Research Update Information
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Spirulina Polysaccharide Restores Mitochondria Function via Upregulated Antioxidant Enzyme in an Aging Cell Model

Aging causes chronic age-related diseases and general health loss, and a variety of studies are being conducted to identify strategies to inhibit aging, thereby prolonging the healthy lifespan of humans. Mitochondria plays a crucial role in the aging process through the production of reactive oxygen species (ROS). ROS are known to accelerate cellular senescence by damaging various cellular components, such as DNA and proteins, and inhibiting the function of various organelles. On the other hand, we have a defense system to eliminate ROS, such as superoxide dismutase 1 and 2 (SOD1, localized in the cytosol; SOD2, localized in mitochondria), which convert superoxide to hydrogen peroxide. Loss of SOD2 accelerates mitochondrial dysfunction and aging in cultured cells and animal models; thus, SOD2 is considered an important target for mitochondrial homeostasis maintenance and anti-aging.

In this study, collaboration research was conducted together with Kochi University and DIC Corporation in Japan to determine whether polysaccharide derived from Spirulina (*Arthrospira platensis*) could have an impact on mitochondrial function using an aging fibroblasts cell system. The group found that the Spirulina polysaccharide complex (SPC) could restore mitochondrial function by scavenging ROS and increasing collagen production through the upregulation of SOD2, generally downregulated in aging fibroblasts. The study also noted that the upregulation of SOD2 was linked to inflammatory pathways by decreasing Iκ-B expression and thereby activating NF-κB signaling. However, SPC did not upregulate the expression of most inflammatory cytokines (IL-6) produced by LPS and TNF-α in aging fibroblasts, indicating that SPC induces SOD2 without activation of inflammatory cytokines. It suggests that SPC may rejuvenates aging fibroblasts and be useful in antiaging material.

Dr. Toshi Ide, Sr. Technical Division Manager mentions that “This is a new interesting research publication that polysaccharide derived from spirulina (*Arthrospira platensis*) could reduce oxidative stress and restore the mitochondrial function using in vitro system. What’s more captivating is the mechanism of action by which this complex upregulates SOD2 is linked to inflammatory pathway, but without activation of inflammatory signaling. Also, it has been reported that spirulina contains a variety of antioxidants, e.g. carotenoids, phycocyanin, and gamma-linolenic acid. In addition to these bioactive compounds, spirulina lipopolysaccharide could be a unique ingredient due to the chemical characters, which molecular weight is considered between 1,000 and 20,000 and maybe interact with receptors on the cell membrane, though specific direct targets have not been elucidated yet. Current cell culture study has still some limitation to elucidate the exact mechanisms yet, and further research will be expected in the future.”

Reference

Machihara, K., et al (2023). Restoration of mitochondrial function by Spirulina polysaccharide via upregulated SOD2 in aging fibroblasts. *iScience* 26: 107113. https://doi.org/10.1016/j.isci.2023.107113

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