Technical Report

Significance of *Lactobacillus acidophilus* in CanXida Restore (Formula RST)

"In CanXida Restore (Formula RST), Lactobacillus acidophilus aids in enhancing gut health, boosts immunity, and maintains microbiome balance for overall digestive well-being"

Contents

Executive Summary

Lactobacillus acidophilus, a resilient probiotic found in the human gut and fermented foods, exhibits diverse health benefits. Its functional mechanisms include regulating intestinal flora, reducing cholesterol, producing antimicrobial compounds, and aiding immune function. *L. acidophilus* contributes to digestive health, preventing diarrhea and alleviating irritable bowel syndrome symptoms.

With a favorable biosafety profile, it is generally safe but requires caution for specific groups. This bacterium effectively targets harmful bacteria and fungi, showcasing antibacterial and antifungal properties. *L. acidophilus* may play an important role in rebalancing the microbiome and combating Candida overgrowth in CanXida Restore because its contributions include gut regulation, immune support, and targeted pathogen inhibition, making it a valuable asset for overall health*.

1. Introduction

Lactobacillus acidophilus, a probiotic found in the human gastrointestinal tract, was first discovered and named in 1900 (Huang et al., 2021).

According to the International Scientific Association for Probiotics and Prebiotics, probiotics are defined as “live microorganisms that, when administered in adequate amounts, confer a health benefit to the host” (El-Sohaimy & Hussain, 2023).

It belongs to lactic acid bacteria (LAB) family, and has been extensively studied and developed due to its strong association with human health. It has extensive potential for use in functional, edible probiotic formulations on account of its high resistance to acid and bile salts (Gao et al., 2022).

The characteristics of *L. acidophilus* include its small size (<10µm) and its classification as a Gram-positive *bacillus* (Saidin et al., 2021). It thrives best at temperatures ranging from 37 to 42°C, but it is also capable of surviving in temperatures as high as 45°C. The optimal pH range for maximum growth is between 5.5 and 6.0, while growth stops completely at pH 4.0.

Being one of the least oxygen-tolerant LABs, *Lactobacillus acidophilus* is an obligatory homofermentative organism that produces lactic acid by fermenting carbohydrates (Bull et al., 2013).

L. acidophilus occurs naturally in various fermented foods like sauerkraut, miso, and tempeh, providing a source of probiotics. Furthermore, it is incorporated into products such as cheese and yogurt intentionally to enhance their probiotic content.

2. Functional Properties of *Lactobacillus acidophilus*:

Lactobacillus acidophilus has a range of functional mechanisms that play a role in promoting the host's health*. Following are the primary functional mechanisms linked to *L. acidophilus:*

2.1. Regulation of Intestinal Flora:

L. acidophilus is capable of producing lactic acid, which has the effect of lowering the pH within the intestinal environment. The acidic condition present in this environment hinders the growth of harmful bacteria that thrive in a pH that is either neutral or slightly alkaline (Van Zyl et al., 2020).

** These statements have not been evaluated by Food and Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.*

L. acidophilus has been found to disrupt the entry of harmful bacteria into the cells of the host. This includes processes like the release of antimicrobial compounds and the competition for nutrients needed for pathogenic invaders to grow (Bull et al., 2013; Saidin et al., 2021).

2.2. Competition for Adhesion Sites:

The competition for adhesion sites is a crucial mechanism that *L. acidophilus* utilizes to hinder the function of pathogenic bacteria. This interference effectively prevents the invasion of pathogenic bacteria into cells. The S-layer protein, extracellular polysaccharide, and lipoteichoic acid found in various strains have the ability to effectively compete for adhesion with pathogenic bacteria (Kopp-Hoolihan, 2001; Tegegne & Kebede, 2022).

2.3. Cholesterol Level Reduction:

L. acidophilus plays a significant role in promoting overall health by effectively lowering levels of serum cholesterol. This probiotic possesses the ability to absorb and assimilate cholesterol, which could potentially influence lipid metabolism and offer advantages in terms of cardiovascular well-being (Lee et al., 2021; Oh et al., 2021; Wang et al., 2019) .

2.4. Production of Bioactive Compounds:

L. acidophilus is recognized for its ability to generate bioactive compounds through its metabolic processes, which contain antimicrobial peptides and organic acids. These compounds may exert direct inhibitory effects on the proliferation and pathogenic potential of microorganisms, thereby aiding in the preservation of gut health as a whole (Abdul Hakim et al., 2023; Amiri et al., 2022; da Silva et al., 2023; Liévin-Le Moal & Servin, 2014).

2.5. Anti-inflammatory Effects:

It is shown to have potential anti-inflammatory properties, helping regulate gut inflammation (Agh et al., 2022; Heydari et al., 2019; Li et al., 2016).

2.6. Maintenance of Epithelial Barrier Integrity:

L. acidophilus plays a crucial role in preserving the integrity of the gut epithelial barrier (COCETTA et al., 2023). An effective barrier is crucial in hindering the entry of harmful substances into the bloodstream.

2.7. Antimicrobial Properties

Lactobacillus acidophilus is widely known for its positive impact on gastrointestinal health and the balance of microorganisms in the gut. Although not conventionally regarded as an antimicrobial agent, specific strains of *L. acidophilus* have demonstrated antimicrobial characteristics. Here are some antimicrobial ways *L. acidophilus* can act (H. Gao et al., 2022b; Lievin Moal, 2016).

- *L. acidophilus* shows time-dependent antimicrobial activity against various harmful bacteria.
- Demonstrates bactericidal effects, including within cellular vacuoles, targeting various pathogens
- Forms a protective biofilm, offering adhesive and cytoprotective properties.
- Exhibits bacteriostatic action

3. Health Benefits of *Lactobacillus acidophilus*

Lactobacillus acidophilus is a type of bacteria that is known for its positive effects on the human gut **(Table 1)**. Listed below are several health benefits associated with *Lactobacillus acidophilus*.:

3.1. Aids in Dysbiosis:

Dysbiosis is defined as an imbalance in the body's microbial community, particularly in the gastrointestinal tract. Changes in the composition, diversity, and abundance of the microbiota can result from this imbalance, potentially causing various inflammatory and digestive health problems (María Remes Troche et al., 2020; McFarland, 2014).

Dysbiosis refers to the imbalance between beneficial (good) and potentially harmful (bad) bacteria in the gut microbiota.

L. acidophilus helps prevent dysbiosis by:

- Regulating microbial balance.
- Producing antimicrobial substances.
- Modulating immune responses.
- Protecting against enteric pathogens.
- Supporting gut barrier function
- Increase levels of short-chain fatty acids, such as butyrate, promoting gut health

It also restores the gut microbiome affected by *antibiotic use***.**

3.2. Digestive Health:

It promotes digestive health by:

Prevention of Diarrhea: Diarrhea occurs when the consistency of your stools becomes loose, watery, and you experience a higher frequency of bowel movements. *L. acidophilus* may help prevent or alleviate diarrhea, especially that associated with antibiotic use or infections (Chitapanarux et al., 2010; X. W. Gao et al., 2010; María Remes Troche et al., 2020b; Szajewska et al., 2014).

Dysbiosis can be a consequence of diarrhea, especially if the underlying cause of diarrhea disrupts the normal microbial balance in the gut

Irritable Bowel Syndrome (IBS): IBS, a prevalent gastrointestinal disorder, appears as a collection of symptoms impacting the colon, or large intestine. IBS is characterized by abdominal pain or discomfort, alterations in bowel habits, and bloating.

Some studies suggest that *L. acidophilus may* alleviate symptoms of IBS, such as bloating and abdominal pain (Sadrin et al., 2020).

3.3. Immune System Support:

L. acidophilus may stimulate the immune system, promoting the production of antibodies and enhancing the body's defense mechanisms.

Studies highlight the immunomodulatory effects of *L. acidophilus* ATCC 4356 EPSs, suggesting their potential as a safe and effective probiotic for immune system support (Khedr et al., 2022).

3.4. Vaginal Health:

L. acidophilus helps maintain a balanced vaginal microbiota, reducing the risk of infections such as bacterial vaginosis and yeast infections.

Several scientific studies have discovered that the consumption of *L. acidophilus* as a probiotic supplement can effectively prevent and treat vaginal infections. This is achieved by promoting the growth of *lactobacilli* in the vaginal area (Hilton et al., 1992; Mezzasalma et al., 2017; Ya et al., 2010)

3.5. Nutrient Absorption:

The presence of *L. acidophilus* plays a crucial role in maintaining a well-balanced gut microbiota, which in turn supports the ideal conditions for efficient nutrient absorption in the intestines.

Table 1: *List of specific clinical trials with* ***Lactobacillus acidophilus*** *as an active component for therapeutic or preventive purposes. Source: clinicaltrials.gov*

Clinical trial ID	Health Condition	Status
NCT01551186	Infectious Disease of Digestive Tract	*Completed*
NCT02226263	Infectious Diseases	*Completed*
NCT04572932	Irritable Bowel Syndrome	*Completed*
NCT04053790	Irritable Bowel Syndrome with Diarrhea	*Completed*
NCT01064661	• Abdominal Discomfort • Abdominal Pain • Bloating • Functional Bowel Disorders	*Completed*
NCT01475942	Intestinal C. Difficile	*Completed*
NCT04329338	Bacterial Vaginoses	*Completed*
NCT02711800	• Abdominal Pain • Anxiety	*Completed*
NCT01716910	• Composition of Gut Microbiota • Healthy Humans • Short and Branched-chain Fatty Acids • Synbiotics	*Completed*
NCT00374725	Ulcerative Colitis	*Completed*
NCT02307383	Bacterial Colonization	*Unknown status*
NCT05086458	Gut Microbiota	*Unknown status*
NCT03074552	• Infection	*Completed*

	• Trauma • Ventilator associated Pneumonia	
NCT04368351	• COVID • Diarrhea • Pneumonia	*Unknown status*
NCT02957591	Severe Depression	*Completed*
NCT03330678	Microbial Flora	*Completed*
NCT05162209	• Obesity, Adolescent • Obesity, Childhood	*Completed*
NCT03893162	Major Depressive Disorder	*Completed*
NCT05614726	• Candida • Constipation • Microbiota	*Completed*
NCT03388112	Gastrointestinal Microbiome	*Unknown status*
NCT04471116	Vaginal Microbiome	*Completed*
NCT03510936	Gastrointestinal Microbiome	*Unknown status*

3.6. Inflammatory Bowel Diseases (IBD):

Some studies suggest that probiotics, including *L. acidophilus*, may help reduce inflammation in conditions like Crohn's disease and ulcerative colitis (María Remes Troche et al., 2020).

3.7. Others:

Lactobacillus acidophilus, a probiotic, shows promise in diverse health aspects.

- May reduce LDL ("bad") cholesterol levels (Cho & Kim, 2015).
- Contributes to mental health via the gut-brain axis (Appleton, 2018).
- Shows potential in weight regulation (Million et al., 2012).

- Enhances oral health by inhibiting harmful bacteria (Eslami et al., 2020).

4. Biosafety Profile of *Lactobacillus acidophilus*

Lactobacillus acidophilus is a probiotic bacterium that is widely recognized for its health-promoting properties and is commonly found in fermented foods and dietary supplements. Generally regarded as safe (GRAS) by regulatory agencies, including the U.S. Food and Drug Administration (FDA), *L. acidophilus* is considered safe for consumption in appropriate amounts.

Lactobacillus acidophilus is also an approved, experimented as medicinal use by **DRUG BANK** with accession ID DB15823

Extensive research and clinical trials have consistently demonstrated the high tolerance of L. acidophilus among the majority of individuals. The analysis of 57 clinical trials revealed that it is also safe to administer probiotics and/or symbiotic organisms to immunocompromised individuals (those with critical, surgical, or autoimmune diseases, human immunodeficiency virus infections) (Van den Nieuwboer et al., 2015).

It is commonly found in the human gut microbiota and plays a role in maintaining a healthy microbial balance in the digestive system. The occurrence of adverse effects related to the consumption of L. acidophilus is rare, and when they do happen, they are usually mild and temporary.

Although probiotics, including *L. acidophilus*, are commonly found in fermented foods, supplements often contain higher concentrations, and it is essential to adhere to recommended dosages to avoid potential adverse effects*.

Additionally, the quality of probiotic products varies among brands. Choosing reputable and well-established brands that follow good manufacturing practices is crucial to ensure the safety and efficacy of *L. acidophilus* supplements. It's important to note that the safety of probiotics is generally dose-dependent, and excessive intake may lead to gastrointestinal symptoms such as bloating and gas*.

5. Effective Targets of *Lactobacillus acidophilus*

Lactobacillus acidophilus exhibits diverse and effective targeting capabilities(H. Gao et

** These statements have not been evaluated by Food and Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.*

al., 2022; María Remes Troche et al., 2020), including:

5.1. Antibacterial Targets

- ***Salmonella***: Salmonella causes gastrointestinal infections and food poisoning, leading to symptoms such as diarrhea, abdominal cramps, and fever.
- ***Listeria***: Listeria leads to listeriosis, a serious foodborne infection associated with flu-like symptoms, meningitis, and potential complications, especially in pregnant individuals.
- ***Shigella***: It causes Shigellosis, resulting in severe diarrhea, abdominal pain, and fever, with potential for more severe complications.
- ***Yersinia***: *Yersinia* triggers yersiniosis, causing gastroenteritis with symptoms like abdominal pain, diarrhea, and fever.
- ***Helicobacter pylori*** *H. pylori* is associated with peptic ulcers and gastritis, contributing to symptoms like abdominal pain, bloating, and discomfort.
- ***Escherichia coli***: Virulent strains of *E. coli* can cause gastrointestinal infections with symptoms ranging from mild diarrhea to severe complications.

5.2. Antifungal Targets

- ***Candida* spp.:** Fungal infections, including candidiasis, which can result in oral thrush, genital infections, and systemic complications, may be induced by them.
- *L. acidophilus* may target the microbes, contributing to the prevention or reduction of fungal and bacterial infections*.

6. Significance of *Lactobacillus acidophilus* in CanXida Restore Formula

Lactobacillus acidophilus is believed to have a significant impact on maintaining a well-balanced microbiome and combating Candida overgrowth within a "Candida Restore" formula*.

It can outcompete Candida by engaging in resource competition, preventing overgrowth. Its ability to acidify the gut creates an unfavorable environment for Candida. Additionally, *L. acidophilus* may support immune function, potentially aiding in the

** These statements have not been evaluated by Food and Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.*

control of Candida overgrowth. With its biofilm-disrupting capabilities, it has the potential to break down Candida biofilms, enhancing susceptibility to interventions and immune responses*.

In conclusion, *Lactobacillus acidophilus* in Candida Restore formulas has many uses beyond Candida overgrowth. It supports immunity, disrupts biofilms, absorbs nutrients, and improves gut health, making it a valuable ingredient for digestive system balance*.

References

Abdul Hakim, B. N., Xuan, N. J., & Oslan, S. N. H. (2023). A Comprehensive Review of Bioactive Compounds from Lactic Acid Bacteria: Potential Functions as Functional Food in Dietetics and the Food Industry. *Foods*, *12*(15). https://doi.org/10.3390/FOODS12152850

Aghamohammad, S., Sepehr, A., Miri, S. T., Najafi, S., Pourshafie, M. R., & Rohani, M. (2022). Anti-inflammatory and immunomodulatory effects of Lactobacillus spp. as a preservative and therapeutic agent for IBD control. *Immunity, Inflammation and Disease*, *10*(6). https://doi.org/10.1002/IID3.635

Amiri, S., Rezaei Mokarram, R., Sowti Khiabani, M., Rezazadeh Bari, M., & Alizadeh Khaledabad, M. (2022). Characterization of antimicrobial peptides produced by *Lactobacillus acidophilus* LA-5 and Bifidobacterium lactis BB-12 and their inhibitory effect against foodborne pathogens. *LWT*, *153*, 112449. https://doi.org/10.1016/J.LWT.2021.112449

Appleton, J. (2018). The Gut-Brain Axis: Influence of Microbiota on Mood and Mental Health. *Integrative Medicine: A Clinician's Journal*, *17*(4), 28. /pmc/articles/PMC6469458/

Bull, M., Plummer, S., Marchesi, J., & Mahenthiralingam, E. (2013). The life history of *Lactobacillus acidophilus* as a probiotic: a tale of revisionary taxonomy, misidentification and commercial success. *FEMS Microbiology Letters*, *349*(2), 77–87. https://doi.org/10.1111/1574-6968.12293

Chitapanarux, I., Chitapanarux, T., Traisathit, P., Kudumpee, S., Tharavichitkul, E., & Lorvidhaya, V. (2010). Randomized controlled trial of live *Lactobacillus acidophilus* plus bifidobacterium bifidum in prophylaxis of diarrhea during radiotherapy in cervical cancer patients. *Radiation Oncology (London, England)*, *5*(1). https://doi.org/10.1186/1748-717X-5-31

Cho, Y. A., & Kim, J. (2015). Effect of Probiotics on Blood Lipid Concentrations: A Meta-Analysis of Randomized Controlled Trials. *Medicine*, *94*(43). https://doi.org/10.1097/MD.0000000000001714

COCETTA, V., GIACOMINI, I., TINAZZI, M., BERRETTA, M., QUAGLIARIELLO, V., MAUREA, N., RAGAZZI, E., CARNEVALI, I., & MONTOPOLI, M. (2023). Maintenance of intestinal epithelial barrier integrity by a combination of probiotics, herbal extract, and vitamins. *Minerva Pediatrics*. https://doi.org/10.23736/S2724-5276.23.07128-8

da Silva, B. S., Díaz-Roa, A., Yamane, E. S., Hayashi, M. A. F., & Silva Junior, P. I. (2023). Doderlin: isolation and characterization of a broad-spectrum antimicrobial peptide from *Lactobacillus acidophilus*. *Research in Microbiology*, *174*(3), 103995. https://doi.org/10.1016/J.RESMIC.2022.103995

El-Sohaimy, S. A., & Hussain, M. A. (2023). Functional Probiotic Foods Development: Trends, Concepts, and Products. *Fermentation 2023, Vol. 9, Page 249*, *9*(3), 249. https://doi.org/10.3390/FERMENTATION9030249

Eslami, M., Bahar, A., Keikha, M., Karbalaei, M., Kobyliak, N. M., & Yousefi, B. (2020). Probiotics function and modulation of the immune system in allergic diseases. *Allergologia et Immunopathologia*, *48*(6), 771–788. https://doi.org/10.1016/J.ALLER.2020.04.005

Gao, H., Li, X., Chen, X., Hai, D., Wei, C., Zhang, L., & Li, P. (2022a). The Functional Roles of *Lactobacillus acidophilus* in Different Physiological and Pathological Processes. *Journal of Microbiology and Biotechnology*, *32*(10), 1226. https://doi.org/10.4014/JMB.2205.05041

Gao, H., Li, X., Chen, X., Hai, D., Wei, C., Zhang, L., & Li, P. (2022b). The Functional Roles of *Lactobacillus acidophilus* in Different Physiological and Pathological Processes. *Journal of Microbiology and Biotechnology*, *32*(10), 1226. https://doi.org/10.4014/JMB.2205.05041

Gao, X. W., Mubasher, M., Fang, C. Y., Reifer, C., & Miller, L. E. (2010). Dose-response efficacy of a proprietary probiotic formula of *Lactobacillus acidophilus* CL1285 and Lactobacillus casei LBC80R for antibiotic-associated diarrhea and Clostridium difficile-associated diarrhea prophylaxis in adult patients. *The American Journal of Gastroenterology*, *105*(7), 1636–1641. https://doi.org/10.1038/AJG.2010.11

Heydari, Z., Rahaie, M., & Alizadeh, A. M. (2019). Different anti-inflammatory effects of *Lactobacillus acidophilus* and Bifidobactrum bifidioum in hepatocellular carcinoma cancer mouse through impact on microRNAs and their target genes. *Journal of Nutrition & Intermediary Metabolism*, *16*, 100096. https://doi.org/10.1016/J.JNIM.2019.100096

Hilton, E., Isenberg, H. D., Alperstein, P., France, K., & Borenstein, M. T. (1992). Ingestion of yogurt containing *Lactobacillus acidophilus* as prophylaxis for candidal vaginitis. *Annals of Internal Medicine*, *116*(5), 353–357. https://doi.org/10.7326/0003-4819-116-5-353

Huang, Z., Zhou, X., Stanton, C., Ross, R. P., Zhao, J., Zhang, H., Yang, B., & Chen, W. (2021). Comparative Genomics and Specific Functional Characteristics Analysis of *Lactobacillus acidophilus*. *Microorganisms 2021, Vol. 9, Page 1992*, *9*(9), 1992. https://doi.org/10.3390/MICROORGANISMS9091992

Khedr, O. M. S., El-Sonbaty, S. M., Moawed, F. S. M., Kandil, E. I., & Abdel-Maksoud, B. E. (2022). *Lactobacillus acidophilus* ATCC 4356 Exopolysaccharides Suppresses Mediators of Inflammation through the Inhibition of TLR2/STAT-3/P38-MAPK Pathway in DEN-Induced Hepatocarcinogenesis in Rats. *Nutrition and Cancer*, *74*(3), 1037–1047. https://doi.org/10.1080/01635581.2021.1934490

Kopp-Hoolihan, L. (2001). Prophylactic and therapeutic uses of probiotics: A review. *Journal of the American Dietetic Association*, *101*(2), 229–241. https://doi.org/10.1016/S0002-8223(01)00060-8

Lee, N. Y., Shin, M. J., Youn, G. S., Yoon, S. J., Choi, Y. R., Kim, H. S., Gupta, H., Han, S. H., Kim, B. K., Lee, D. Y., Park, T. S., Sung, H., Kim, B. Y., & Suk, K. T. (2021). Lactobacillus attenuates progression of nonalcoholic fatty liver disease by lowering cholesterol and steatosis. *Clinical and Molecular Hepatology*, *27*(1), 110–124. https://doi.org/10.3350/CMH.2020.0125

Li, H., Zhang, L., Chen, L., Zhu, Q., Wang, W., & Qiao, J. (2016). *Lactobacillus acidophilus* alleviates the inflammatory response to enterotoxigenic Escherichia coli K88 via inhibition of the NF-κB and p38 mitogen-activated protein kinase signaling pathways in piglets. *BMC Microbiology*, *16*(1), 1–8. https://doi.org/10.1186/S12866-016-0862-9

Lievin Moal, V. (2016). A gastrointestinal anti-infectious biotherapeutic agent: the heat-treated Lactobacillus LB. *Therapeutic Advances in Gastroenterology*, *9*(1), 57–75. https://doi.org/10.1177/1756283X15602831

Liévin-Le Moal, V., & Servin, A. L. (2014). Anti-Infective Activities of Lactobacillus Strains in the Human Intestinal Microbiota: from Probiotics to Gastrointestinal Anti-Infectious Biotherapeutic Agents. *Clinical Microbiology Reviews*, *27*(2), 167. https://doi.org/10.1128/CMR.00080-13

María Remes Troche, J., Coss Adame, E., Ángel Valdovinos Díaz, M., Gómez Escudero, O., Eugenia Icaza Chávez, M., Antonio Chávez-Barrera, J., Zárate Mondragón, F., Antonio Ruíz Velarde Velasco, J., Rafael Aceves Tavares, G., Antonio Lira Pedrín, M., Cerda Contreras, E., Carmona Sánchez, R. I., Guerra López, H., & Solana Ortiz, R. (2020a). *Lactobacillus acidophilus* LB: a useful pharmabiotic for the treatment of digestive disorders. *Therapeutic Advances in Gastroenterology*, *13*. https://doi.org/10.1177/1756284820971201

María Remes Troche, J., Coss Adame, E., Ángel Valdovinos Díaz, M., Gómez Escudero, O., Eugenia Icaza Chávez, M., Antonio Chávez-Barrera, J., Zárate Mondragón, F., Antonio Ruíz Velarde Velasco, J., Rafael Aceves Tavares, G., Antonio Lira Pedrín, M., Cerda Contreras, E., Carmona Sánchez, R. I., Guerra López, H., & Solana Ortiz, R. (2020b). *Lactobacillus acidophilus* LB: a useful pharmabiotic for the treatment of digestive disorders. *Therapeutic Advances in Gastroenterology*, *13*. https://doi.org/10.1177/1756284820971201

McFarland, L. V. (2014). Use of probiotics to correct dysbiosis of normal microbiota following disease or disruptive events: a systematic review. *BMJ Open*, *4*(8), e005047. https://doi.org/10.1136/BMJOPEN-2014-005047

Mezzasalma, V., Manfrini, E., Ferri, E., Boccarusso, M., Di Gennaro, P., Schiano, I., Michelotti, A., & Labra, M. (2017). Orally administered multispecies probiotic formulations to prevent uro-genital infections: a randomized placebo-controlled pilot study. *Archives of Gynecology and Obstetrics*, *295*(1), 163–172. https://doi.org/10.1007/S00404-016-4235-2

Million, M., Angelakis, E., Paul, M., Armougom, F., Leibovici, L., & Raoult, D. (2012). Comparative meta-analysis of the effect of Lactobacillus species on weight gain in humans and animals. *Microbial Pathogenesis*, *53*(2), 100–108. https://doi.org/10.1016/J.MICPATH.2012.05.007

Oh, J. K., Kim, Y. R., Lee, B., Choi, Y. M., & Kim, S. H. (2021). Prevention of Cholesterol Gallstone Formation by *Lactobacillus acidophilus* ATCC 43121 and Lactobacillus fermentum MF27 in Lithogenic Diet-Induced Mice. *Food Science of Animal Resources*, *41*(2), 343–352. https://doi.org/10.5851/KOSFA.2020.E93

Sadrin, S., Sennoune, S., Gout, B., Marque, S., Moreau, J., Zinoune, K., Grillasca, J. P., Pons, O., & Maixent, J. M. (2020). A 2-strain mixture of *Lactobacillus acidophilus* in the treatment of irritable bowel syndrome: A placebo-controlled randomized clinical trial. *Digestive and Liver Disease*, *52*(5), 534–540. https://doi.org/10.1016/J.DLD.2019.12.009

Saidin, S., Jumat, M. A., Mohd Amin, N. A. A., & Saleh Al-Hammadi, A. S. (2021). Organic and inorganic antibacterial approaches in combating bacterial infection for biomedical application. *Materials Science and Engineering: C*, *118*, 111382. https://doi.org/10.1016/J.MSEC.2020.111382

Szajewska, H., Ruszczyński, M., & Kolaček, S. (2014). Meta-analysis shows limited evidence for using *Lactobacillus acidophilus* LB to treat acute gastroenteritis in children. *Acta Paediatrica (Oslo, Norway : 1992)*, *103*(3), 249–255. https://doi.org/10.1111/APA.12487

Tegegne, B. A., & Kebede, B. (2022). Probiotics, their prophylactic and therapeutic applications in human health development: A review of the literature. *Heliyon*, *8*(6). https://doi.org/10.1016/J.HELIYON.2022.E09725

Van den Nieuwboer, M., Brummer, R. J., Guarner, F., Morelli, L., Cabana, M., & Claassen, E. (2015). The administration of probiotics and synbiotics in immune compromised adults: is it safe? *Beneficial Microbes*, *6*(1), 3–17. https://doi.org/10.3920/BM2014.0079

van Zyl, W. F., Deane, S. M., & Dicks, L. M. T. (2020). Molecular insights into probiotic mechanisms of action employed against intestinal pathogenic bacteria. *Gut Microbes*, *12*(1). https://doi.org/10.1080/19490976.2020.1831339

Wang, L., Zhou, B., Zhou, X., Wang, Y., Wang, H., Jia, S., Zhang, Z., Chu, C., & Mu, J. (2019). Combined Lowering Effects of Rosuvastatin and L. acidophilus on Cholesterol Levels in Rat. *Journal of Microbiology and Biotechnology*, *29*(3), 473–481. https://doi.org/10.4014/JMB.1806.06004

Ya, W., Reifer, C., & Miller, L. E. (2010). Efficacy of vaginal probiotic capsules for recurrent bacterial vaginosis: a double-blind, randomized, placebo-controlled study. *American Journal of Obstetrics and Gynecology,* *203*(2), 120.e1-120.e6. https://doi.org/10.1016/J.AJOG.2010.05.023