

## Anti-Inflammatory potentials of black tea compounds aiding Neuro-protection

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**Abstract:** This review aims to explore the anti-inflammatory potentials of black tea compounds for combating neuro-inflammation in Alzheimer's disease. Black tea has shown the presence of multifunctional pharmacophores that are responsible for its versatile pharmacology. Structural and anti-inflammatory activity relationship studies of benzotropolone moiety containing compounds of black tea, flavonoids, flavones, phenolic compounds and methylxanthines e.g. caffeine, theobromine, theophylline have been reviewed. Black tea compounds can combat neuro-inflammation in AD and can provide neuroprotection from multidimensional perspectives.

**Introduction:** Alzheimer's disease (AD) is a fatal neurodegenerative disorder with progressive cognitive impairment and memory loss. Apart from devastating consequences, the disease puts on great social and financial implications. No therapeutic regimens that assures total curative outcomes or absolutely halt the progression of AD is available till yet (Heppner et al., 2015). Pharmacotherapeutics can target either to provide protection prior to or at early onset or attempt to compensate for the progressive cognitive impairment after the disease has already been diagnosed. However the strategy of prevention at early onset is obviously a more beneficial approach. The pathophysiological cascade of AD being multi factorial, therapeutic entities with multi modal perspectives can be implemented to combat the disease at early onset. The paradigm of drug discovery now focuses to develop multi targeting therapeutic entities not only by multi component agents but also by single entity or pharmacophore (Zhang, 2005). Multi potent therapeutic entities both of natural and synthetic origin are in vogue and natural pharmacologically active entities are gaining the equivalent lime light as the synthetic counter parts (Zhang, 2005). AD, being affected by multi pathogenic factors, need of therapeutic candidates for AD that can be chosen or designed that encompasses one or more of the properties such as inhibitors of acetylcholinesterase (AChE), antioxidant, anti-inflammatory, anti-apoptotic potentials, catechol-o-methyl transferase inhibitors, monoamine oxidase inhibitors, elevators of the level of neurotransmitters like nor epinephrine, dopamine, serotonin etc (Moussa and Buccafusco, 2005).

In this context, adoption of adjuvant therapy, dietary and lifestyle interventions are being well practiced simultaneously with western classical medicine so as to achieve synergistic therapeutic outcomes. Healthy beverages, dietary supplements and nutraceuticals can serve the purpose of adjuvant therapy along with synthetic drug therapy and

can result in better therapeutic outputs (Barnard et al., 2014).

Tea has been a popular worldwide accepted beverage as a rich source of polyphenols whose multidimensional health potentials have attracted research attention. Antioxidant potentials of green tea and its health potentials have been studied widely (Forester and Lambert, 2011). However in Indian context, CTC (Cut, Tear, Curl) black tea alone accounts for around 89% of the total tea production; mass consumer acceptance of black tea accounts for 78% in comparison to other varieties amongst different sections of the society (Source: Tea Board of India, www.ibef.org) (Li et al., 2013). Documented research evidences have already highlighted the multifaceted health benefits and antioxidant potentials of black tea (Luczaj and Skrzydlewska, 2005; Sen and Bera, 2013; Sharangi et al., 2014; Skotnicka et al., 2011). Apart from the neuropathological hall marks of  $\beta$  amyloid plaques and neurofibrillary tangles, inflammatory processes also have a fundamental role in AD pathogenesis (Rubio and Morillas, 2012). Anti-inflammatory effects of black tea have been reported to have different protective functions in several diseases e.g. arthritis, inflammatory bowel disease (IBD), etc; and also reduce oxidative/nitrosative stress in lipopolysaccharide (LPS) induced by murine macrophages and exhibited immunomodulatory role in immunocompetent/ immunodeficient mice (Chattopadhyay et al., 2012; Maity et al., 2003a; Maity et al., 2003b; Pan et al., 2013; Gomes et al., 2014). Such findings highlight the potency of the beverage for protection of the inflammation induced by neurodegeneration. This review discusses in details the anti-inflammatory effects of black tea compounds and their effectivity as neuroprotective in early onset of AD.

**Conclusion:** AD is a progressive neurodegenerative disorder that lacks treatment modalities with total curative outcomes. However, if proper preventive approaches be adopted at early detection of the disease further deterioration can be prevented. Such complex diseases can be combated either by multicomponent therapeutic strategy where several active ingredients will act within a single drug cocktail or any active therapeutic molecule that is capable to hit the multiple targets. Surprisingly, black tea is such a drug cocktail that have one to more pharmacologically active molecules that can exert multidimensional protective measures in AD. Along with the presence of multifunctional pharmacophores like the catechin nucleus, black tea and also the black tea extract being enriched in potent antioxidants viz. theaflavins, amino acids, like l-theanine and methylxanthines like caffeine, theobromine, theophylline are effective scavengers of reactive oxygen species, can exert neuroprotective and brain boosting effect and is also effective in combating neuroinflammation. Thus black tea compounds or black tea can be considered as an effective adjuvant therapy that can provide protection in AD from multidirectional perspectives.