



Overview of Global Research on Tea and Health

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Tea

- **Most popular beverage, next only to water and consumed world over, made from leaves of *Camellia sinensis* .**



Tea

- **Three major varieties of tea.**
 - **Black tea**
 - **Green tea**
 - **Oolong tea**



Constituents

- **More than seven hundred constituents.**
- **Polyphenols such as**
 - **Catechins**
 - **Theaflavins**
 - **Thearubigins**
- **Caffeine**
- **L-Theanine**



Tea

- **Polyphenols – Antioxidant property**
- **L-Theanine – Neuroprotective and modulating brain function.**
- **Caffeine – Stimulant**



Effects of tea on Health

Cancer

Cardiovascular

Diabetes

Neurological Disorders

Inflammatory Diseases

Bone Health

Microbial Activity

Metabolic Disorder and Obesity



Why black tea?

- **Black tea consumption accounts for 80% of tea consumption worldwide.**
- **Black tea derived polyphenols (Theaflavins and Thearubigins) are well known antioxidants.**



Tea and Cancer



Tea and Cancer prevention

- Epidemiological studies indicate that people who regularly consume tea have decreased risk of several types of cancers.
- Polyphenols exert antioxidative, anticarcinogenic and antimutagenic activity which may protect cells from DNA damage caused by ROS.
- Black tea and theaflavins prevent activity of MMPs and thereby migration of cancer cells.



Breast Cancer

- Theaflavin inhibits gene and protein expression of fatty acid synthase in breast cancer cells.
- Daily consumption of black tea by women, lowered the concentration of 17β -estradiol, reducing hormone-related cancer risks.
- Black tea showed cytotoxic effects against human breast carcinoma cell line.
- Black tea induces DNA strand breaks and oxidative damage to DNA in carcinoma cells.



Prostrate Cancer

- Tea increases the level of antioxidant enzymes which prevents oxidative stress.
- Androgens (testosterone) play an important role in the initiation and the progression of prostate cancer.
- Polyphenols in BT scavenge the pro-oxidants generated by testosterone.



Prostrate Cancer

- **Black tea polyphenol blocks Insulin-like Growth Factor-1 induced progression of cells into S-phase of cell cycle.**
- **Black tea polyphenols show inhibitory effect on development and progression of prostate cancer cells.**



Lung Cancer

- **TF-1 shows concentration dependent and time-dependent growth inhibitory effects against lung cancer cells.**
- **TF1 inhibits bronchiolar cell proliferation and tumor formation in lung carcinogenesis.**
- **TF3 Induces cell cycle arrest combined with ascorbic acid in human lung adenocarcinoma cells.**



Skin Cancer

- **Black tea consumption prevents :**
 - **Squamous cell carcinoma of skin.**
 - **Cutaneous malignant melanoma risk.**



Intestinal/Colon/Rectal Cancer

- **Black tea :**
 - **Reduces colon cancer risk in both men and women.**
 - **Induces the activity of glutathione S transferase.**
 - **Reduces the activity of quinone reductase in colorectal epithelium.**
 - **Mitotic Index reduces three fold.**
 - **Suppresses colonic tumorigenesis by inhibition of cyclin D1, c-myc and COX-2 gene expression.**



Oral Cancer

- **Tea polyphenols and tea infusion both have antioxidative and antigenotoxic effect against tobacco associated carcinogenesis.**
- **Regular tea drinking restricts oxidative DNA damage induced by tobacco in normal individuals and oral cancer patients.**
- **Black tea protects oral leukoplakia and oral submucous fibrosis caused by areca nut chewing.**



Esophageal cancer

- **Black tea inhibits esophageal tumors and causes decline in their multiplication.**



Liver Cancer

- **Black tea polyphenols are effective inhibitors of DNA replication of hepatoma cells.**
- **Black tea extract decreases tumor formation in liver.**



Blood Cancer

- **Black tea/theaflavin inhibits growth of leukemic cell lines through promotion of apoptosis, mediated by activation of caspases 3 and 8, and a decreasing Bcl2/Bax ratio by suppressing the expression of Bcl-2.**



Gastrointestinal tract

- **Black tea extract was found to have anti-ulcer activity. Administration of black tea extract for one week decreased the incidence of ulcer, ulcer number, and ulcer index produced by various ulcerogens.**



Cardiovascular Diseases



- **Epidemiological studies revealed that tea polyphenols reduce the risk of the heart disease by reducing C-reactive protein, blood cholesterol levels, lowering LDL level and increasing HDL level .**
- **Atherosclerosis inhibition effect of black tea is due to antioxidative, antifibrinolytic and hypolipidemic properties of polyphenols.**



Cardio Vascular Diseases

- **Black tea reduces serum glucose, triglyceride, LDL/HDL cholesterol ratio and increases plasma antioxidant level.**
- **Black tea consumption is associated with reduced risk of CAD by reduction of plasma uric acid, C-reactive protein levels in both men and women.**
- **Black tea polyphenols significantly improve endothelium dependent vasodilation.**
- **Theaflavin prevents cardiovascular disease by inhibiting Cu²⁺-mediated low density lipoprotein (LDL) oxidation in vitro.**
- **Black tea consumption @ 450 ml/day has lowered incidence of ischemic stroke, blood pressure and BMI of 1100 patients in Kolkata.**



Cardio Vascular Diseases

- **TF3 increases nitric oxide (NO) production and endothelial NO synthase (eNOS) activity in bovine aortic endothelial cells.**
- **TF3 inhibits plasminogen activator inhibitor type 1 (PAI-1) activity.**



Effect on Blood Pressure

- **Black tea polyphenols lower the rise in blood pressure in stroke-prone spontaneously hypertensive rats.**
- **Long term regular intake of black tea lowered blood pressure in cross-sectional study of 218 women above 70 years of age.**
- **Black tea improves flow-mediated vasodilatation and thus vascular function.**



Hypolipidemic Effect

- **Tea extract suppresses hypolipidaemia through enhancing of super oxide dismutase activity.**
- **Black tea extract lowers triglyceride and cholesterol levels.**



Platelet Function

- **Regular daily intake of black tea was found to improve platelet function and decrease in vivo oxidation damage by reducing the levels of thromboxane and isoprostaglandins.**
- **The effect was found to be more for females.**



Diabetes Type-2



- ❖ **Research findings show that black tea consumption may reduce the risk of Type 2 Diabetes and increase insulin sensitivity.**
- ❖ **The polyphenols act as a preventive agent against lipid and glucose metabolism disorders associated with Type-2 diabetes.**



Diabetes Type-2

- Tea polyphenols inhibit carbohydrate hydrolysing enzymes in the digestive organs and helping management of T2 diabetes.
- Cohort studies in Kolkata have demonstrated that black tea effectively provides protection from T2 diabetes to pre-diabetic patients as well as diabetic patients.



Diabetes Type-2

- In diabetes, glucose concentration in ocular lens and plasma increase and sorbitol in Red-Blood cells (RBCs) and eye lens also increase. Black tea decreases formation of diabetic cataracts.
- Human clinical studies showed tea polyphenols improve control of glucose metabolism and endothelial function.



Neurological Disorders



- **L-Theanine increases alertness and neutralises effects of caffeine and provides neuro protection.**
- **Polyphenols present in black tea prevent oxidative damage and exert the positive effects against neurodegenerative disorders.**



Neurodegenerative Disorders

- **In vitro studies showed that theaflavins enhance autophagy to reduce the incidence of neurodegenerative diseases indicating prophylactic effect of black tea in Parkinson's Disease.**



Effect on cognition and memory

- **Black tea ingestion:**
 - **Increases alertness and improves mood.**
 - **Improves memory and learning ability through modulation of serotonin and dopamine levels.**
 - **Provides beneficial effect on cognitive function in elderly persons.**



Inflammatory Diseases



- **The anti-inflammatory activity of black tea is mainly through suppression of cyclooxygenase and lipoxygenase genes which generate pro inflammatory activity.**



Anti-inflammatory Property

- In case of Gastric inflammation Black tea extract suppressed IL-1-induced IL-8 production and secretion by inhibition of NF- κ B activation.
- Tea polyphenols inhibit NO synthase activity in lipopolysaccharide activated murine macrophages cells.
- Theaflavin-3,3-digallate showed highest inhibition.



Bone Health



- **Tea polyphenols may have positive role in maintaining bone mineral density and prevent osteoporosis.**
- **Phytoestrogens and fluoride present in tea help in maintaining bone mineral density.**



Effect on Bone and Muscle

- **Black tea extract was found to maintain skeletal health through reduction of active osteoclasts, inflammatory cytokines production and oxidative stress.**
- **Black tea protects against the clastogenic effects of cyclophosphamide and dimethyl benz(a)anthracene in bone marrow cells.**



Effect on Bone and Muscle

- A US study conducted among multiethnic post menopausal women aged 50–79 years found that total body bone mineral density increased with daily consumption of black tea.
- In another osteoporosis cross-sectional study (The Mediterranean region), tea drinking was found to be associated with 30% reduction in risk of hip fracture in both men and women over 50 years of age in southern Europe.



Microbial Activity



- **For several years the microbial activities of black tea have been demonstrated in several diseases which include gastrointestinal and oral health in particular.**



Antiviral Activity

- Theaflavins have anti HIV-1 activity by inhibiting entry of HIV-1 cells into the target cells. Anti HIV activity of theaflavins are stronger than catechins.
- Theaflavin 3, 3 digallate, and theaflavin 3 gallate were found to inhibit Severe Acute Respiratory Syndrome.



Effect on dental caries

- **Black tea enriches oral health due to antioxidative activities of polyphenols and presence of fluoride.**



Effect on Gastrointestinal tract

- Consumption of black tea decreases the number of selected bacteria in the human intestinal tract.
- Consumption of black tea demonstrates anti *Helicobacter* activity.
- Thearubigins prevent diarrhoea and damage to colonic architecture of inflammatory bowel diseases.



Metabolic Disorders and Obesity



- **Black tea contains a number of physiologically active components like caffeine, theanine, saponins which have antiobesity effects.**



Metabolic Disorders and Obesity

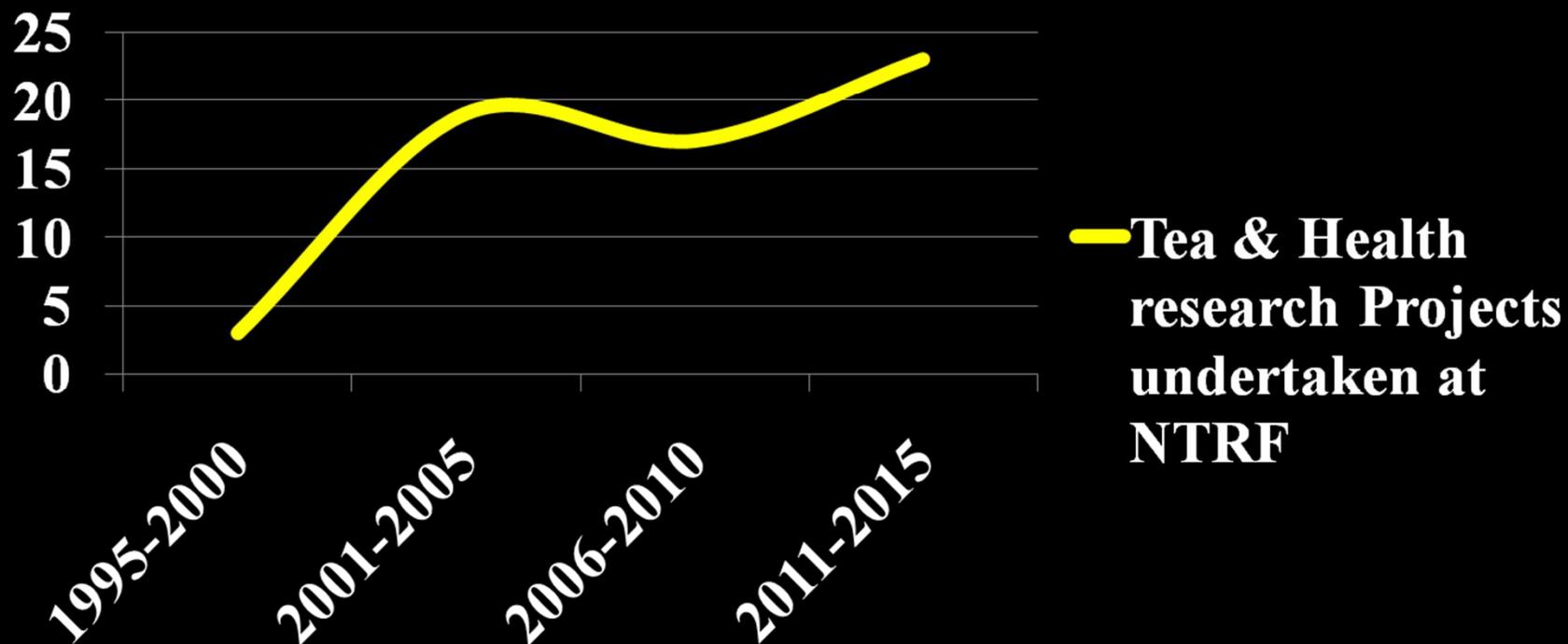
- **Black tea polyphenols contribute to the prevention of diet-induced obesity.**
- **Consumption of black tea suppresses potential fat accumulation through decrease of hepatic fatty acid synthase and increase AMP activities.**



Contribution of NTRF on Tea and Health studies

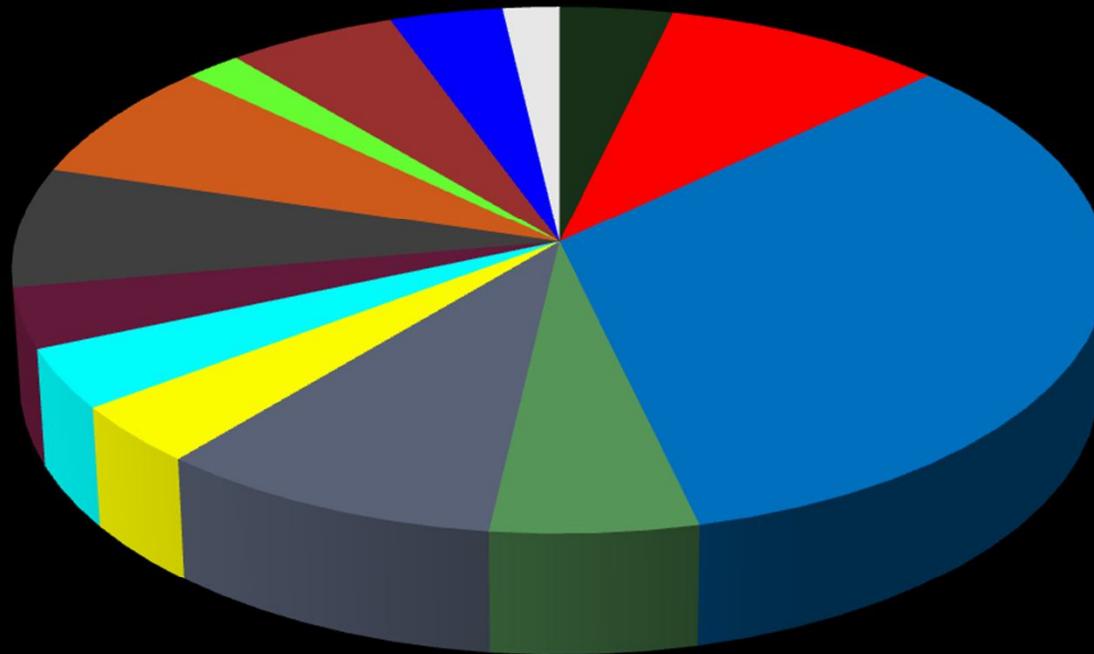


Tea & Health research Projects undertaken by NTRF





Tea & Human Health Projects of NTRF



- Cardiovascular Disease
- Stress and Aging
- Cancer
- Gastrointestinal Disorders
- Bone Health
- Immunomodulatory Disease
- Lung Disease
- Oral Disorder
- Gynaecological Disorder
- Antioxidant, Metal Toxicity
- Tea With / Without milk
- Diabeties
- Alzheimer Disease
- Disease and Epigenetics



Universities and Research Institutes involved

- **Calcutta University**
- **Madras University**
- **Dibrugarh University**
- **Jadavpur University**
- **Rajib Gandhi University, Arunachal Pradesh**
- **West Bengal University of Sciences & Technology**
- **Vellore Institute of Technology**
- **Bose Institute, Kolkata**
- **Industrial Toxicological Research Centre,
Lucknow**
- **Indian Institute of Chemical Biology, Jadavpur**

Contd....



Universities and Research Institutes involved

- **Tata Memorial Centre (ACTREC), Mumbai**
- **Institute of Post Graduate Medical Research & Education, Kolkata**
- **Vivekananda Institute of Medical Science, Kolkata**
- **Agartala Govt. Medical College, Tripura**
- **B. C. Guha Centre for Genetic Engineering**
- **Bharathi Women's College, Madras University**
- **Indian Institute of Technology, Kharagpur**
- **Presidency College, Calcutta**
- **Allergy & Asthma Research Institute, Kolkata**



**Studies undertaken by NTRF
so far have given evidence
regarding a number of positive
health effects of drinking of
Black Tea**



Future Thrust Areas

- ❑ Extensive population studies are required to prove the beneficial effects against many diseases as the human clinical evidences are still limited.
- ❑ Future research needs to define the actual magnitude of health benefits, establish the safe range of tea consumption associated with these benefits, and elucidate the mechanism of action.
- ❑ A more dose-responsive and mechanistic studies are needed to understand the effects of tea consumption against human ailments.



Future Thrust Areas

- Isolation of specific compounds of pharmacological importance with linkages to specific diseases.
- Identification of tea varieties with high antioxidant potentials.
- Appropriate strategies for future clinical trials to translate animal data and experiments on human.
- Bio-availability of flavonoids and pharmacokinetic studies on black tea.



Cardiovascular effects

Antioxidant property

Neurotransmitter

Immune defense

Anticarcinogenic effects

Anti-Ulcer

Anti-Microbial

Anti-Inflammatory

Anti-tumor

Anti-Diabetic



Thank You

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Chai piyo mast jiyo !