

# Postbiotics: potential applications in early life nutrition and beyond

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#### **ABSTRACT:**

Postbiotics, also known as bioactive compounds, are those that form in a matrix after fermentation and arethen employed to promote health. Realizing that an unbalanced population of microorganisms in the gut might contribute to the onset of a variety of diseases has sparked renewed interest in prebiotics, probiotics, and postbiotics as potential means of effecting such a change (including cancer and type-1 diabetes). Any metabolic by-products of a microorganism that have a positive impact on the host are considered postbiotics. By altering the gut microbiome, probiotics have a number of health benefits; nevertheless, technological restrictions such as viability controls have restricted their full potential usage in the pharmaceutical and food industries. As a result, the focus is changing away from viable probiotic bacteria and towards non-viable paraprobiotics and/or biomolecules produced from probiotics, also known as postbiotics. Because they impart a variety of health-promoting properties, paraprobiotics and postbiotics are developing idea in the functional foods sector. Although these concepts are not fully defined, they have been defined as follows for the time being. Probiotics produce postbiotics, which are detected in the cell-free supernatants of live microorganisms. Among them are amino acids, vitamins, enzymes, biosurfactants, organic acids, and short-chain fatty acids. The current review summarizes and discusses a variety of postbiotic molecules as well as their impact on human health.

Keywords: Biomolecules, Biosurfactants, Fermentation, Gut microbiota, Organic acids, Short chain fatty acids.

### **INTRODUCTION**

Before knowing about postbiotics, it is important to known about probiotics. Mainly live bacteria are referred to as probiotics since they can benefit the gastrointestinal tract when given in appropriate quantity (Cicenia et al., 2014; Tewari et al., 2019). Besselink et al. (2008) found that individuals with severe acute pancreatitis who took a probiotic containing a mix of microorganisms found to increase the chance of death.

Tsilingiri et al. (2012) remarked upon the fact that "postbiotics," a word for the soluble components of probiotics, have been identified. Metabolic by-products of probiotics are called "postbiotics," and they may be discovered in cell-free supernatants as a wide variety of compounds 2019). (Wegh et al., According to recent research, phenolic compounds' health effects are actually related to their microbially produced metabolites (postbiotics), not their parent molecules (Hervert-Hernández and Goñi,

2011; Possemiers et al., 2011). Comparatively to other chemicals and micronutrients, phenolic compounds in postbiotics play a crucial role in anticancer activities. This might be the cause of the postbiotic made from plain yogurt's decreased anticancer activity (Darwish et al., 2022). The mucosal gut barrier may be strengthened by postbiotics in a number of ways, as illustrated in Table 1. (Wang et al., 2011; Wang et al., 2012; Lin et al., 2008; Yan and Polk, 2002; Yan et al., 2013; Yan et al., 2007)

Postbiotic activities of species of Lactobacilli Table 1. Species of Lactobacilli involved in postbiotic activities.

Species of Lactobacilli involved in	References
postbiotic	
activities	
Mucosal effects	
Maintenance of intestinal integrity	
Lactobacillus rhamnosus	Wang et al. (2011); (Wang et al., 2012)
Luminal effect	
Competition with pathogen	
Lactobacillus fermentum	Chery et al. (2013)
Lactobacillus paracasei	Munoz-Quezada et al. (2013); Zagato et al. (2014)
Lactobacillus casei	Fayol-Messaoudi et al. (2005)
Lactobacillus brevis	Ward et al. (2013)
Lactobacillus rhamnosus	Munoz-Quezada et al. (2013); Fayol-Messaoudi et al.
	(2005)
Anti-inflammatory activity	
Lactobacillus paracasei	Tsilingiri et al. (2012); Zagato et al. (2014);
	Bermudez-Brito
	et al. (2012)
Lactobacillus fermentum	Frick et al. (2007)
Inhibition of proinflammatory mediators	
Lactobacillus plantarum	Paszti-Gere et al. (2012); Nemeth et al. (2006)
Lactobacillus reuteri	Jones and Versalovic (2009
Lactobacillus fermentum	Chery et al. (2013)
Inhibition of enterocyte apoptosis	
Lactobacillus rhamnosus	Lin et al. (2008); Yan and Polk (2002); Yan et al.
	(2013)

# **Effects of Postbiotics on Microbial Community Interactions**

Some of this research looked into how postbiotic products affected diarrhoea in young children under the age of four. The results were conflicting, suggesting that postbiotics should only be used with extreme caution in children who had diarrhoea. Oral rehydration arrangement (ORS) with or without heat-killed L. acidophilus LB and its growth medium was evaluated for its efficacy in treating diarrhoea in young children caused by an illness other than rotavirus. There was a median reduction of one extra day in recovery time for individuals in the mediation group compared to those receiving just ORS. In this investigation, we looked at the effects of the postbiotic supplement on liquid-shaped arches, a marker of anti-secretory activity, in human digestive Caco2/TC7 cell monolayers that had been infected in vitro with Escherichia coli C1845. Liévin-Le Moal et al. (2007) showed that the postbiotic product reduced paracellular porousness.

Kaila et al. (1995) noted that the positive effects of the postbiotic with heatinactivated L. casei strain GG on rotavirus diarrhoea in children less than 4 years old were significantly lower compared to those seen with the viable L. casei strain. There were no appreciable differences in the length of the diarrhoea across the groups. The amount of IgA-secreting cells in surviving L. casei changed considerably after exposure to rotavirus, in contrast to the postbiotic group.

Corsello et al. (2017) found that the former significantly decreased the incidence of common infectious disease (CID) in babies aged 12 to 48 months. This research shows that this treatment may be effective in reducing upper respiratory tract infections, acute gastroenteritis and CID in young children, based on the prevalence of these disorders.

# Short Chain Fatty acid: probiotics' metabolic by-products in cell-free supernatants''

During fermentation, gut bacteria produce a wide variety of metabolites, the most common of which are short chain fatty acids (SCFAs) (Kim et al., 2018). Postbiotics may have indirect effects on the human gut flora.

However, other microorganisms in the gut, such as those that produce SCFAs, may also use fermentation products like organic acids to impede the growth and activity of potential pathogens. We'll talk about the immediate and long-term consequences of several postbiotic substances below (Berni Canani et al., 2017). SCFAs are important end products of gut microbial activity, as was already discussed in this article. These may be present in postbiotic products, which may result in the SCFAs' direct impacts or microbial cross-feeding. The main SCFAs generated in terms of direct impacts are acetate, propionate, and butyrate (Scheppach, 1994).

It has been shown that the primary SCFAs boost colonic salt and fluid absorption and also stimulate the proliferation of colonocytes. For humans, acetate is the most often identified SCFA in the peripheral circulation because butyrate is taken up and utilized by colonocytes as their primary source of energy and propionate is converted by the liver into gluconeogenesis (Koh et al., 2016; den Besten et al., 2013). This is why butyrate is singled out for study and attention among the several SCFAs that are manufactured. Butyrate has also been linked to a number of health advantages, including improved mucosal immunity and intestinal barrier integrity (Bedford and Gong, 2018; Wu et al., 2018; Liu et al., 2018).

# Clinical studies of Short Chain Fatty acid (SCFA) on humans

Perron and Malouin (1997) reported that the Acetate (SCFA) that have ability to reduce Calcific Shoulder tendonitis disease. Vernia et al. (2003) observed that the SCFA butyrate aids in the avoidance of distal ulcerative colitis. Researchers Luceri et al. (2016) found that using 30 mL of 600 mM butyrate twice day for 30 days helpedlessen Colitis symptoms.

# Enzymes: metabolic products produced by probiotics

Some biochemical processes. physiological functions, and managerial duties rely on proteins produced by bacteria (Kumar et al., 2017). Bacillus licheniformis, subtilis. Bacillus Aspergillus niger, and Aspergillus oryzae are the four bacterial and parasite species essential for commercial protein production (Kumar et al., 2017).

Contesini et al. (2018) noted that most bacteria that produce useful proteins are members of the genus Bacillus. Because of their fast growth, secretion of proteins into the extracellular environment, and relative safety, they play an important role in a variety of fermentation processes. Bacillus is a major contributor to the bacterial protease supply chain. Among its many impressive properties is its resistance to oxidizing agents, detergents, organic solvents, and high temperatures. Protein-breaking enzymes (both acidic and basic) may be produced in large quantities (Contesini et al., 2018).

It has been observed that the following conditions and nutrients are necessary for Bacillus subtilis to generate sufficient amounts of proteases: For 48 hours at 45 degrees Celsius, pH 7.5, and continual stirring at 220 revolutions per minute, combine 2% skim milk, 300 mL yeast sludge, 0.4% ammonium sulfate, 0.2% urea, and 0.03% cane molasses (Butt et al., 2018). Additionally, it has been shown that a biofilm generated by Serratia marcescens, a recently discovered opportunistic pathogen responsible for a high frequency of hospital-acquired was entirely degraded diseases. by 3-19's Bacillus pumilus proteolytic enzymes (Mitrofanova et al., 2017).

# Human intervention studies with postbiotics from birth to adulthood (>18 years), including newborns, infants, and toddlers

The benefits of a formula with postbiotics from S. thermophilus and B. breve C50 have been studied and shown to last for at least the first year of life for newborns, full-term babies, and preterm infants (Yan et al., 2013; Dupont et al., 2010; Indrio et al., 2007; Mullié et al., 2004; Thibault et al., 2004).

Aldescription's effects of postbiotic products on diarrhoea in children less than four years old is particularly useful (Liévin-Le Moal et al., 2007). With findings so mixed, it is clear that postbiotics need to be administered with great care around young children who are suffering from diarrhoea. The effects of heat-killed L on babies less than 24 months old who were experiencing diarrhoea due to a virus other than were investigated rotavirus in one research. Acidophilus LB and its culture medium provide an excellent addition to oral rehydration solution (ORS), making the latter much more effective than the former. Recovery time in the intervention group was reduced by one day compared to the ORS-only group. Scientists cultured digestive human Caco2/TC7 cell monolayers with Escherichia coli C1845 and observed the effects of a postbiotic item on liquid-shaped vaults, a marker of anti- secretory activity. The paracellular permeability increase induced by C1845 was thought to be attenuated by the postbiotic product.

# CONCLUSION

The cell-free supernatants of probiotics have been discovered to include a wide variety of postbiotics, including proteins, peptides, organic acids, short-chain fatty acids, vitamins, enzymes, amino acids, and other metabolic by- products. Postbiotics provide advantages and may mimic the favourable therapeutic effects of probiotics, which are either live bacteria or a component of living bacteria (such as a metabolite). They do this with the help of livebacteria, which poses no risk to the human body. Postbiotics show promise as a therapeutic option for human patients, opening the door to the development of novel pharmaceuticals and nutritional supplements with specific physiological effects.

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# Conflict of Interest. None

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