CHAPTER 8
VSL#3 PROBIOTIC AND ITS POTENTIAL ROLE IN NEURODEGENERATIVE DISEASES MICROBIOLOGICAL PERSPECTIVE

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INTRODUCTION

Probiotics and VSL#3: Definition and Formulation

The Food and Agriculture Organization (FAO) and World Health Organization (WHO) define probiotics as "live microorganisms which, when operated in adequate amounts, granted a health benefit on the host" (1). Unlike standard probiotic supplements that typically provide one or two bacterial strains at relatively low doses, VSL#3 is a high-strength, multi-species preparation composed of eight different strains. Genomic analyses confirm that the formulation includes Streptococcus thermophilus, Lactobacillus acidophilus, L. paracasei, L. plantarum, L. helveticus, Bifidobacterium breve, and two distinct strains of Bifidobacterium animalis subsp. lactis (2). Collectively, these strains support diverse probiotic functions, including reinforcement of the intestinal barrier, modulation of host immunity, and host-microbe signaling via structures such as pili and surface proteins (2).

Epidemiology of Neurodegenerative Diseases

The most notably neurodegenerative disorders Alzheimer's disease (AD), Parkinson's disease (PD), and Amyotrophic Lateral Sclerosis (ALS) represent a growing global burden, largely due to the aging population.

- Alzheimer's disease (AD): The leading cause of dementia, with prevalence rising steeply with age. Around 3% of individuals between 65-69 years are affected, increasing to more than 30% among those aged 85 and above. Omis-

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metabolites, improved mucosal barrier function, and reduced pro-inflammatory signals-key factors associated with the gut-brain axis.

Experimental studies in animal models and in vitro systems consistently highlight VSL#3's ability to reduce neuroinflammation, support neuronal survival, and improve cognitive and motor outcomes. Early human trials and related probiotic interventions provide encouraging signals that these mechanisms may have clinical relevance. At the same time, inter-individual variability, differences in microbial composition, and the limited scope of current clinical studies underscore the need for cautious interpretation. Clinically, VSL#3 represents a crossroads between microbiology, neuroscience, and precision medicine. It offers a promising addition to conventional therapeutic approaches, but its implementation in routine care will require long-term, standardized, and highly efficient human studies. As the field develops, the integration of personalized microbiome analysis, advanced laboratory methodologies, and synergistic strategies may enhance the therapeutic potential of this combination.

In summary, VSL#3 is a strong candidate for microbiome-based interventions in neurodegenerative diseases, offering both scientific promise and clinical opportunity. However, its true value will only be realized through rigorous validation, ensuring that future applications are based on robust evidence and tailored to each patient's individual needs.

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