BROAD COMPOSITIONAL DIFFERENCES AND BENEFITS: FLAVONOIDS, THEANINE, CAFFEINE

“Tea tempers the spirit and harmonize the mind,
Dispels lassitude and relieves fatigue,
Awakens thought and prevent drowsiness,
Lightens up or refreshes the body,
And clears the perceptive faculties.”

Confucius
Tea and human health is closely linked with each other and they are indissoluble. If you take a look at the Chinese character ‘TEA’, you will find out that it is composed by the Chinese words of ’20’ & ’88’, meaning that if you take tea regularly you are bound to live on until the age of 108 years old. So ‘TEA’ represents ‘longevity’.
A MYTH: TEA A SWEET POISON:

- Tea is more harmful than alcohol:
  ----- Dr O.D. Ned

- Drinking tea does not finish tiredness instead it increases it.
  ----- Dr Reeves. Cambridge University.

- Tea has caused loss of appetite among thousands men and women
  ----- Mahatma Gandhi

- Brain gets damaged by Tea & Coffee.
  ----- Maharsi Dayanand Saraswati.
ORIGINS OF TEA & HEALTH

BUT

- Health benefits have been associated with tea from the beginning of time
- Modern day science is verifying what has always been known intuitively
- Range of health benefits an impressive
- Tea has always enjoyed a positive health perception

THUS

- Is not it just a bit ironic that a product that owes its very existence to health benefits, took the industry nearly 5000 years to rediscover!
- Better late than never
SOME OF PAPER CLIPPINGS

Tea improves memory

New Delhi: Drinking tea regularly could help improve memory, a new research by British scientists from the University of Newcastle upon Tyne suggests.

The scientists found that tea and black tea inhibit the activity of certain enzymes in the brain which are associated with memory.

The findings, which are published in the Journal, Physiology Research, may lead to the development of a new treatment for Alzheimer’s disease, a form of dementia, a term used for a range of brain disorders that affects memory and other aspects of cognitive function. It affects at least 10 million people worldwide. For their experiment, the scientists investigated the properties of coffee and green and black tea in a series of experiments.

Tea clips cancer risk

London, Dec. 18: Women who drink two cups of tea per day are significantly less likely to get ovarian cancer than those who drink less, according to research published on Monday.

Researchers in Boston found that women who drank two or more cups of black or green tea were found to be almost 50 per cent less likely to get the disease, according to a report in the American Journal of Internal Medicine.

Physiological and animal research has suggested that green and black tea can inhibit the growth of certain cancers but this is the first study to demonstrate a specific link with lower ovarian cancer rates.

A group of over 61,000 women from central Sweden, aged 40 to 75, were asked to record how often they drank green or black tea in relation to food and drink items between 1987 and 1990.

Coffee, tea good for liver

Washington, Dec. 4 (AP) -- Coffee and tea may reduce the risk of serious liver damage, according to a study released on Tuesday.

The study, conducted by researchers at the University of Massachusetts and the University of California, found that coffee and tea drinkers had a lower risk of developing chronic liver disease than those who drank alcohol, had too much iron in their diet, or had excess fat in their bodies.

A study of nearly 3,000 people conducted by the researchers found that those who drank a cup of coffee or tea a day developed chronic liver disease at half the rate of those taking less than a cup.

The study, published in the journal Hepatology and Digestive and Kidney Diseases & Scientific Systems, Inc., found that coffee and tea drinkers were less likely to develop liver disease than those who drank alcohol, had too much iron in their diet, or had excess fat in their bodies.

While it is too soon to encourage patients to increase their coffee and tea intake, the study is one of the first to show a benefit for liver health.

Healing Power of Tea

Hot or cold, green or black, this ancient beverage is steeped in health benefits.

What would the world do without tea? the writer Sydney Smith asked over 100 years ago.

It’s no idle question, Tea is the world’s most popular drink, after water. And it provides protection against several health threats.

Heart Helper In a Dutch study last December, those who drank at least two cups daily had half the heart attack risk of non-tea drinkers. Last year, researchers in Boston found that heart patients who drank two or more cups daily were 44% less likely to die over the next four years.

A recent US study showed that tea can lower bad cholesterol levels by an average of 10%. In cases where dangerous cholesterol has already built in artery walls, flavonoids, the antioxidants in tea, are thought to prevent it from damaging the inner lining.

Cancer Fighter In Japan, a 1994 study found that drinking tea or more cups of green tea every day delayed the onset of cancer by almost nine years in women and about three in men. And a Canadian study from 1998 suggests another benefit for males: Men who drank three cups a day were 30% less likely to develop prostate cancer.

Bone Builder Flavonoids in tea seem to protect bones. Tea also contains fluoride and substances that stop bacteria from sticking to teeth, which together help fight cavities.

Green and black tea are probably equally protective, says Todd Blumberg, a US nutrition researcher. Even cold tea is beneficial, though it’s usually more diluted. Since flavonoids break down over time, making your own tea is better than buying any kind of bottled or tetrapack treated tea. (The health benefits of herbal teas are not well established.) “If you don’t drink tea now, having just one cup a day is likely to keep you healthier,” says Blumberg. “Drinking four cups is probably even better. I love tea, so I say drink as much as you like.”
STRUCTURE OF THE CATECHIN MONOMERS

(+) Catechin

(-) Epicatechin

(-) Epigallocatechin

(-) Epicatechin gallate

(-) Epigallocatechin gallate
Theaflavin
Theaflavin 3’ gallate
Caffeine

- Systematic (IUPAC) name: 1,3,7-trimethyl-1H-purine-2,6(3H,7H)-dione 3,7-dihydro-1,3,7-trimethyl-1H-purine-2,6-dione
Flavonols 10%
Free catechin 90%

GREEN TEA

Free Catechin 30%
TRs/PBPs 47%
TFs 13%
Flavonols 10%

BLACK TEA
TEA & HEALTH
PHARMACOLOGICAL AVENUES EXPLORED FOR ACTIVITIES OF BLACK TEA EXTRACT SINCE 1966
Health & Caffeine

Effects of moderate caffeine consumption

- Increased attention
- Increased memory performance
- Increased intraocular pressure
- Decreased risk of heart disease
- Increased physical performance
- Increased muscular recovery
- Decreased risk of liver disease
Identification of effective chemo preventive diets for human use is of much interest today. Tea is one of the known food substance having high polyphenolic constituents. Tea as cancer chemo preventive agent results in cell cycle arrest, thereby reducing the growth and proliferation of cancerous cells through apoptosis.
DIRECT EFFECT ON CANCER KILLING

CANCER REGRESSION BY PROTECTING INTRINSIC DEFENCE SYSTEM

TEA

CANCER REGRESSION BY ALTERATION OF SIGNALING CASCADE

CANCER CELL APOPTOSIS

AMELIORATION OF IMMUNE SUPPRESSION

PROTECTION OF DNA REPAIR SYSTEM AND INHIBITION OF MUTAGENICITY

PROTECTION OF DETOXIFICATION AND ANTIOXIDANT SYSTEM
List of Theaflavins with health benefits

- **Theaflavin-3'-monogallate** (TFMG, TF-2) causes apoptosis in *colon cancer* cells.
- **Theaflavin-3,3'-digallate** (TFDG, TF3) binds to **gp41** of **HIV** as well as inhibit 3CLPro of **severe acute respiratory syndrome** (SARS).
- **3-Isotheaflavin-3-gallate** (TF2B) inhibits **3CLPro** of **SARS**.
(+)-Catechin and (-)-epicatechin are also selective **monoamine oxidase inhibitors** (MAOIs) of type **MAO-B**. They could be used as part of the treatment of Parkinson's and Alzheimer's patients.
Protection of the mouse brain after a stroke

Ninety minutes after feeding mice a single modest dose of epicatechin, the scientists induced an ischemic stroke by, in essence, cutting off blood supply to the animals' brains. They found that the animals that had preventively ingested the epicatechin suffered significantly less brain damage than the ones that had not been given the compound. While most treatments against stroke in humans have to be given within a two- to three-hour time window to be effective, epicatechin appeared to limit further neuronal damage when given to mice 3.5 hours after a stroke. Given six hours after a stroke, however, the compound offered no protection to brain cells.
Blood brain barrier

- Theaflavins and Thearubigins compounds found in black teas penetrate the blood brain barrier, and have been shown to be effective against dementia in aging as well as AIDS related dementia plaques *in vitro*. 
Several tea polyphenols, especially those with galloyl moiety, can inhibit HIV-1 replication with multiple mechanisms of action. Theaflavin derivatives have been found to have more potent anti-HIV-1 activity than catechin derivatives in laboratory investigations.
Some of Salient Findings from National Tea Research Foundation (NTRF) Projects on Tea and Health
Tea & Cancer

The findings from Indian Institute of Chemical Biology & Chittaranjan National Cancer Institute Kolkata, Indian Institute of Toxicological Research, Lucknow, & Tata Memorial Centre, Mumbai on tea polyphenols and their polymerized compounds like TF(3-6%) and TR(12-18%) acts on similar fashion to inhibit significantly tumor genesis in mouse skin tumor, oral mucosal cancer and others.
Immunomodulatory Activity

- Black Tea Extract possess a significant immunomodulatory effect that in turn may be beneficial in several pathophysiological conditions.
Diabetis & Tea

- Tea improved hyperglycemia and glucose intolerance through stimulating glucose uptake activity accompanied by translocation of glucose transporter (GLUT)4 & insulin resistance.
It is interesting that mint when mixed with black tea if drink during pregnancy; it reduces neonatal deaths associated with preeclampsia.
A study conducted at the Inst of Post graduate Medical Education & Research using black on NSAIDs-induced Gastric Ulcer in mice model indicated faster healing effect against acute ulceration caused by NSAID( indomethacin). Test results were marginally better than omeprazole to have healing within three days compared to seven days in case of auto healing. Bioavailability of TF and EGCG were also studied.
Comparative effects of Black Tea Extracts, Theaflavins, Epigallocatechin gallate on healing gastric ulcer

**Dose details**

- Different concentration
- Histopathological study
- MDS

**Exp. Groups**

- Control
- Vehicle control
- Indomet. @ 18 mg/kg X 1 d, p.o

**Ulcerated untreated**

- BT – 10, 20, 30, 40, 50 mg/kg
- TFs – 0.5, 1, 2.5, 4, 5 mg/kg
- EGCG – 0.5, 1, 2.3, 5 mg/kg

**Treatment for 3 days**

- 6 h after indomet.

**Time point: 3rd day**

- BT @ 40 mg/kg bw
- TFs @ 1 mg/kg bw
- EGCG @ 2 mg/kg bw
- Omez @ 3 mg/kg bw
Does milk blunt the benefits of black tea?

A biochemical and physiological study (both sexes, 40 to 80 years) at the SN Pradhan Institute, Kolkata, reported caseins in milk decreases the efficiency of tea catechins (with 10% addition of milk), the major health benefit compounds in tea, i.e. addition of milk reduces the bioavailability of flavonoids in tea.

However, University of Shizuoka, Japan recently reported that interaction of catechins with milk proteins contributes to stability of catechins against oxidation.
EFFECT ON ENDOCRINE

It is commonly believed that tea drinking, both black and green tea, affects the endocrine system (thyroid-gonadal), but studies at the Calcutta university on animal modal reveals that GT and BT has no adverse effect on the alteration of physiology of thyroid and testis in experimental animals at normal dose, upto 10 cups per day (20g).
Protective effect of tea on arsenic induced damage on chromosomes (VIMS, Kolkata).
STROKE – A Clinical Study

A preliminary report from VIMS, Kolkata, on a clinical trial of tea on suggested that ≥3 cups/day reduces the risk of occurrence of STROKE volume & mortality from stroke.
Black tea on Hypertension

S.N. Pradhan Center of neurosciences, Kolkata, suggested on their clinical trial a beneficial effect of Black tea on Hypertensive patients.
TEA & CIGARETTE SMOKING

Dr B C Guha Center for Genetic Engineering & Technology, Calcutta University worked on the effect of Tea on Cigarette smoking.

There are about $1.25 \times 10^9$ smokers in the world. About 15% of them are afflicted with lung disease, particularly emphysema. However, until now there is no effective treatment of emphysema. Concentrated black tea extract or tea polyphenols may be used for the prevention of emphysema in smokers.
Toxicity study of the test samples
Test compounds @ 100 mg/kg X 1 day, p.o, sacrificed after 1 month

Serum concentration of liver & kidney enzymes

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Normal mice</th>
<th>BT-treated mice</th>
<th>TF-treated mice</th>
<th>EGCG-treated mice</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGOT (IU L⁻¹)</td>
<td>173.18 ± 12.5</td>
<td>175.27 ± 9.12</td>
<td>167.51 ± 10.7</td>
<td>177.16 ± 14.8</td>
</tr>
<tr>
<td>SGPT (IU L⁻¹)</td>
<td>68.67 ± 7.88</td>
<td>72.39 ± 8.65</td>
<td>73.32 ± 8.5</td>
<td>66.87 ± 9.92</td>
</tr>
<tr>
<td>Urea (mg dL⁻¹)</td>
<td>31.25 ± 2.17</td>
<td>33.18 ± 2.43</td>
<td>34.20 ± 4.35</td>
<td>33.79 ± 3.19</td>
</tr>
<tr>
<td>Creatinine (mg dL⁻¹)</td>
<td>0.41 ± 0.08</td>
<td>0.36 ± 0.1</td>
<td>0.38 ± 0.11</td>
<td>0.38 ± 0.06</td>
</tr>
</tbody>
</table>

All the test samples are non-toxic
Future Direction of Research on Health Benefits of Black Tea
Theanine is biosynthesized from glutamic acid and ethylamine via enzyme theanine synthetase. It synthesized in the roots of the tea plant from where it is transferred, via the phloem, through the stem to the growing shoots where it subsequently accumulates in the developing leaves.
L-Theanine

- Relaxation Effect
- Improvement of Learning Ability
- Prevention of Neurodegenerative Disorders
- Prevention of Vascular Diseases
- Improvement of Immune System
- Cancer Prevention
Estimation of L-Theanine from 4 Darjeeling Tea using spectrofluorometric method

Quantity of L-Theanine in different Darjeeling Tea different Darjeeling Tea Clones (Green Leaves and Processed Tea)

<table>
<thead>
<tr>
<th>Different Darjeeling Tea Sample/ Clones</th>
<th>AV2</th>
<th>HV39</th>
<th>B777</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-Theanine Contents (mg/cup tea)</td>
<td>8</td>
<td>6</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

Different Darjeeling Tea Samples/ Clones: AV2, HV39, B777, CT
Quality & Components

AV2: Highest flavor components
   i.e., ethyl salicylate, geraneol, etc.
   L-theanine (+)

HV39: Highest total phenolics
   L-theanine (+)

B777: Highest Theaflavin
   L-theanine (+++)  

As per the planters’ view B777 is one better quality tea among these three
Neuroprotection Assay of L-Theanine

Neuroprotective Efficacy of Crude and Pure L-Theanine

Different Treatment Group

- Untreated PC12 Cell
- PC12 + ETC blocker
- PC12 + ETC blocker + Crude L-Theanine
- PC12 + ETC blocker + Pure L-Theanine
Thank You
Come oh come,
Ye tea thirsty
Restless ones.
The kettle boils
Bubbles and sings
Musically

Rabindra Tagore