Regulatory Mechanisms of Probiotics and Metabolites on Neurodegenerative Diseases in *Caenorhabditis elegans*

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Outline

I. Introduction
II. *Lactobacillus paracasei* HII01 enhances lifespan and promotes neuroprotection in *Caenorhabditis elegans*
III. Fatty acids derived from the probiotic *Lacticaseibacillus rhamnosus* HA-114 suppress age-dependent neurodegeneration
IV. Conclusion

Abstract

The gut microbiome is strongly linked to various neurodegenerative diseases, suggesting that regulating the microbiome could be a potential strategy for preventing or treating these conditions. Using genetically modified *Caenorhabditis elegans* models to express neurodegenerative traits, this study explores how probiotics can improve these diseases and investigate the underlying mechanisms. *Lactobacillus paracasei* HII01 had been shown to extend worms' lifespan, reduce lipofuscin accumulation, and decrease mitochondrial oxidative stress during aging. These effects were mediated through the p38/MAPK signaling pathway, with the upregulation of antioxidant and mitochondrial activity-related genes associated with the longevity gene *daf-16*. Additionally, *Lactobacillus rhamnosus* HA-114 had been found to improve paralysis phenotypes in worm models of amyotrophic lateral sclerosis (ALS) and Huntington's disease (HD) by upregulating lipid metabolism-related genes, thereby mitigating impaired β-oxidation and reducing lipid accumulation. Long-chain fatty acids are transported into the mitochondria for β-oxidation via the CPT-1 carnitine shuttle system; however, in ALS models, the carnitine transport function is impaired. HA-114 contains specific fatty acids that could shuttle into the mitochondria independently of the carnitine shuttle, contributing to stabilized energy metabolism, thereby reducing neurodegeneration and improving lipid homeostasis. In conclusion, both HII01 and HA-114 could enhance mitochondrial function, alleviating the symptoms of neurodegenerative diseases. Therefore, mitochondria may be a critical pathogenic mechanism in neurodegenerative diseases and offer a potential target for future therapeutic development.

參考文獻

Kumaree, K. K., Prasanth, M. I., Sivamaruthi, B. S., Kesika, P., Tencomnao, T., Chaiyasut, C., & Prasansuklab, A. (2023). Lactobacillus paracasei HII01 enhances lifespan and promotes neuroprotection in Caenorhabditis elegans. *Scientific Reports*, *13*(1), 16707.

Labarre, A., Guitard, E., Tossing, G., Forest, A., Bareke, E., Labrecque, M., Tétreault, M., Ruiz, M., & Alex Parker, J. (2022). Fatty acids derived from the probiotic Lacticaseibacillus rhamnosus HA-114 suppress age-dependent neurodegeneration. *Communications Biology*, *5*(1), 1340.