APPENDIX
Effect of Moringa oleifera in experimental model of Alzheimer’s disease: Role of antioxidants

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Effect of chronic treatment of standardized aqueous extract of Moringa oleifera (MO) leaves (250mg/Kg; PO) on colchicine infused Alzheimer model in rats, behavioral testing (Radial Y arm maze task) and brain antioxidants (superoxidedismutase, SOD, Catalase and Lipidperoxidase, LPO) level was studied in Holtzman strain adult albino rats. The result revealed that pretreatment with MO markedly increased the number of correct choices in a radial Y arm maze task. Chronic treatment with MO significantly increased the SOD and Catalase activity and decreased LPO activity in the cerebral cortex (CC). MO leaves may help to scavenge free radicals either by non enzymatic defenses like vitamins or by bioactive compounds like flavonoids or both. Thus it can be concluded that MO leaves may give protection against this devastating disease like Alzheimer’s.
Protective role of an Indian herb, *Moringa oleifera* in memory impairment by high altitude hypoxic exposure: Possible role of monoamines.

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The influence of medicinal plants on hypobaric hypoxia was assessed by behavioral, electroencephalographic study and brain monoamines estimation. Holtzman strain rats were divided into 3 groups: Control, hypobaric hypoxia and *Moringa oleifera* (MO) treated hypobaric hypoxia. Rats exposed to hypobaric hypoxia 412.0 mm Hg (18,000 ft) for 21 days showed loss of memory as evidenced by increase in latency period and decrease in number of correct choices in daily trials in radial maze learning task. Biochemical studies showed decrease in norepinephrine (NE) level in cerebral cortex (CC), cerebellum (CB), midbrain (MB) and increase in caudate nucleus (CN). Dopamine (DA) level was decreased in CC and CN but increased in CB and MB, while serotonin (5-HT) level was decreased in CC but increased in CB, MB, and CN. The EEG studies showed persistent, high voltage fast wave discharges with a few β waves. Pretreatment with MO leaf extract (250 mg/kg), hypobaric hypoxic group showed an increase in correct choices and decrease in latency period. The EEG studies showed abolition of high voltage fast wave discharges and increase in β and α waves. NE level was significantly increased in CB and MB and decreased in CN whereas 5-HT level was decreased in CB and MB while increased in CN. The results suggest that MO improves maze-learning task possibly by specific brain monoamines on exposure to hypobaric hypoxia simulating at high altitude.
Effect of chronic treatment of standardized hot water extract of Camellia sinensis (BTE) for 14 days on stress and hypertensive models of rat, behavioural (learning and memory) testing (Shuttle box avoidance test), brain EEG activity and serum neurotransmitter (NE, 5-HT, DA) was studied in male Charles Foster strain rats. The result revealed that oral pretreatment with BTE (5ml/kg) markedly increase in the performance of active avoidance learning in the Shuttle box avoidance test. Electroencephalographic recording showed that BTE pretreatment to experimental animals elicited significant decrease in β-waves and increase in α-waves. It also resulted in the elevation of serum serotonin (5-HT) level and significant decrease in norepinephrine (NE) level. The present study suggests that chronic administration of BTE helps in combating stress and hypertension possibly by altering serum monoamine level.
Alteration of brain monoamines and EEG wave pattern in rat model of Alzheimer’s Disease and Protection by *Moringa oleifera*.

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*Background & Objectives:* The monoaminergic systems which exert a modulatory role in memory processing are disturbed in Alzheimer’s disease (AD) and *Moringa oleifera* (MO) was found to exert its role in CNS by altering the brain monoamines. So, the objective of the present study is to see whether chronic treatment of ethanolic extract of MO can alter the brain monoamines including norepinephrine, dopamine and serotonin in distinct brain areas of rat and hence can provide protection against monoaminergic deficits associated with AD.

*Methods:* Rats were given ICV infusion of colchicine (15µgm/5µl) and MO leaf was given in various doses. The effective dose was standardized by radial arm maze training (RAM). From the selected dose of 250mg/Kg B.W, the biochemical estimation and EEG studies were performed.

*Results:* Stereotaxic ICV infusion of Celchicine significantly impaired the RAM performance together with decrease in norepinephrine (NE) level in cerebral cortex (CC), hippocampus (HC) and caudate nucleus (CN). Dopamine (DA) and serotonin (5-HT) level was decreased in CC, HC and CN. The EEG studies showed a decrease in beta and alpha waves and increase in biphasic spike wave pattern in experimental Alzheimer rat model. Treatment with MO extract markedly increased the number of correct choices in a RAM task with variable alteration of brain monoamines. The
EEG studies showed an increase in beta waves and a decrease in spike wave discharges.

**Interpretation & conclusion:** From the results it was observed that different brain monoamines are altered discreetly in different brain areas after colchicine infusion in brain which is associated with loss of memory but with treatment of MO, the monoamine levels of brain regions were restored to near control levels. So, we may assume that MO can overcome the monoaminergic deficits apart from the cholinergic loss associated with memory loss.


3. Ranita Ganguly, Rimi Hazra, Shyamal Das Gupta and Debjani Guha. *Studies on Two herbal plants Acorus calamus and Moringa oleifera on behavior, brain monoamines and EEG on rats exposed to hypobaric hypoxia.* International Symposium on Medicinal Plants and Herbal products in Biomedicine and Their Efficacy in the Present Era & XXVI Annual Conference of Indian Association of Biomedical Scientists, Kolkata, West Bengal, 2005.


5. Ranita Ganguly, Shyamal Das Gupta and Debjani Guha. Protective role of *Moringa oleifera* in Hypoxia induced Memory loss in rats. XVIII Annual Conference of Physiological Society of India, Kolkata, West Bengal, 2006. (Best oral presentation award in XVIII Annual Conference of Physiological Society of India.)
