KEPU GRANT

Exploring the Potential Neuroprotective Properties of Astaxanthin Nanoemulsion in Modulating Brain Insulin Resistance in Alzheimer's Disease

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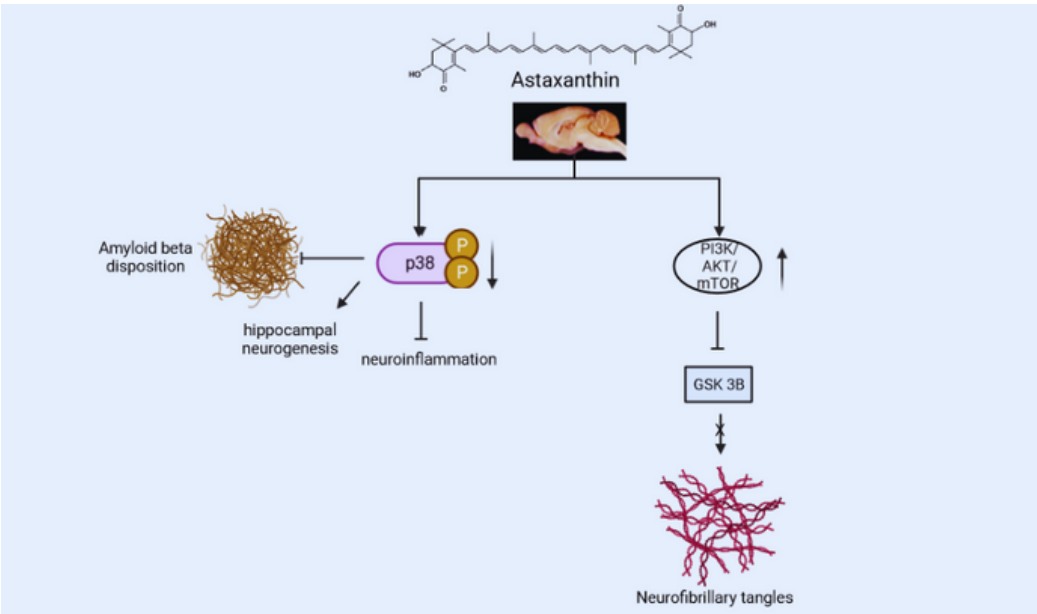
Freshwater and marine ecosystems are valuable sources of high-quality proteins, healthy fats, vitamins, and minerals for the human diet due to their diverse species and distinctive biodiversity. Astaxanthin, a xanthophyll carotenoids compound, has gained attention in recent years and can be acquired from seafood or isolated from the green microalga *Haematococcus pluvialis* for use as a dietary supplement in both humans and animals. Salmon, crab, and shrimp are all potential sources of astaxanthin. Due to its high concentration of antioxidants, astaxanthin has become a subject of interest among researchers. Studies have demonstrated that astaxanthin contains up to 1000 times the antioxidant capacity of beta carotene and vitamin E. With the potential benefits of astaxanthin in human health, researchers are actively studying its potential in treating diseases such as cancer, heart disease, diabetes, and even brain-related disease.



The hypothesised neuroprotective effect of astaxanthin nanoemulsion on insulin signaling pathways. P13K: phosphatidylinositol 3-kinase, AKT: protein kinase B, mTOR: mammalian target of rapamycin complex, GSK 3B: glycogen synthase kinase-3 beta.

As Malaysia's population ages rapidly, turning it into an aging nation by 2030, a sizable portion of the population is at risk for Alzheimer's disease (AD). AD is characterised by neuronal degeneration that affects cognition, behaviour, language, and visual-spatial abilities. Growing data supports the idea that AD is basically a metabolic disorder in which brain glucose consumption and energy production are compromised. Metabolic problems have been related to brain insulin and insulin-like growth factor (IGF) resistance, as well as alteration of signalling networks that regulate neuronal survival, energy production, gene expression, and plasticity. High-fat diets have been associated with brain insulin resistance in AD, and it has been proposed that insulin and IGF supplementation may help reduce the amyloid plaques, one of AD's pathological characteristics.

Prevention and treatment should be prioritised as there is no cure for AD; a compound that can maintain cognitive function and eliminate neurological disorders is highly sought after. This study will investigate how astaxanthin nanoemulsion affects the P38 kinase and phosphoinositide 3-kinase-protein kinase B-mammalian target of rapamycin (PI3K/AKT/mTOR) pathways in the brain of an AD rat model. Specifically, it will examine the potential of astaxanthin nanoemulsion to reduce inflammation and oxidative stress, which are both associated with AD, by modulating the activity of the PI3K/AKT/mTOR pathway. Additionally, the study will assess the neuroprotective effects of astaxanthin nanoemulsion on cognitive function in the AD rat model. Astaxanthin nanoemulsion is hypothesised to protect the neurons from the toxin amyloid beta and phosphorylated tau protein through the inhibition of P38 kinase and upregulation of PI3K/AKT/mTOR signalling. This study will expand our knowledge and comprehension of the molecular mechanisms behind the neuroprotective effects of astaxanthin nanoemulsion in AD.

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