Investigating the Effects of Citrus Flavonoids on Antioxidation and Anti-Aging Capabilities in *Caenorhabditis elegans* and Mice Model

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Outline

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Abstract

The global issue of population aging is becoming increasingly severe and is now a focus of international concern. Oxidative stress is recognized as one of the primary factors driving the aging process. Continuous oxidative damage leads to cellular dysfunction, promoting age-related diseases such as neurodegenerative disorders and cardiovascular diseases. Among natural antioxidants, citrus flavonoids have gained considerable attention for their antioxidant, anti-inflammatory, and potential anti-aging effects. This study investigated the antioxidant and anti-aging potential of citrus extracts across various biological models. Orange extract significantly extended the lifespan of wild-type *Caenorhabditis elegans* N2 strain by up to 26.2%. In addition to lifespan extension, orange extract enhanced the activity of superoxide dismutase (SOD) and catalase (CAT). It inhibited the generation of reactive oxygen species (ROS) and malondialdehyde (MDA), protecting cells from damage and slowing aging. Furthermore, mRNA expression analysis revealed that orange extract upregulated the longevity-associated gene *daf-16* while downregulating *age-1* expression. This indicated that the insulin/IGF-1 signaling pathway (IIS) was a crucial mechanism through which orange extract exerts its anti-aging effects. Building on the findings from orange extract, studies on naringenin demonstrated its broader anti-aging potential. Naringenin extended the lifespan of wild-type N2 *C. elegans* and alleviated signs of brain aging in middle-aged mouse models. Naringenin promotes the activity of metabolic enzymes (citrate synthase and cytochrome C oxidase) and increases the expression of SIRT1 while upregulating downstream antioxidant (*Foxo3, Nrf2, Ho-1*), anti-aging (*p16*), and anti-inflammatory (*Il-6*, *Il-18*) markers. These genes are related to age-associated inflammation and chronic diseases. In conclusion, citrus flavonoids possess antioxidant and anti-inflammatory properties that can slow the aging process and promote healthy longevity, holding potential for interventions in aging and the prevention of age-related diseases.

Reference

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