



Enhancing learning & memory through innovative dietary planning

Nigar Naqvi^{1*}, Mohsin Ali Khan², Sarina Zehra³

¹ Consultant Dietician, Era University Sarfarazganj, Hardoi Road, Lucknow, Uttar Pradesh, India

² Chancellor, Era University (EU), Lucknow, India & Chairman, American University of Barbados.

³ MBBS Undergraduate Student, Era University (EU), Lucknow, Uttar Pradesh, India

Abstract

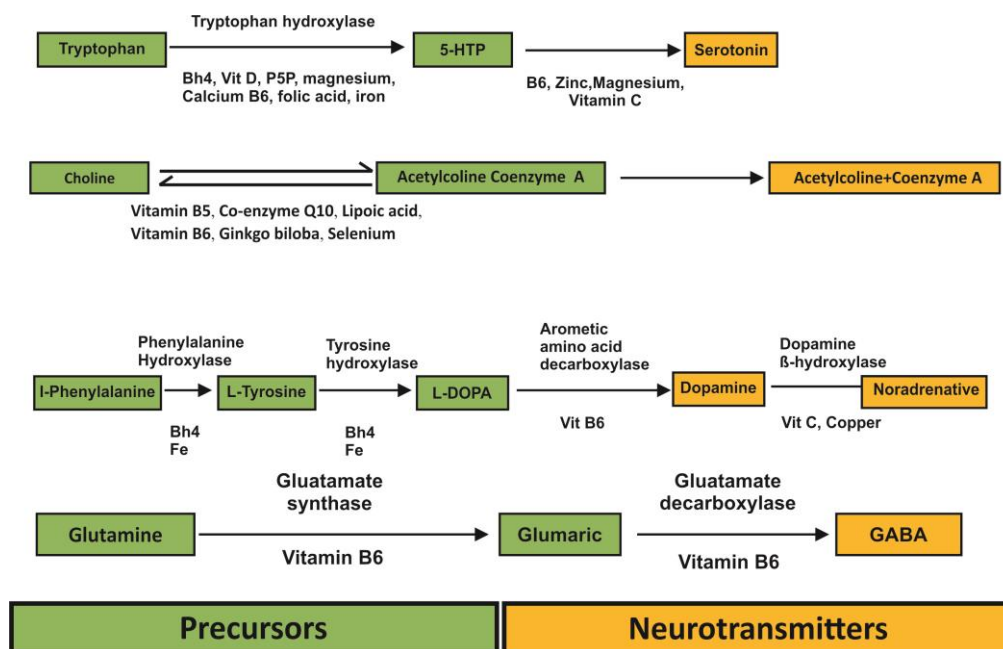
There are various neurotransmitters which help to enhance learning and memory these are serotonin, dopamine, acetylcholine etc. These neurotransmitters are derived from their precursors. The precursor of neurotransmitters are the active compound or nutrients which is found in various food products. In spite of these there are various cofactor of particular neurotransmitter. These cofactors are also vitamins and minerals for example- cofactor of serotonin is zinc, iron, vitamin C, vitamin E, manganese etc. The cofactor of acetylcholine is vitamin B5, alpha lipoic acid & cofactor of dopamine is vitamin B6 & iron. These cofactors or nutrients of particular neurotransmitters have their respective enhancer which is also a nutrient example- zinc is cofactor of serotonin whereas vitamin A is enhancer of zinc. Every nutrient has its particular peak & t_{1/2} value as medicine. So there is a need to plan such a type of dietary pattern to patients to enhance learning through their respective cofactors with enhancers & there is also a need to give enhancers before cofactor peak & t_{1/2} level will attain.

Keywords: neurotransmitters, precursors, cofactors, enhancer

Introduction

It has long been suspected that the relative abundance of specific nutrients can affect cognitive development & emotions. Newly described influences of dietary and medicines are responsible for the action of diet on brain health & mental function. There are several neurotransmitters which

help to raise learning & memory include Dopamine, Acetylcholine, Serotonin, GABA & nor epinephrine. Every neurotransmitter has its particular mechanism & various co-factors are responsible for conversion of neurotransmitter as shown below.



Method

We have searched databases including MEDLINE, PubMed, and Science direct

Discussion

There are various co-factors/nutrients which are found in various food products helps to raise particular

neurotransmitters level. These co-factors or nutrients have their specific peak and $t_{1/2}$ half values.

There are few antipsychotic drug like monoamine oxidase inhibitor (which raised serotonin, dopamine, norepinephrine level), acetylcholinesterase inhibitor (which raised acetylcholine) Glutamatergic drug (which raised glutamate level).

The first class of antipsychotic drug monoamine amino oxidase inhibitor (MAOIS). MAOIs elevate the level of serotonin by inhibiting the enzyme monoamine oxidase. Drug selegiline act as monoamine oxidase inhibitor. The peak & $t_{1/2}$ value of drug selegiline are 30 minutes and 10 hours. Just

like any medicine each active constituent in a dietary substance has its occurs time of peak plasma concentration (T_{max}) & plasma half-life ($T_{1/2}$) values. Medicine & dietary substance can have a synergistic effect by timing the intake of medicine & dietary product according to the T_{max} & $T_{1/2}$ of the active constituent medicine & corresponding food.

If drug selegiline (MOIs) is taken at 9:00 am it attain its $t_{1/2}$ at 7:00 pm. The active constituent quercetin, apigenin, curcumin found in onion, apple & turmeric act as natural MOIs inhibitors. The $t_{1/2}$ values of quercetin, apigenin and quercetin are 13.4 hrs, 8.4 hrs, 12.84 hrs respectively.

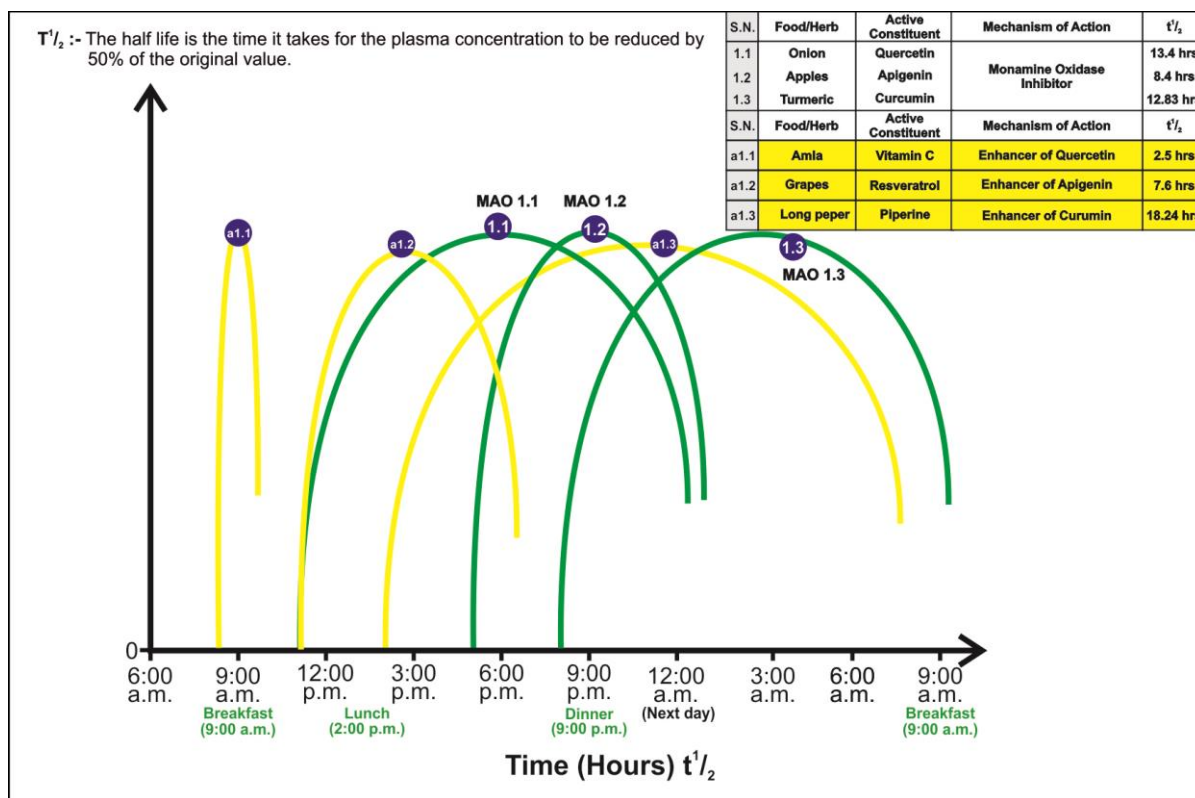


Fig 1: Monoamine Oxidase Inhibitor

There are few active constituent found in various food product as bioenhancer of other nutrients as well as drugs. Vitamin C most abundantly found in amla act as enhancer of quercetin where as resveratrol found in grapes act as enhancer of apigenin and piperine found in long pepper as well as black pepper act as enhancer of curcumin. The $t_{1/2}$ values of vitamin C, resveratrol & curcumin are 2.5 hrs, 7.6 hrs & 18.24 hrs respectively. If onion is given at 11:00 am it attain its $t_{1/2}$ at 12:00 am it is better to take vitamin C (bioenhancer of quercetin) before consumption of onion (active constituent

quercetin) for its better absorbtion. In the same way if apple (active constituent apigenin) is given at 5:00 pm it attains its $t_{1/2}$ at 1:00 am for enhancing the bioavailblity of apigenin its enhancer resveratrol most abudantaly found in grapes should be given at 11: 00 am at it reaches its $t_{1/2}$ at 6:30 pm. The food/Herb like aloe vera, apple act as natural acetylcholinesterase inhibitor where as some active constituents like choline, rosemarinic acid, caffeine, lipoic acid, CoQ10, Vitamin B6 & Vitamin B5 found in egg rosemary, tea, tomato, soyabean,

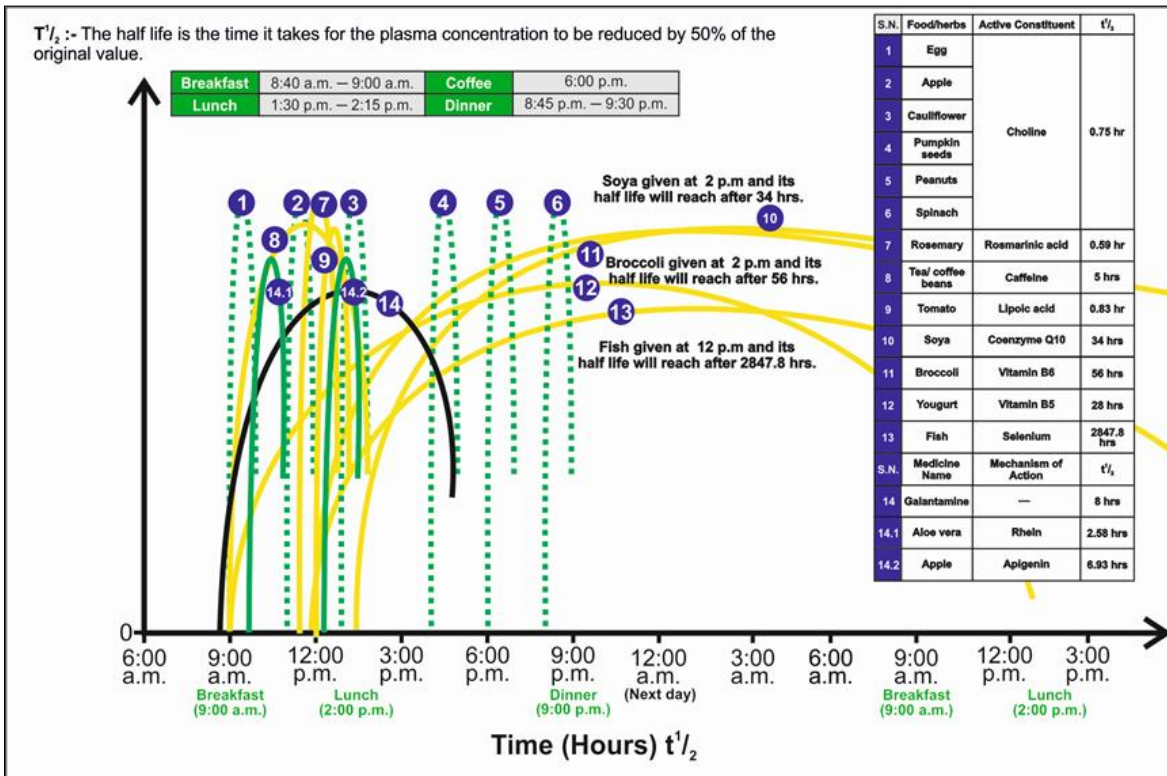


Fig 2: Neurotransmitters Acetylcholine Pathway

The food/Herb like aloe vera, apple act as natural acetylcholinesterase inhibitor where as some active constituents like choline, rosmarinic acid, caffeine, lipoic acid, CoQ10, Vitamin B6 & Vitamin B5 found in egg rosemary, tea, tomato,

soyabean, broccoli & yogurt act as acetylcholinesterase inhibitor. Green tea having active constituent theanine act as natural glutamatergic inhibitor.

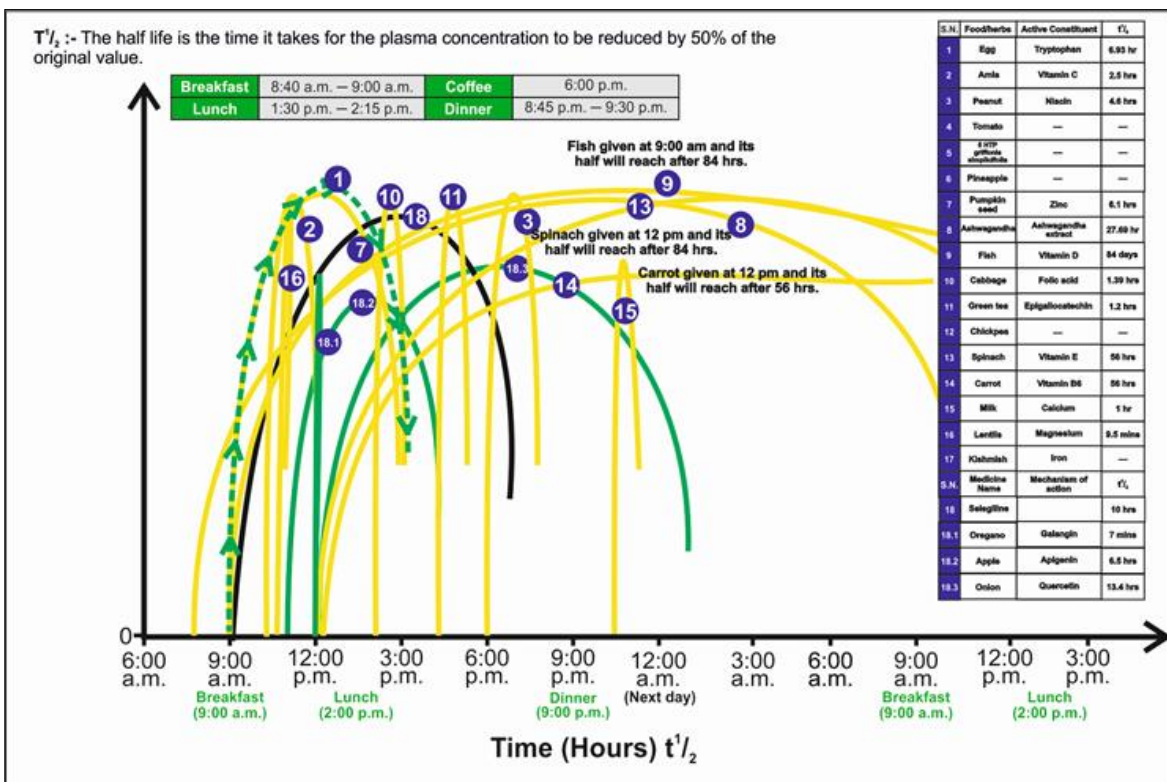


Fig 3: Neurotransmitters Serotonin Pathway

Tryptophan is an amino acid is converted into 5 HTP (hydroxytryptophan) which is converted into serotonin but the tryptophan rich food products do not cross the blood brain barriers so the serotonin level will not be raised. So the diet which are deficient in branch chain amino acid leucine, isoleucine & valine but having tryptophan like mango, guava & apple help to raised ourserotonin level. Griffonia simplicifolia is the only herb which contain 5 HTP hydroxy

tryptophan. There are various active constituents/cofactor like tryptophan, vitamin C, niacin, zinc, vitamin D, vitamin E, vitamin B6, Iron, magnesium, folic acid, found in various food products helped to raised serotonin level. Glutamine an amino acid found egg, carrot and fish is converted into GABA in the presence of vitamin B6. Vitamin B6 act as co-factor of GABA and enhancer of glutamine. Sanjoinine A the active constituent found in ber also help to modulation of GABA.

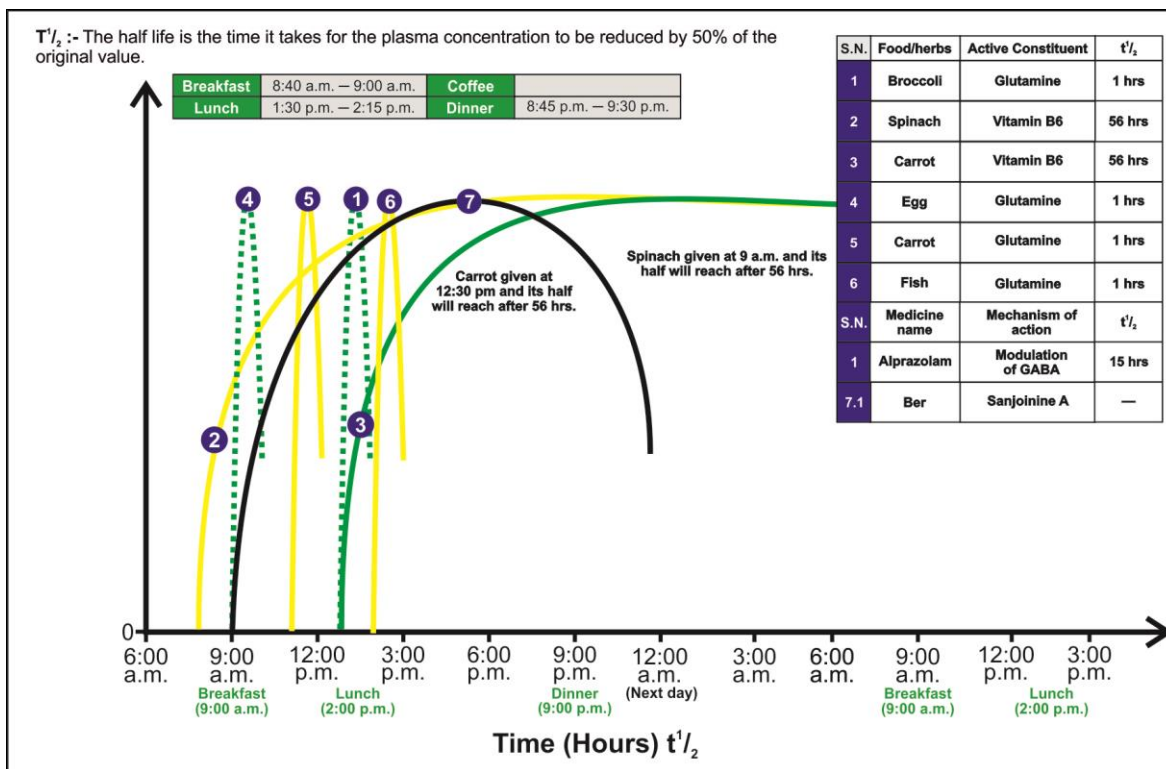


Fig 4: Neurotransmitters GABA

Conclusion

It is concluded that there is a need to give such type of diet which raised neurotransmitters level without any difficulty of digestion. Mango, papaya & guava are the; best fruit which raised serotonin level it is better to give such type of food/herb which raised neurotransmitters level naturally with their respective enhancer. This type of dietary prescription help to enhance neurotransmitters level which is more beneficial for raising memory and learning.

References

- Ean-Luc Martin and Charles Finsterwald. Cooperation between BDNF and glutamate in the regulation of synaptic transmission and neuronal development. *Communicative & Integrative Biology* January/February. 2011; 4(1):14-16
- Wei Z, Liao J, Qi F, Meng Z, Pan S. Evidence for the contribution of BDNF-TrkB signal strength in neurogenesis: An organotypic study. *Neurosci Lett*. 2015; 8(606):48-52.

- Andrew H. Miller and Charles L. Raison. The role of inflammation in depression: from evolutionary imperative to modern treatment target. *Nature reviews, immunology* January, 2016, 16.
- Gupta P. Relationship between Depression and Vitamin C Status: A Study on Rural Patients from Western Uttar Pradesh in India. *International Journal of Scientific Study*. 2014; 1(4):38-39.
- Sharma P. Nutrition: Preventive Psychiatry. *World Journal of Pharmacy and Pharmaceutical Sciences*. 2015; 4(10), 394-403.
- Sarubbo F. Chronic Silymarin, Quercetin and Naringenin Treatments Increase Monoamines Synthesis and Hippocampal Sirt1 Levels Improving Cognition in Aged Rats. *J Neuroimmune Pharmacol*. 2018; 13(1):24-38. <http://dx.doi.org/10.1007/s11481-017-9759-0>
- Kulkarni S. An Overview of Curcumin in Neurological Disorders. *Indian J Pharm Sci*. 2010; 72(2):149-154. <http://dx.doi.org/10.4103/0250-474X.65012>.
- Schliemann W. The Decisive Step in Betaxanthin

- Biosynthesis Is a Spontaneous Reaction1. *Plant Physiol.* 1999; 119(4):1217-1232.
9. Hussein J. Evaluation of brain monoamines in diabetic rats treated with quercetin. *Journal of Chemical and Pharmaceutical Research.* 2014; 6(10):384-390. <http://dx.doi.org/www.jocpr.com>.
 10. Szwajgier D. Anticholinesterase Activities of Selected Polyphenols – a Short Report. *Pol. J Food Nutr. Sci.* 2013; 64(1):59-64. <http://dx.doi.org/10.2478/v10222-012-0089-x>.
 11. Pohanka M. Caffeine Inhibits Acetylcholinesterase, But Not Butyrylcholinesterase. *Int J Mol Sci.* 2013; 14(5):9873-9882. <http://dx.doi.org/10.3390/ijms14059873>.