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Review Article

A review of Green tea constituents on reducing risk of cancer and its treatment

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Amongst the thousands of degenerative diseases that afflict human populations worldwide, cancer is considered bythe majority to be one of the most devastating and traumatic health crises that can be experienced today. Although the etiology of cancer is unquestionably one that is multifactorial in nature, there is a constant emphasis placed upon the attempt to identify specific areas that can be targeted for prevention and conjunctive treatment of this disease. Cancer's cell cyclehinders healthy cells from living and flourishing, resulting in the eventual destruction and overtaking of the body's organs/tissues and the eventual cessation of the individual's health. These subsequent cellular degradation events result in death of the host from cellular starvation and homeostatic disruption.[1] With an estimated worldwide cancer rate increase of 75% in the next two decades,[2] it is crucial to identify and implement the use of chemopreventive substances into our diets that reduce the likelihood of developing cancer and facilitate the treating of it.

Alike the manner in which cancer cells disrupt normal physiological processes of human cells, so must a therapeutic phytochemical be capable of interrupting the normal life cycle that allows cancerous cells to metastasise and overtake healthy functioning human tissue. Being in the best interest of both health practitioners and their patients, the oncological medical research community is in a constant dynamic of searching for effective methods to help (1) reduce the risk and prevalence of cancer within a given population and (2) identify and incorporate therapeutic substances into the conjunctive treatment plan for those afflicted by cancer. Through the use of the 21st century positivistic research methods and technologies, a therapeutic imbibed substance known to many as Green Tea (GT), has in recent years been identified to have strong therapeutic capabilities as a result of its high potency of a strong antioxidant catechin phytochemical; Epigallocatechin 3-gallate (EGCG). The oncological capabilities of GT can now be not only considered simply as a palatable beverage with medicinal capabilities rooted in thousand year old Asiatic medicine, but rather be seen as an effective therapeutic substance that after undergoing rigorous and scrupulous scientific analysis has shown to possess true medical practicality in combating cancer.

The body possesses an intrinsic first line of defence against foreign pathogens and cells that attempt to establish themselves within healthy functioning cells and tissues leading to the eventual development of ailments and disorders. The body's immune system is regulated by lymphocytes (the birth place of immune cells) and accompanying T-lymphocyte cells (which can target and destroy cancer cells) which possess immunological memory capabilities. When an antigen (non-self) enters the body and begins to inflict damage via endo and/or exo-toxins and multiply, the body begins to mount a response to stop the spread of contamination. T-Cells, once aware of the threat being imposed within the body, begin to produce antibodies within 5–10 days to achieve a significant amount in the blood to fight off the antigen (*Human Anatomy & Physiology*, pp. 786–789).[1] Our T-Cells moreover have the ability to employ simple cellular memory, which allows them to remember which antigens have entered the body in the past and what they "look" like so to speak, *via* specific glycoproteins (cellular identification markers) embedded in the antigen's cell wall.

Regular consumption of GT has been shown to aid tone the immune system, specifically by promoting T-Cells to recognise and phagocytise cancerous cells. A specific cellular chemical property known as an alkylamine, is shared amongst a number of cells which include cancer cells and more astonishingly amongst edible plants such as GT. Therefore, drinking GT primes T-

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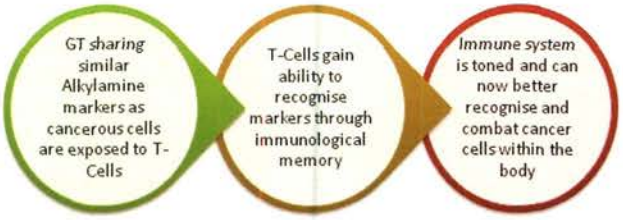
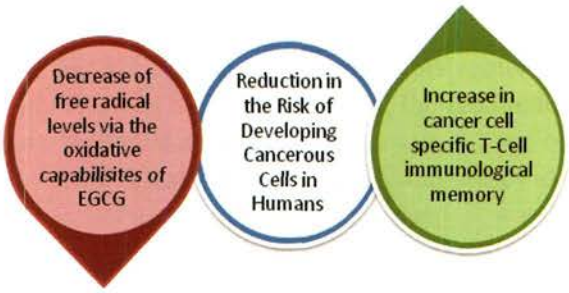
cells to mediate a response to re-exposure of such alkylamines which could be caused by cancerous cells, thus teaching the body to recognise such cellular property markers and better mount an immunological response to it in future. The similar alkylamine characteristics found in GT expose the T-Cells to their structure and unique composition allowing them to recognise similar patterns in the future which could be found on cancerous cells. The ability that GT has on toning immunological memory allows for a bridge between the innate and acquired immunological abilities of the body.[3]



Beyond cell-to-cell recognition and destruction of harmful cells and antigens, the body has another first line of defence mechanism that has the capability of reducing amounts of instable molecular builds ups that could lead to cellular dysfunction.Strong antioxidants, such as those found in GT, can have a substantial impact on the effectiveness of the immune system by aiding it in reducing the amount of free radicals (unstable and highly reactive electrically unpaired atoms) by means of apoptosis (self-destruction of cell).[4] The instability of free radicals can cause disturbances in homeostatic balance at the cellular level, which may influence cells to become cancerous. Therefore, antioxidants such as EGCG, aid in oxidizing them and allowing them to become stable and non-detrimental to our health. To put the efficacy of the antioxidant EGCG into perspective, it is 100 times stronger than vitamin C used in chemotherapy to soak up free radicals and is over 200 times more powerful than renowned vitamin E in neutralizing them.[5,6]

As for reducing the risk of developing cancer, EGCG initiates a toning of the immune system by (1) increasing cancer cell specific immunological memory of T-Cells and (2) augmenting free radical oxidization which decreases the amount of molecular instability and potentially harmful molecular proliferations. These two mechanisms of defence reduce the risk of developing cancer by increasing the physiological ability to destroy cancer cells while simultaneously decreasing molecules that could lead to cellular dysfunction and carcinogenesis.



While prevention of cancer is without a doubt an important part of maintaining the health of an individual, it is with an equal or greater importance for a phytochemical such as EGCG to provide tertiary therapeutic intervention properties. Once diagnosed with cancer, the aim is to provide therapeutic interventions that attempt to disrupt the cancerous lifestyle and create an uninhabitable and undesirable environment which does not allow cancer cells to thrive and spread.

Identical to the containment of any infection or disease, being able to reduce the spread of cancer cells and restrict them to one area of the body both facilitates treatment and prevents any further destruction of neighbouring tissue. EGCG, found in abundance in GT, initiates physiological reactions that can aid in the containment of cancer cell *via* prevention of metastasis (the growth and spreading of cancerous cells), thus reducing the area that the cancer can consume. This reduction in the amount of cancerous cells makes treatment of the diseases more manageable and area specific.Once metastasis is hindered, EGCG inhibits angiogenesis (growth of new blood vessels that form to feed the growing tumour), thus starving tumours of energy and oxygen needed to allow for malignant growth and invasion of neighbouring tissues.[3]

EGCG alongside a potent amount of strong anti-oxidant catechins have been shown to null the growth receptor signalling ability of cancerous cells, thus preventing growth and eventual spread of cancerous cells.[7] Without the orchestrated signalling ability of the cancerous receptors amongst many cancer cells, growths are now left without the cellular trigger and direction needed to further develop itself and engulf more surrounding cells. It is speculated that EGCG has the ability to bind to a wide range of specific molecular targets which in turn inhibit activities of enzymes thus preventing certain receptor-dependant signalling pathways that cancer cell formation depend on.[8] This severs the communication pathway that would otherwise give means to spreading (metastasis).

Amalgamation of these two therapeutic capabilities of EGCG with regard for disease control and afflicted tissue containment, prime the body for any other chemical orsurgical conjunctive intervention.

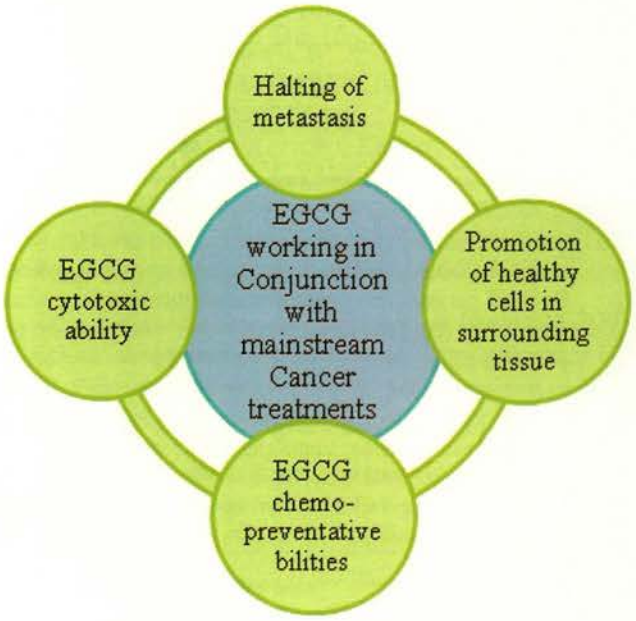
In conjunction to starving and disrupting the cancerous cycle preventing it from growing, there must be attention veered towards the ridding of cancerous cells already established in the tissue. EGCG has been shown to expedite the elimination of harmful cells by promoting programmed cell death while also increasing the activity of healthy cell production.[3] If we look at these abilities at a micro level, what we are seeing at a cellular level is the starving of harmful cells and the promotion of healthy cells while at the macro level a decrease in cancer prevalence amongst select populous groups.

These components of GT that aid in the conjunctive treatment of cancer are not exclusive to only simple forms of cancer, but can be applied to a large range of types and cancerous functions before and after the onset of disease. Its full effective potential can be witnessed in the treatment of advanced stage liver cancer, lung tumour-genesis and even extremely rare muscular tissue cancer known as rhabdomyosarcomas (Chung S. Yang, 4), relaying a pan-cancerous therapeutic capability

To further exemplify the vast cancer inhibiting and healing capabilities of EGCG, this bioactive compound when present in therapeutic doses has been shown to demonstrate chemopreventive capabilities (treatment of disease-by means of cyto-killing) in both in vitro and in vivo preclinical models of cancers of various major organ systems.[4] EGCG and similar present antioxidant/polyphenols function as an influential prompter for cellular activity, giving forth the ability to inhibit key cancerous inflammatory processes, modulating epigenetic mechanisms (changes in gene expression) and disallowing carcinogenis (initiation of cancer cell development) by means of apoptosis (self-destruction of cell).[4]

The trifecta of preventing metastasis directly through cell receptor disruption and indirectly through anti-angiogenesis, being cytotoxic to cancerous cells causing apoptosis/cell death and promoting healthy cellular function and decreasing disruptive ones shows the true conjunctive therapeutic capabilities of EGCG; GT.

EGCG is giving the body a fighting chance at the cellular level. Proper introduction of GT into a compromised host aids in not only the collective ridding of cancerous cells, but all the while the enhancement of natural bodily defence functions and cell growth. The bioactive ingredients are both a disposer of harmful cells and a cultivator of healthy ones; an expediter for well-being. In an oncological setting EGCG found in GT can be considered a very useful primary preventative substance and one that would be advantageous to cancer patients to be used in conjunction to other tertiary cancer treatments.



With cancer continuing to be a disease that can afflict anyone at any time, it is essential to recognise the therapeutic abilities, both preventative and conjunctive, of substances such as GT which contain medicinal phytochemicals, in this case EGCG. On both ends of the spectrum, it is essential for medical practitioners and staff alike to introduce GT as a preventative aid in reducing the risk of cancer being that it has been observed to reduce free radicals in the body and tone our immune system. Beyond prevention, EGCG, as shown through *in vivo* and *in vitro* studies worldwide, has the ability to alter the overall aggressiveness of cancer by (1) reducing its ability to spread and (2) destroying cancerous cells while promoting the growth of healthy ones. The two effects that EGCG has on cancer cells already established in the human body relay the concept of utilizing it in conjunction to conventional chemotherapy and surgery because of its ability to facilitate treatment and expedite wellbeing.

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