on gut microbiota: mechanisms of intestinal immunomodulation and neuromodulation. Therap Adv Gastroenterol 2013; 6(1): 39-51. doi: 10.1177/1756283X12459294. PMID: 23320049; PMCID: PMC3539293.
16. Kesavelu D and Jog P: Current understanding of antibiotic-associated dysbiosis and approaches for its management. Ther Adv Infect Dis 2023; 10: 20499361231154443. doi: 10.1177/20499361231154443. PMID: 36860273; PMCID: PMC9969474.
17. Lau CS and Chamberlain RS: Probiotics are effective at preventing Clostridium difficile-associated diarrhea: a systematic review and meta-analysis. Int J Gen Med 2016; 9: 27-37 doi: 10.2147/IJGM.S98280. PMID: 26955289; PMCID: PMC4769010.
18. Collado MC, Meriluoto J and Salminen S: Development of new probiotics by strain combinations: is it possible to improve the adhesion to intestinal mucus?. Journal of Dairy Science 2007; 90(6): 2710-2716, ISSN 0022-0302,https://doi.org/10.3168/jds.2006-456.
19. Yang Z, Zhou Y and Han ZL:The effects of probiotics supplementation on Helicobacter pylori standard treatment: an umbrella review of systematic reviews with meta-analyses. Sci Rep 2024; 14: 10069. https://doi.org/10.1038/s41598-024-59399-4
20. Tegegne BA and Kebede B: Probiotics, their prophylactic and therapeutic applications in human health development: A review of the literature. Heliyon 2022 ;8(6): 09725. doi: 10.1016/j.heliyon.2022.e09725. PMID: 35785237; PMCID: PMC9240980.
21. Nelwan EJ, Herdiman A, Kalaij AGI, Lauditta RK, Yusuf SM and Suarthana E: Role of probiotic as adjuvant in treating various infections: a systematic review and meta-analysis. BMC Infect Dis 2024; 24(1): 505. doi: 10.1186/s12879-024-09259-3. PMID: 38773400; PMCID: PMC11106949.
22. Wang J, Liu N, Chen Y, You J, Yang Y, Jin Y, Sun G and Zhou J: Knowledge, attitude, and practice of Chinese parents with infants (aged 0-3 years) toward immunity, gut microbiota and biotics: a comprehensive study. Front Immunol 2024; 15: 1396087. doi: 10.3389/fimmu.2024.1396087. PMID: 39076968; PMCID: PMC11284022.
23. Lee CH, Choi Y, Seo SY, Kim SH, Kim IH, Kim SW, Lee ST and Lee SO: Addition of probiotics to antibiotics improves the clinical course of pneumonia in young people without comorbidities: a randomized controlled trial. Sci Rep 2021; 11(1): 926. doi: 10.1038/s41598-020-79630-2. PMID: 33441702; PMCID: PMC7806890
24. Dierikx TH, Malinowska AM, Lukasik J, Besseling-van der Vaart I, Belzer C, Szajewska H and de Meij TGJ; Multispecies Probiotic in AAD Study Group. Probiotics and Antibiotic-Induced Microbial Aberrations in Children: A Secondary Analysis of a Randomized Clinical Trial. JAMA Netw Open 2024; 7(7): 2418129. doi: 10.1001 / jamanetworkopen.2024.18129. PMID: 38967929; PMCID: PMC11227081.
25. Sanmith TD & Paliwal, Abhay & Bagul and Koustubh: To compare efficacy of probiotic nutraceuticals and probiotic food (curd) along with antidepressant in subjects suffering from depression. Indian Journal of Applied Research 2022; 6-8. 10.36106/ijar/9500368.
26. Ishaq M, Ibrahim J, Shahbaz Ul Haq, Hayat MN, Ahmad M, Rauf U, Adrian Shah SK, Zafar M, Said Jamil and Shafiq Ur Rehman: Role of Prebiotics and Probiotics in Regulating Gut Health and Maintaining Healthy Normal Flora of Animals. IJBR 2024; 2(02): 646-52. Available from: https://induspublishers.com/IJBR/article/view/258
27. Mazziotta C, Tognon M, Martini F, Torreggiani E and Rotondo JC: Probiotics mechanism of action on immune

cells and beneficial effects on human health. Cells 2023; 12(1): 184. doi: 10.3390/cells12010184. PMID: 36611977; PMCID: PMC9818925. (Year check pananum discussion la 2019 irku)

28. Abbas MO, Ahmed H, Hamid E, Padayachee D, Abdulbadia MT, Khalid S, Abuelhana A and Abdul Rasool BK: Pharmacists' Knowledge, Perception, and Prescribing Practice of Probiotics in the UAE: A Cross-Sectional Study. Antibiotics (Basel) 2024; 13(10): 967. doi: 10.3390/antibiotics13100967. PMID: 39452233; PMCID: PMC11505214.
29. Đanić M, Marković N, Ostojić T, Kojić M, Lazarević S, Mikov M and Pavlović N: Intestinal microbiota, probiotics and their interactions with drugs: knowledge, attitudes and practices of health science students in Serbia. BMC Med Educ 2024; 24(1): 1381. doi: 10.1186/s12909-024-06249-6. PMID: 39605036; PMCID: PMC11600795.
30. Zavišić G, Popović M, Stojkov S, Medić D, Gusman V, Jovanović Lješković N and Jovanović Galović A: Antibiotic Resistance and Probiotics: Knowledge Gaps, Market Overview and Preliminary Screening. Antibiotics (Basel) 2023; 12(8): 1281. doi: 10.3390/antibiotics12081281. PMID: 37627701; PMCID: PMC10451169.
31. Shen NT, Leff JA, Schneider Y, Crawford CV, Maw A, Bosworth B and Simon MS: Cost-Effectiveness Analysis of Probiotic Use to Prevent Clostridium difficile Infection inHospitalized Adults Receiving Antibiotics. Open Forum Infect Dis 2017; 4(3): ofx148. doi: 10.1093/ofid/ofx148. PMID: 29230429; PMCID: PMC5692276.
32. Saini N, Saini V and Mehta PW: Misuse of antibiotics: A potential threat. IOSR J Dent Med Sci. 2014; 13(7): 68-72.
33. Hasosah M, Qurashi M, Balkhair A, Alzahrani Z, Alabbasi A, Alzahrani M, Alnahdi W, Shafei S, Bafaqih M and Khan M: Knowledge, attitudes, and understanding of probiotics among pediatricians in different regions of Saudi Arabia. BMC Med Educ 2021; 21(1): 68. doi: 10.1186/s12909-021-02499-w. PMID: 33478488; PMCID: PMC7819255.
34. Rahila Yakoob and Pradeep BV: Bifidobacterium sp as Probiotic Agent – Roles and Applications. J Pure Appl Microbiol 2019; 13(3): 1407-1417. https://doi.org/10.22207/JPAM.13.3.11
35. Soleymanzadeh Moghadam S, Khodaii Z, Fathi Zadeh S, Ghooshchian M and Fagheei Aghmiyuni Z: Synergistic or antagonistic effects of probiotics and antibiotics- alone or in combination- on antimicrobial-resistant *Pseudomonas aeruginosa* Isolated from Burn Wounds. Arch Clin Infect Dis 2018; 13(3): 63121.
36. Liu Y, Wang J and Wu C: Modulation of Gut Microbiota and Immune System by Probiotics, Pre-biotics, and Post-biotics. Front Nutr 2022; 8: 634897. doi: 10.3389/fnut.2021.634897. PMID: 35047537; PMCID: PMC8761849.
37. Kok CR and Hutkins R: Yogurt and other fermented foods as sources of health-promoting bacteria. Nutr Rev 2018; 76(1): 4-15. doi: 10.1093/nutrit/nuy056. PMID: 30452699.
38. Govaert M, Rotsaert C, Vannieuwenhuyse C, Duysburgh C, Medlin S, Marzorati M and Jarrett H: Survival of Probiotic Bacterial Cells in the Upper Gastrointestinal Tract and the Effect of the Surviving Population on the Colonic Microbial Community Activity and Composition. Nutrients 2024; 16(16): 2791. https://doi.org/10.3390/nu16162791
39. Satish Kumar R, Kanmani P, Yuvaraj N, Paari KA, Pattukumar V and Arul V: Traditional Indian fermented foods: a rich source of lactic acid bacteria. Int J Food Sci Nutr 2013; 64(4): 415-28. doi: 10.3109/09637486.2012.746288. Epub 2012 Nov 27. PMID: 23181843.
40. Al-Fakhrany OM and Elekhnawy E: Next-generation probiotics: the upcoming biotherapeutics. Mol Biol Rep 2024; 51(1): 505. doi: 10.1007/s11033-024-09398-5. PMID: 38619680; PMCID: PMC11018693.
41. Abouelela ME and Helmy YA: Next-generation probiotics as novel therapeutics for improving human health: current trends and future perspectives. Microorganisms 2024; 12(3): 430. doi: 10.3390/microorganisms12030430. PMID: 38543481; PMCID: PMC10972033.
42. Lalowski P and Zielińska D: The Most Promising Next-Generation Probiotic Candidates Impact on Human Health and Potential Application in Food Technology. Fermentation 2024; 10(9): 444. https://doi.org/10.3390/fermentation10090444
43. Romero-Luna HE, Hernández-Mendoza A, González-Córdova AF and Peredo-Lovillo A: Bioactive peptides produced by engineered probiotics and other food-grade bacteria: A review. Food Chem X 2021; 13: 100196. doi: 10.1016/j.fochx.2021.100196. PMID: 35498967; PMCID: PMC9039921.
44. Bober JR, Beisel CL and Nair NU: Synthetic biology approaches to engineer probiotics and members of the human microbiota for biomedical applications. Annu Rev Biomed Eng 2018; 20: 277-300. doi: 10.1146/annurev-bioeng-062117-121019. Epub 2018 Mar 12. PMID: 29528686; PMCID: PMC6100750.
45. McFarland LV, Evans CT and Goldstein EJC: Strain-Specificity and Disease-Specificity of Probiotic Efficacy: A Systematic Review and Meta-Analysis. Front Med (Lausanne) 2018; 5: 124. doi: 10.3389/fmed.2018.00124. PMID: 29868585; PMCID: PMC5949321.

How to cite this article:
Venugopal J, Krishna Y, Kumar MR, Gowtham V, Raj NK and Vignesh M: Evaluation of knowledge and perception among the pharmacy students on use of probiotics as an adjunct therapy with antibiotics. Int J Pharm Sci & Res 2025; 16(8): 2348-56. doi: 10.13040/IJPSR.0975-8232.16(8).2348-56.