Technical Report

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

*"In CanXida Restore (Formula RST), **Lactobacillus rhamnosus** supports gut balance, immune function, and urogenital health, potentially reducing candida yeast overgrowth.*

Contents

Executive Summary

Lactobacillus rhamnosus, a potent probiotic that reside in the human gastrointestinal, urinary, and genital tracts, has a high level of resilience and a wide range of functional properties. This article delves into its numerous mechanisms, focusing on its potent antimicrobial activity, inflammation modulation, production of beneficial metabolites, and strong antioxidant capabilities. These mechanisms provide significant health benefits, such as balanced gut microbiome restoration, effective gastrointestinal illness management, urogenital health promotion, and other potential advantages.

Recognized as safe by the U.S. Food and Drug Administration (FDA) and widely utilized in both general consumption and medicinal applications, *L. rhamnosus* offers a compelling case for its role in maintaining a healthy microbial environment. *L. rhamnosus* emerges as a valuable component in promoting overall wellness, exemplified by its inclusion in the CanXida Restore Formula, a targeted approach to gut health, immune modulation, and urogenital well-being*****.

1. Introduction

Lactobacillus rhamnosus is a strain of bacteria belonging to the group of lactic acid bacteria. It is typically present in the human gastrointestinal tract, urinary tract, and genital area (Petrova et al., 2021). The bacterium is Gram-positive, facultative anaerobic, and has a rod-like morphology (Zayet et al., 2023). Bacteria belonging to this genus, such as *L. rhamnosus*, are classified as "**Probiotic**".

Probiotics are defined as:

"*Live microorganisms that, when administered in adequate amounts, confer a health benefit to the host***"**

(FAO/WHO)

This bacterium possesses remarkable adaptations that enable its survival in a wide range of acidic and basic conditions found within the human body (Mathipa-Mdakane & Thantsha, 2022).

Additionally, it has the ability to firmly attach to and establish colonies on the walls of the intestines (Segers & Lebeer, 2014). *L. rhamnosus* possesses certain characteristics that enhance its chances of survival, potentially leading to long-term benefits (Yan & Polk, 2012).

It has variety of strains, each possessing unique characteristics. *L. rhamnosus* is commonly found in probiotic supplements and is frequently incorporated into various dairy products such as yoghurts, cheeses, and milk to enhance their probiotic properties.

2. Functional Properties of *Lactobacillus rhamnosus*:

Lactobacillus rhamnosus is a probiotic bacterium that possesses a wide range of functional properties and mechanisms. These attributes play a crucial role in enhancing gut health and promoting overall well-being*. These include:

2.1. Survivability in Harsh Conditions:

Unlike many other probiotic strains, *L. rhamnosus*_can survive the low pH and high bile concentrations of the stomach, as well as the high temperatures (Mathipa-Mdakane & Thantsha, 2022). This ensures that *L. rhamnosus* reaches the large intestine alive and intact*.

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

2.2. Antimicrobial Activity:

Lactobacillus rhamnosus exhibits antimicrobial activity through various mechanisms (Foster et al., 2011; Huang et al., 2022; Oliveira et al., 2017; Polak-Berecka et al., 2014; Tytgat et al., 2016; Von Ossowski et al., 2010):

- *L. rhamnosus* ***competes for binding sites on mucosal surfaces***, preventing the attachment of pathogenic bacteria.
- Certain strains of *L. rhamnosus* ***produce antimicrobial substances***, such as bacteriocins, inhibiting the growth of other bacteria.
- *L. rhamnosus* contributes to gut health by ***acidifying the environment*** through the production of lactic acid.
- *L. rhamnosus* engages in ***competitive nutrient utilization***, limiting resources for the growth of harmful bacteria.
- Some strains of *L. rhamnosus* ***inhibit biofilm formation***, disrupting the protective layers of pathogenic bacteria.
- *L. rhamnosus* ***modulates the immune system***, enhancing the activity of immune cells against pathogens.
- Certain strains of *L. rhamnosus* directly ***bind to pathogens***, preventing their adherence to the intestinal lining.

2.3. Anti-Inflammatory Effects:

Lactobacillus rhamnosus modulates inflammation through various mechanisms thus result in immunomodulation (Foster et al., 2011).

- *Lactobacillus rhamnosus* modulates inflammation by ***regulating inflammatory cytokines***.
- The ***inhibition of the NF-κB pathway*** is another mechanism to reduce inflammation.
- *L. rhamnosus* ***reduces inflammatory mediators***, contributing to its anti-inflammatory properties.
- It plays a role in ***gut barrier protection***, preventing inflammation.
- Certain strains produce ***anti-inflammatory metabolites***, further supporting overall gut health.

2.4. Metabolites Production:

Lactobacillus rhamnosus is a versatile bacterium that contributes to gut health

through the production of various metabolites (Foster et al., 2011; LeBlanc et al., 2017).

- Short-Chain Fatty Acids such as propionate, acetate, and butyrate.
- Bacteriocins
- Exopolysaccharides
- Lactic acid Formation
- Conjugated Linoleic Acid

2.5. Antioxidant Property

Certain strains have been observed to scavenge reactive oxygen species, reducing oxidative stress in the gut. Some of the antioxidant properties associated with *L. rhamnosus*:

- Some *L. rhamnosus* strains ***detoxify hydrogen peroxide***, a reactive oxygen species (Kumar et al., 2023).
- *L. rhamnosus* strains donate electrons, neutralizing free radicals, ***reducing oxidative damage***.
- *L. rhamnosus* transforms dietary polyphenols into ***bioactive antioxidants***, contributing to antioxidant activity (Liu et al., 2021).
- Some strains stimulate ***glutathione production***, an intracellular antioxidant.
- *L. rhamnosus* strains may ***quench singlet oxygen***, a highly reactive form of oxygen that can cause cellular damage.

3. Health Benefits of *Lactobacillus rhamnosus*

Lactobacillus rhamnosus, a well-studied probiotic, offers a range of health benefits **(Table 1)**. Some of them are listed below:

3.1. Gut Microbiota Restoration:

Lactobacillus rhamnosus plays a crucial role in the complex ecosystem of the gastrointestinal tract, contributing to the balance and preservation of a healthy gut microbiota. The impact of this phenomenon is revealed through a set of strategic mechanisms that work together to maintain a well-balanced microbial environment, which include (Foster et al., 2011):

- Competition for nutrients
- Production of Bacteriocins
- Mucosal adhesion

Table 1: *Clinical trials that have used Lactobacillus rhamnosus for either treatment or prevention are detailed here. Source: clinicaltrials.gov*

Clinical trial ID	Health Condition	Status
NCT01551186	Infectious Disease of Digestive Tract	*Completed*
NCT06103240	Intestinal Flora	*Completed*
NCT02711800	• Abdominal Pain • Anxiety	*Completed*
NCT01279265	• Colic • Inflammation	*Completed*
NCT03815617	Irritable Bowel Syndrome	*Completed*
NCT00374725	Ulcerative Colitis	*Completed*
NCT02725138	Helicobacter	*Completed*
NCT04960878	• Gut Microbiota • Immune Function • Upper Respiratory Tract Infection	*Completed*
NCT03103958	• Intestinal Bacteria Flora Disturbance • Constipation	*Completed*
NCT06124313	• Irritable Bowel Syndrome • Vaginal Health	*Active*
NCT03611400	Intestinal Barrier Function	*Completed*
NCT03980327	Short Bowel Syndrome	*Completed*
NCT03812445	Gastrointestinal Microbiome	*Unknown status*

NCT05836155	Dysbiosis	*Recruiting*
NCT04471116	Vaginal Microbiome	*Completed*
NCT05796921	• Bacterial Vaginosis • Candidiasis Vaginal • Urinary Tract Infections	*Recruiting*
NCT04638257	Bacterial Vaginosis	*Completed*
NCT00479947	Vaginal Candidiasis	*Unknown status*
NCT00536848	• Bacterial Vaginosis • Diarrhea • HIV Infections	*Unknown status*
NCT02139839	Vaginosis, Bacterial	*Completed*
NCT01258556	Bacterial Vaginosis	*Completed*
NCT00717600	Bacteriuria	*Unknown status*
NCT03940612	Vaginal Diseases	*Completed*
NCT04471116	Vaginal Microbiome	*Completed*
NCT02730494	• Candidiasis • Vulvovaginal	*Completed*
NCT05176535	• Dysbiosis • Fertility Issues • Microbial Colonization	*Completed*
NCT03975569	Candidiasis, Vulvovaginal	*Completed*

3.2. Gastrointestinal Disorder Management:

Studies have demonstrated the potential of *L. rhamnosus* in managing gastrointestinal disorders, including;

Irritable Bowel Syndrome:

Irritable bowel syndrome is a common condition that affects a significant portion of the global adult population, with a prevalence rate ranging from 9% to 23%. It is characterized by various symptoms such as abdominal pain, bloating, and irregular bowel movements (Saha, 2014).

According to research, certain strains of *L. rhamnosus* may improve gut barriers, which could lessen the symptoms of IBS (Han et al., 2019).

Different types of Diarrheas:

L. rhamnosus has been found to provide protection against different forms of diarrhea (Bae, 2018; Basu et al., 2009; Guarino et al., 2015) including;

- Acute watery diarrhea
- Traveler's diarrhoea,
- Diarrhoea related to acute gastroenteritis.

Similarly, *L. rhamnosus* may play a role in preventing antibiotic-associated diarrhea, showcasing its ability to maintain microbial balance even in challenging conditions (Agamennone et al., 2018).

3.3. Urogenital Tract Health:

Urogenital infections, are common issues among young women. The use of this bacterium has been found to efficiently restore the urogenital flora in individuals who have a history of Bacterial Vaginosis, Yeast Vaginitis, or Urinary Tract Infections. For instance, it has been shown that the inclusion of probiotic combination including, *L. rhamnosus HN001*, resulted in a significant reduction in itching and discharge in cases of Vaginal Candidiasis (Rossi et al., 2010).

L. rhamnosus has implications for urogenital health and vaginal discomfort, and ongoing research explores its potential applications in preventing and managing them (Stivala et al., 2021).

3.4. Others:

Lactobacillus rhamnoses exhibits a range of potential health benefits, including

- Appetite suppression

- Increased insulin sensitivity
- Cholesterol reduction
- Prevention of allergy symptoms
- Reduce acne appearance.

These results, which are derived from various studies (Blümer et al., 2007; Fabbrocini et al., 2016; Kim et al., 2013; Park et al., 2018; Sanchez et al., 2014), highlight the many benefits connected to *L. rhamnoses*.

4. Biosafety Profile of *Lactobacillus rhamnosus*

Lactobacillus rhamnosus is a probiotic that has been recognized by the U.S. Food and Drug Administration (FDA) as safe for consumption. *L. rhamnosus* is well-known for its wide range of uses, including both general consumption and medicinal purposes.

While generally safe and well-tolerated, *L. rhamnosus* products may induce mild symptoms like stomach bloating or gas in some cases. Notably, individuals with compromised immune systems, are advised to avoid *L. rhamnosus* and other probiotics to mitigate the risk of potential infections*.

L. rhamnosus is commonly integrated into dairy products like yogurts and milk to boost their probiotic content. Its addition to cheese aids the ripening process. While dosage guidelines for various *L. rhamnosus* applications remain undefined, experts suggest that a daily dose similar to traditional purposes may be suitable.

However, a person should always seek guidance from a physician regarding the type and amount of probiotic, according to his health condition*.

5. Effective Targets of *Lactobacillus rhamnosus*

Lactobacillus rhamnosus demonstrates a wide range of precise and efficient targeting abilities.

5.1. Antibacterial Targets

- ***Salmonella**: L. rhamnosus* has been shown to reduce the growth of Salmonella typhimurium, a bacterium that can cause food poisoning (De Keersmaecker et al., 2006).

- ***Helicobacter pylori** L. rhamnosus* has been shown to inhibit the growth of *Helicobacter pylori*, a bacterium that can cause stomach ulcers and other gastrointestinal problems (Chen et al., 2018).

- ***Escherichia coli*:** *L. rhamnosus* has been shown to reduce the growth of *Escherichia coli*, a bacterium that can cause food poisoning and other infections
- ***Staphylococcus aureus:*** *L. rhamnosus* has been shown to inhibit the growth of *Staphylococcus aureus*, a bacterium that can cause skin infections and other illnesses.
- ***Clostridium difficile:*** *L. rhamnosus* has shown promise in preventing the growth and colonization of *Clostridium* difficile, a bacterium responsible for antibiotic-associated diarrhea and more severe colonic diseases.

5.2. Antifungal Targets

- ***Candida albicans:*** Lactobacillus rhamnosus has been shown to inhibit the growth of Candida albicans, a fungus that can cause yeast infections (Verdenelli et al., 2009).

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

Lactobacillus rhamnosus in the CanXida Restore Formula can potentially play a significant role in supporting various aspects of health.

L. rhamnosus has been found to have numerous beneficial effects on the gastrointestinal tract. These include enhancing intestinal barrier function, modulating the immune system, preventing and managing diarrhea, and inhibiting the growth of harmful bacteria. It is known for promoting a healthy gut microflora, also aid in digestion and supporting a favorable gut environment, contributing to overall gastrointestinal health.

Furthermore, *L. rhamnosus* has the potential to improve women's health by managing and preventing urogenital infections, which may help with vaginal diseases. This probiotic strain's immune-modulating properties and potential anti-inflammatory effects may also have consequences for treating allergies and inflammatory diseases*.

It is also suggested that *L. rhamnosus* may be able to help those suffering from candida yeast overgrowth get rid of extra yeast and fungal infections inside their bodies. It may help create and preserve a healthy bacterial flora by working in combination with other

probiotic strains, which will support a balanced yeast environment within the body*.

By including *L. rhamnosus* in the CanXida Restore Formula, the product aims to provide a comprehensive and balanced probiotic support for optimal digestive and overall wellness*.

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