

Studies on the anti-aging and health-promoting effects of dietary fucoxanthin derived from marine algae toward its advanced utilization

THESIS ABSTRACT

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Fucoxanthin, a major marine xanthophyll characterized by unique structural features, has been reported to exhibit diverse health-promoting effects, including anti-inflammatory, anti-obesity, anti-angiogenic and anti-photoaging activities. In this thesis, the anti-aging properties of fucoxanthin were investigated. Firstly, the study focused on the protective effects of dietary fucoxanthin against natural skin aging in aged mice. Both 0.01% and 0.1% dietary fucoxanthin significantly suppressed age-associated increases in trans-epidermal water loss (TEWL) and wrinkle formation. These effects were accompanied by downregulation of genes associated with cellular senescence (*p16* and *p21*) and inflammation (*Il1rn*, *Il18*, *Ccl11* and *Ccl22*) in the skin. Furthermore, dietary fucoxanthin also reduced the expression of aging-related markers *p16* and *p21* in the liver, kidney, and skeletal muscle. These findings suggest that dietary fucoxanthin prevent not only skin aging but also systemic aging. In addition, the preventive effects of fucoxanthin on cognitive impairment were examined using a doxorubicin-induced aged model in mice. The mice are being maintained on experimental diets for four weeks, and behavioral assessments such as the novel object recognition test and the rotarod test have been conducted. To further explore the health-promoting potential of fucoxanthin, the anti-obesity activity of alkali-treated fucoxanthin was evaluated. In vitro experiment revealed that two metabolites—*isofucoxanthinol* and *fucoxanthinol hemiketal*—particularly the latter, significantly inhibited the differentiation of 3T3-L1 adipocytes. In vivo experiment, mice fed a high-fat diet containing 0.05% *fucoxanthinol hemiketal* showed significant changes in the gene expression levels of *Lpl* and *Cpt1a*, which are related to lipid metabolism, in adipose tissue compared with the control group.

Collectively, the findings of this thesis provide new insights into the potential of fucoxanthin as a functional food ingredient for mitigating age-related declines in physiological function and promoting overall health.