Buttermilk and Krill Oil Phospholipids Improve Hippocampal Insulin Resistance and Synaptic Signaling in Aged Rats

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Impaired glucose metabolism and mitochondrial decay greatly increase with age, when cognitive decline becomes rampant. No pharmacological or dietary intervention has proven effective, but proper diet and lifestyle do postpone the onset of neurodegeneration and some nutrients are being investigated. We studied insulin signaling, mitochondrial activity and biogenesis, and synaptic signaling in the hippocampus and cortex following dietary supplementation with bioactive phospholipid concentrates of krill oil (KOC), buttermilk fat globule membranes (BMFC), and a combination of both in aged rats. After 3 months of supplementation, although all groups of animals showed clear signs of peripheral insulin resistance, the combination of KOC and BMFC was able to improve peripheral insulin sensitivity. We also explored brain energy balance. Interestingly, the hippocampus of supplemented rats?mainly when supplemented with BMFC or the combination of KOC and BMFC?showed an increase in intracellular adenosine triphosphate (ATP) levels, whereas

no difference was observed in the cerebral cortex. Moreover, we found a significant increase of brain-derived neurotrophic factor (BDNF) in the hippocampus of BMFC+KO animals. In summary, dietary supplementation with KOC and/or BMFC improves peripheral and central insulin resistance, suggesting that their administration could delay the onset of these phenomena. Moreover, n-3 fatty acids (FAs) ingested as phospholipids increase BDNF levels favoring an improvement in energy state within neurons and facilitating both mitochondrial and protein synthesis, which are necessary for synaptic plasticity. Thus, dietary supplementation with n-3 FAs could protect local protein synthesis and energy balance within dendrites, favoring neuronal health and delaying cognitive decline associated to age-related disrepair.

Buttermilk

Hippocampus

Insulin

Krill oil

Phospholipids

adenosine triphosphate

brain derived neurotrophic factor

linolenic acid

omega 3 fatty acid

phosphatidylethanolamine

phosphatidylinositol

phospholipid

brain derived neurotrophic factor

fish oil

insulin

phospholipid

aged

animal cell

animal experiment

animal model

animal tissue

Article

brain cortex

buttermilk

buttermilk fat globule membrane

controlled study

diet supplementation

energy balance

hippocampus

insulin resistance

insulin signaling

krill

lipid membrane

male

mitochondrial biogenesis

nerve cell plasticity

nonhuman

protein synthesis

rat

synaptic transmission

treatment duration

aging

animal

chemistry

diet

drug effect

energy metabolism

hippocampus

insulin resistance

krill

metabolism

organelle biogenesis

pathology

signal transduction

synapse

Wistar rat

Aging

Animals

Brain-Derived Neurotrophic Factor

Buttermilk

Diet

Energy Metabolism

Euphausiacea

Fish Oils

Hippocampus

Insulin

Insulin Resistance

Male

Organelle Biogenesis

Phospholipids

Rats, Wistar

Signal Transduction

Synapses