

BACKGROUND

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by amyloid- β (A β) deposition, neuroinflammation, and cognitive decline. Conventional therapeutic approaches often fail to achieve adequate drug concentrations in the brain because of the blood-brain barrier, resulting in limited efficacy and potential systemic toxicity. Increasing evidence suggests that gut dysbiosis contributes to AD pathogenesis through the gut-brain axis by promoting neuroinflammation and amyloid pathology. Synbiotics, which combine prebiotics and probiotics, have emerged as promising modulators of gut microbiota; however, their therapeutic potential is restricted by poor gastrointestinal stability and non-specific delivery. Therefore, the present study aimed to develop colon-directed synbiotic nanocarriers for targeted modulation of gut microbiota and indirect attenuation of amyloid- β pathology associated with Alzheimer's disease.

METHODS

A colon-targeted synbiotic nanoformulation was developed by combining a prebiotic polyphenol with probiotic bacteria. The nanoparticles were prepared using the ionic gelation technique and coated with Eudragit® S100, a pH-sensitive polymer, to ensure colon-specific delivery. The formulated nanocarriers were characterized for particle size, polydispersity index (PDI), zeta potential, encapsulation efficiency, and probiotic viability. In vitro release studies were performed under simulated gastric, intestinal, and colonic conditions to evaluate targeted drug release. The formulation's ability to modulate the gut microbiota and exert neuroprotective effects was also assessed in vitro.

RESULTS AND CONCLUSION

The optimised nanocarriers showed good stability, high encapsulation efficiency (>75%), and high probiotic viability (>85%). Minimal release occurred in the stomach and intestine, while sustained release (>70%) was achieved in the colon, confirming successful colon targeting.

Colon-targeted synbiotic nanocarriers effectively deliver prebiotics and probiotics to the colon and may offer a promising approach to Alzheimer's disease management by modulating the gut-brain axis.

The pH-responsive delivery system protects synbiotics in the upper gastrointestinal tract and enables their targeted release in the colon, improving gut microbiota modulation and reducing neuroinflammation. This approach has the potential to overcome the limitations of conventional therapies by offering a safe, non-invasive, and disease-modifying treatment.

REFERENCES

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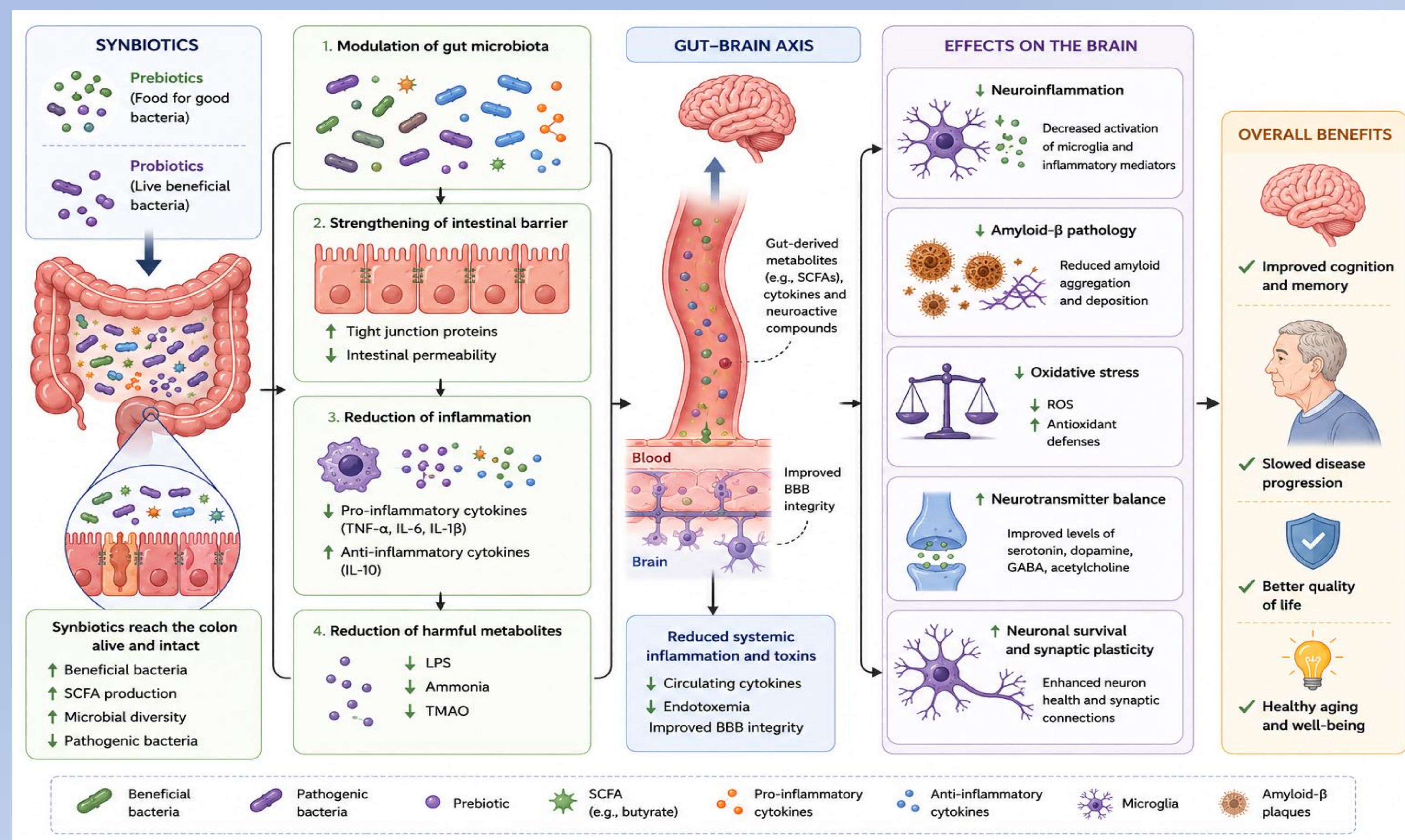


Figure 1. Proposed Mechanism of Synbiotic-Mediated Gut Microbiota Modulation and Neuroprotection in Alzheimer's Disease