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**Role of Coenzyme Q10 & Omega 3 fatty acid in protection,
maintaining and enhancing brain functions and intelligence
that decline with age**

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Abstract

In elderly humans , especially who focus on maintaining or even develop their learning , memory and intelligence progression, there are a clear biological physiological and nutritional obstacles, that the aging brain is increasingly facing inflammatory , oxidative alterations depletion of essential and vital biological and nutritional molecules in brain with progression with age , which may causing decreasing in the quality and the efficacy of memory , learning and brain cognitive functions, the renewal of neurons ,membranes and oligodendrocytes is very slow and even a cell that disappears difficult to be replaced easily ,otherwise the increased risk of developing cerebrovascular or neuropsychiatric disorders with progression in age. The brain and the nervous system character-

ized by the greatest concentration of Lipids, about 60 % of the dry weight portion of the human brain consists of lipids. Omega 3 fatty acid and Coenzyme Q10 or ubiquinone (lipid-soluble compound) play important roles in the development and maintenance of normal central nervous system (CNS) structure and function and enhance brain functions .

Keywords: Coenzyme Q10 , omega-3 fatty acids docosahexaenoic acid (DHA) , eicosapentaenoic acid (EPA) mitochondrial membranes ,low-density lipoprotein (LDL) ,3-NP neurotoxicity grey matter (GM), bioavailability ,co-administration and TNF- α factor and interleukin

Introduction

For elderly human ,the brain is affecting with the progression with age with inflammation and more oxidation stresses , that may be associated with depletion in the availability of essential brain vital precursors substances and nutritional concentrations that could affect its membrane and neuronal plasticity especially those concerning memory and learning.

It was found that there is a strong relation and correlation between age-related impairments and losses in hippocampal dependent memory functions and the decline in neurogenesis.

A neural reserve that if well prepared physiologically , trained and maintained with the vital nutrition and antioxidants early might provide a remarkable benefits on brain plasticity and performance, that will reduce the increasing neuro-degeneration brain functional losses in many adult brain hippocampal neurogenesis(Gózdź, Dębicki, & Pietrow, 2005).

These increases in may be an attempt at brain self-repair and raises the intriguing possibility that enhancing neurogenesis and the subsequent survival of new neurons may have significant therapeutic potential.

Many aging factors characterize changes of normal the brain by time , such as mitochondrial dysfunction ,alterations in energy metabolism , inflammatory effects , increased oxidative stress and even damage to DNA, that may be associated with structural changes over in brain volume and weight and altered membrane lipid content ,so the aging brain is more prone to the development of many inflammations, low quality cognitive roles and even may developed neurodegenerative diseases(Dyall, 2015).

the efficacy of CoQ10 as a targeted treatment for age-related cognitive decline, and aid in increasing productivity and quality of life.

The omega 3 recent hypothesis searching for its the vital brain and increasing higher intelligence otherwise its vital brain and nervous system repair , anti-inflammation , improvement and providing essential vital nutritional brain requirements and enhance brain volume and tissues .

The study problem

Cognitive brain functions declines is associated with mitochondrial dysfunction and oxidative stress, and cognitive aging process is the body's increased vulnerability to damage caused by free radicals.

Oxidative stress increase with progression in age due to the increased proliferation of free radicals with increasing in age that associated with a depletion of antioxidant stores and essential fatty acids within brain tissues and organs .

This research will answer the following questions:-

- 1- What is the vital role of supplementation CoQ10 in the brain and nervous system ?
- 2- What is the best options for brain supplementation with CoQ10 ?
- 3- What is the vital role of supplementation omega 3 to the brain and its positive impacts in cognitive processes ?

4- What is the importance and synergetic effect of co-administration of omega-3 and CoQ10 supplements?

What distinguishes this study from previous studies?

This study focus on the role of supplementation of two essential and vital substances that involves directly in the brain functions and performance that depleted or decreased in their bioavailability in brain with age (omega 3 & CoQ10) ,and highlighting their vital and importance actions and role in enhancing and protection of brain and nervous system for who focus on development and increase their brain performance e, protection and intelligence and prevent cognitive decline with age .

The study content

1.0 Omega 3

It has been found from many previous studies that omega-3 fatty acids play a great role in improving cognitive performance and neurotransmitters regulations in some neuropsychiatric disorders and learning difficulties for the different life stages. Omega-3 IS long-chain polyunsaturated fatty acids (PUFA), are docosahexaenoic acid (DHA) ,alpha-linolenic acid (ALA) and eicosapentaenoic acid (EPA) .

1.1 Docosahexaenoic acid (DHA) role

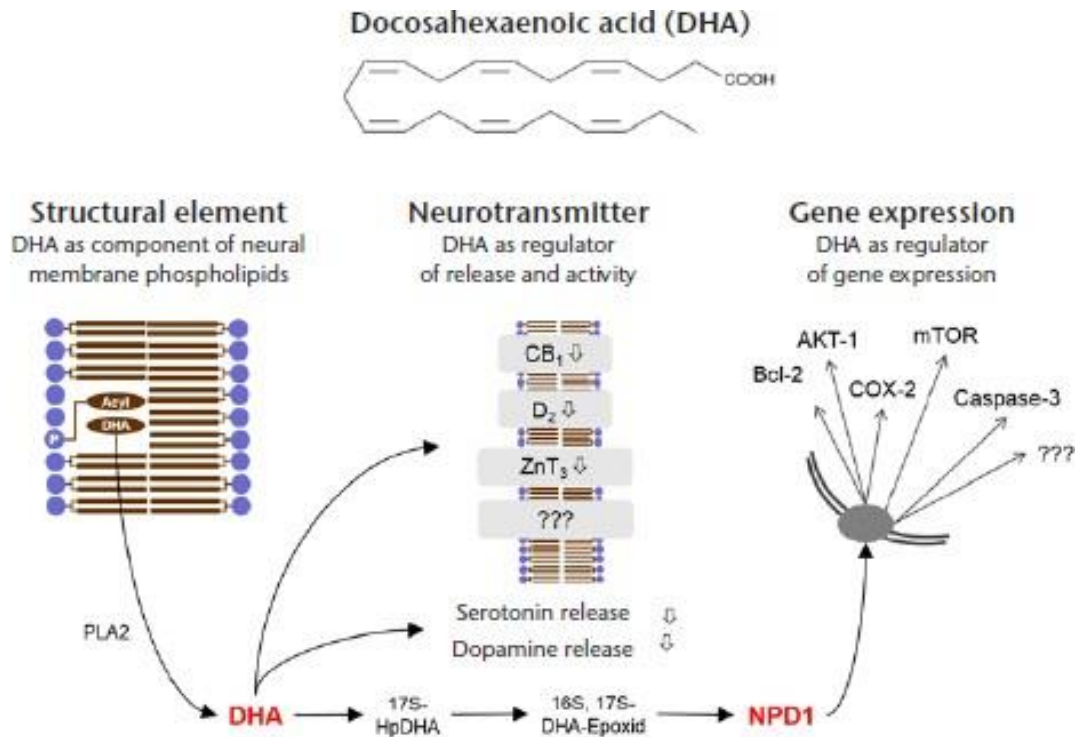


Figure 1 , DHA show neurotransmitters regulations (serotonin & dopamine) , neuro-protection and antiinflammatory (neuroprotectin D1) effects(Smollich, 2015)

It is very vital for the cerebrovascular brain functions to have high level of energy and the regular blood supply , the most critical effect of mega-3 fatty acids, that support many defined areas in brain especially the cerebral cortex and the thalamus by DHA supply that ease the induction of Nitric Oxide synthase ; leading to cerebrovascular vasodilatation , In addition to that it play a great role in serotonin and dopamine release and regulation and support NPDI formation which act has potent neuronal protection , antiinflammatory effects against oxidative stress and play a great role in reduction the formation of senile plaques.

DHA is considered a neurotrophic growth factor that play a vital role in neuroplasticity enhancement and even stimulation of the formation of new synapses , but it was found that DHA supply is decreasing with increasing age , that starting from the age of 20 to the age 40(Smollich, 2015).

The DHA recent hypothesis for its the vital brain and increasing higher intelligence , that DHA support and enhance transfer ,regulations and communications of π -electrons across the membrane ; unique depolarization of retinal membranes and regulate neural signaling that support high moral and intelligence properties(Dyall, 2015).

DHA is the most abundant Phosphatidylserine (PS) species in the brain ,Increasing the PS content of neuronal membranes may positively affect neuronal survival via the Phosphoinositide 3-kinases (PI3Ks) signaling pathway, the DHA group also had significantly increased PC levels. These effects were accompanied by increases in the levels of pre and post-synaptic proteins, postsynaptic density protein 95(PSD-95) , syntaxin-3 (STX3), and synapsin-1 protein(Dyall, 2015).

It is a clear that there is a very important for adult especially elderly people and researchers to increase their daily omega-3 intake to maintain DHA levels in brain to support memory , learning and high intelligence enhancement , the best option of supplementation of omega-3 is in concentration between 500 mg to 1000 mg per day, as 250mg omega-3 daily intake is very low(Martinench, 2014; McBurney & Bird, 2017).

1.2 Eicosapentaenoic acid (EPA) effects

EPA has remarkable cerebral neuronal antinflammatory effects ,it interacts with lipoprotein metabolism and decreases the production of cytokines, TNF- α factor and interleukin that have biological roles in inflammatory effects(Gorelick, Counts, & Nyenhuis, 2016; Maclean et al., 2005).

The eicosanoids derived from Arachidonic acid (AA) promote inflammation, while EPA counteracts the effects of Arachidonic acid (AA) and the production of proinflammatory eicosanoids, that derived from Arachidonic acid (AA)(Layé, Nadjar, Joffre, & Bazinet, 2018).

1.3 DHA and EPA role in maintaining the brain. volume and WM micro-structural integrity

The aging brain is characterized by functional and metabolic changes associated with cognitive decline, impaired brain plasticity and severe neuronal loss .

Omega3 has beneficial effects on white matter micro-structural integrity and grey matter (GM) volume in frontal, parietal, temporal and limbic areas associated with improvements in many executive and memorial functions(Cutuli, 2016).

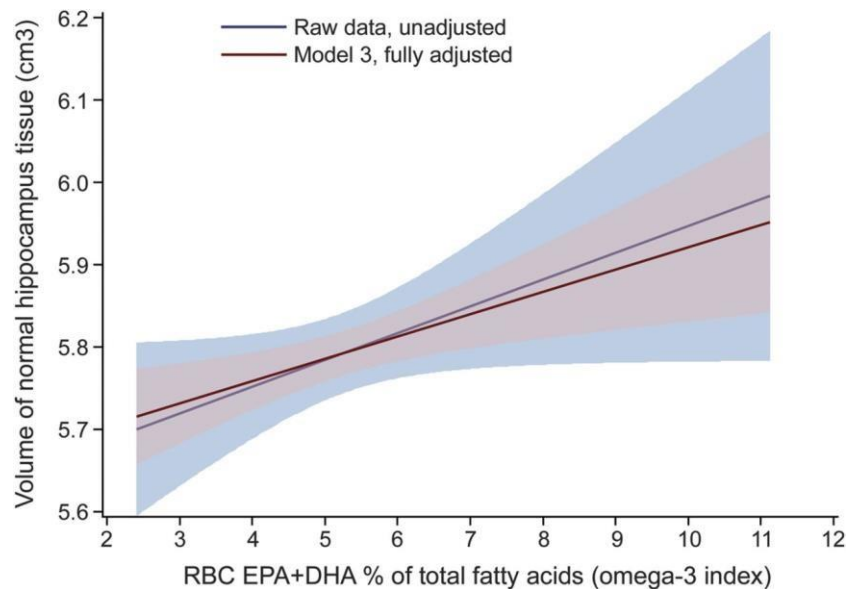


Figure2 .omega 3 intake and brain volume(James V. Pottala et al., 2014)

It is found that higher bioavailability concentration of DHA and EPA were associated with larger grey matter (GM) volume and hippocampal volumes and also with the enhancement in white matter microstructure and vascular signs in older people(James V. Pottala et al., 2014; Witte et al., 2014).

2.0 Coenzyme Q10

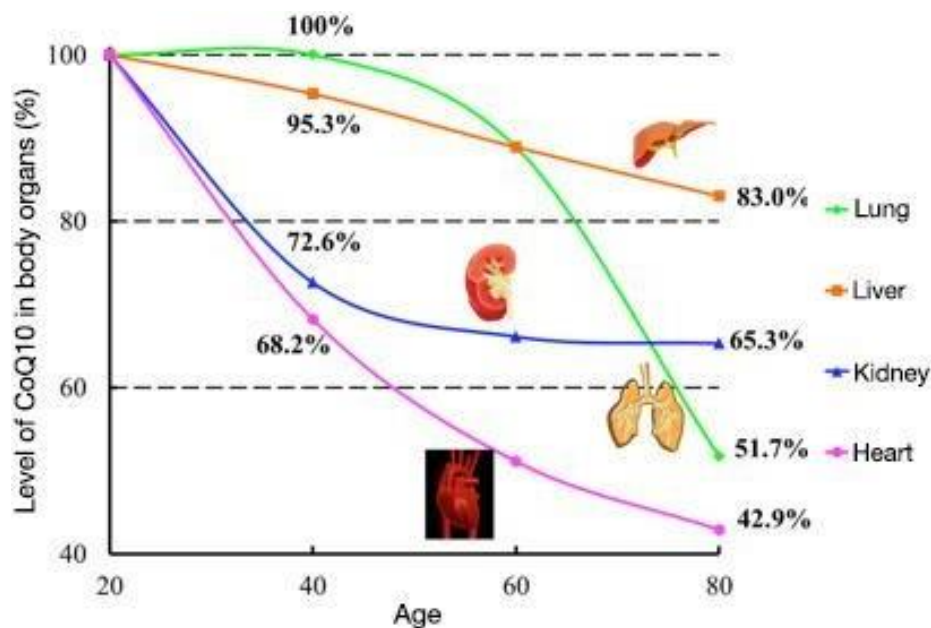
Coenzyme Q10 or ubiquinone (CoQ10 is 2,3 dimethoxy-5-methyl-6-decaprenyl benzoquinone) , is a lipid-soluble quinone compound.

CoQ10 is the only lipid soluble antioxidant, that is synthesized endoge-

nously and found in all cellular membranes and in blood.

Coenzyme Q10 is an essential cofactor of the electron transport chain with a potent antioxidant free radical scavenger in lipid and mitochondrial membranes.

It plays an important role in cellular metabolism, play a great role as an electron carrier in both mitochondrial and even extra mitochondrial membranes.



Source: A pamphlet published by INTERNATIONAL COENZYMEQ10 ASSOCIATION

Figure 1. CoQ10 levels fall with aging in the body.

Coenzyme Q10 levels are known to decrease with aging and this decrease may be caused by reduced synthesis or age-dependent increases in lipid peroxidation that can reduce coenzyme Q10 levels (Matthews, Yang, Browne, Baik, & Beal, 1998)

2.1 Role of coenzyme Q10 in brain functions and the nervous system protection

Brain cognitive declines and neurodegenerative diseases is very associated with a mitochondrial dysfunction, deficits energy metabolism and the increased cellular oxidative stress, that is not neutralized by other antioxidants.

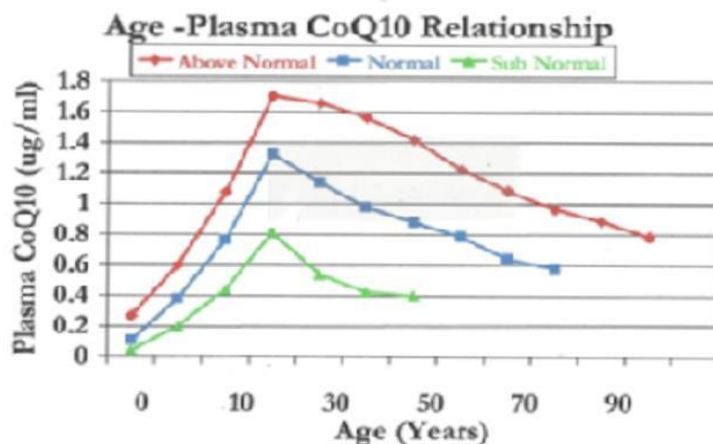
The oral CoQ10 supplementation could be a novel antioxidant and nutri-

tional strategy in this situations(Hussein, El-matty, El-Khayat, & Abdel-Latif, 2013; Villalba, Parrado, Santos-Gonzalez, & Alcain, 2010).

coenzyme Q10 is highly effective in attenuating 3-NP neurotoxicity ,and Coenzyme Q10 protects against glutamate toxicity in cerebellar neuron(Matthews et al., 1998).

Coenzyme Q10 may have a vital cell potential role by retarding the accelerated death of Cells involved in the Aging Process by reversing accelerated Apoptosis of Cells involved in the Aging Process.

CoQ10 Synthesis with Age



100

Folkers & Nylander

SIBR Inc. 2010

Figure 2. CoQ10 synthesis with age , normal range for plasma Coenzyme Q10 was from 0.35 to 1.65 micrograms per milliliter.

CoQ10 decreases other biomarkers for inflammation and inflammatory cytokines(De Barcelos & Haas, 2019)

CoQ10 has potential role for the inhibition of atherosclerosis by decreasing the monocyte expression of integrins, with inhibition the oxidation of low-density lipoprotein (LDL).

CoQ10 is associated with increased cerebral blood flow, enhancing the delivery of oxygen and glucose to the brain(Stough et al., 2019).

Coenzyme Q10 protect Deoxyribonucleic Acid (DNA) from oxidative damage and play a role in the neurotransmitter regulations by prevent the depletion of Dopamine caused by the Neurotoxin(Chemica et al., 2010).

2.2 Supplementation brain with Coenzyme Q10

Coenzyme Q10 is a lipid-soluble compound and is best absorbed with fat in a meal , the effect may be cumulative over time so that longer durations of administration lead to greater functional effects(Stough et al., 2019).

The deficiency involves negatively in the brain damage, especially in the cerebellum which is responsible for coordination and balance , both brain and muscle tissues share the same processes in the synthesis of this substance as supplementation with CoQ10 in doses of 100 mg daily for 3 months was demonstrated improvements in exercise tolerance, cognitive functions, fatigue, stroke volume and cardiac output(Chemica et al., 2010).

The results of the study

CoQ10 supplementation is an optimal treatment which has the potential to improve brain function in healthy elderly populations due to established beneficial effects on mitochondrial function, vascular function and oxidative stress and coenzyme Q10 is highly effective in attenuating 3-NP neurotoxicity

It is a clear that there is a very important for adult especially elderly people and researchers to increase their daily omega-3 intake to maintain DHA and EPA levels in brain to support memory , learning and high intelligence enhancement

EPA has remarkable cerebral neuronal antinflammatory effects

Omega3 has beneficial effects on white matter micro-structural integrity and grey matter (GM) volume in frontal, parietal, temporal and limbic areas.

The is a great promising potential synergetic effect of co-administration of omega-3 and CoQ10 supplements in enhancing and improvement of brain, memory and cognitive functions.

The suggestions

This study required to be applied for prophylaxis or improving brain and memory and enhancing intelligence for learners , researchers especially with progression of age ,that will impact positively in different science ,economy , health and social aspects.

The conclusion

It is a clear that there is a very important for adult especially elderly people and researchers to increase their daily omega-3 intake to maintain DHA levels in brain to support memory , learning and high intelligence enhancement.

CoQ10 is ac vital option to be targeted by supplementation for age-related cognitive decline, and aid in increasing productivity and quality of life.

The is a great promising potential synergetic effect of co-administration of omega-3 and CoQ10 supplements

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