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(71)Name of Applicant :  
**1)JSS Academy of Higher Education & Research**  
Address of Applicant :Sri Shivarathreshwara Nagara, Mysuru, Karnataka,  
India – 570015 Mysuru Karnataka India

(72)Name of Inventor :  
**1)Dr. Sushma B V**  
**2)Sanjana Y K**  
**3)Dr. AKILA PRASHANT**  
**4)Dr. YASHODHARA KUMAR G. Y**

(57) Abstract :

**ABSTRACT INTEGRATED FOOD TRIAD OPTIMIZING PEDIATRIC GUT AND COGNITIVE HEALTH** The present invention provides a synergistic, three-component synbiotic formulation rationally designed to modulate the microbiota-gut-brain axis for pediatric neurodevelopmental support. The composition integrates a psychobiotic *Lactobacillus plantarum* strain, a phytochemically characterized prebiotic extract from *Curcuma amada* (mango-ginger), and a citrus-derived bioactive extract from *Citrus aurantifolia* standardized for polyphenolic flavonoids. The invention operates through an integrated four-pathway mechanism that restores intestinal epithelial barrier integrity, amplifies beneficial microbial colonization, and delivers blood-brain barrier (BBB)-permeable neuroprotective bioactives to the central nervous system. Validated by Orbitrap LC-MS/MS and multi-cell-line models, the formulation demonstrates a non-additive synergistic multiplier of 2.0–2.4x in barrier restoration (TEER) and 1.8x in neuroprotection. Optimized for pediatric compliance, this lyophilized formulation addresses the unmet need for a multi-target intervention in conditions like ADHD and ASD by reducing systemic endotoxemia and neuroinflammation. Fig. 1

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