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Anti-Cancer Effects of a Combination of Four Green Teas

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Abstract

A DNA based assay for screening compounds for anti-cancer potential identified four green teas with impressive anti-cancer effect. An extract was prepared from a combination of all four of the teas and this extract was tested for anti-cancer activity in cell based assays in Dr. Qi Chen's laboratory at the Department of Pharmacology, Toxicology and Therapeutics, University of Kansas Medical Center. When tested against extracts of other well-known teas, the four green tea blend had the most potent anti-cancer effect. This research was accepted for presentation at the 16th International Conference of the Society for Integrative Oncology and published in EC Nutrition: www.ecronicon.com/ecnu/pdf/ECNU-14-00734.pdf.

Keywords: *Anti-Cancer Effects; Green Tea; DNA*

Introduction

Consumption of green tea has significant potential health benefits. Studies have shown that green tea is associated with antioxidant and anti-cancer effects. The green tea anti-cancer effects are acknowledged to be relatively modest among anti-cancer agents, but with daily consumption over time the effects may accrue to cancer prevention and suppression of tumor growth. For tea drinkers, the question is how best to take advantage of the anti-cancer activities of green teas?

The answer is to select and consume teas with comparatively strong anti-cancer effects. Green tea polyphenols have been identified as the active compounds that suppress proliferation of cancer cells. So, teas could be selected on the basis of their comparatively high polyphenol content determined in tea extracts. The team at University of Kansas has taken a different approach. Four green teas were selected because their extracts gave positive results in a DNA based assay that detects anti-cancer potential. The Kansas group proceeded directly to test a combination of all four extracts for their activity against cancer cells.

In vitro test for anti-cancer agents

The Oncotest exploits Mirko Beljanski's discovery at the Pasteur Institute that the DNA duplex in cancer cells is destabilized by chemical reactions with oxidants and carcinogens; hydrogen bonds are broken and segments of the double helix are opened up, exposing single strands. The unregulated exposure of single strands enables enhanced DNA synthesis in cancer cells.

When used as a template for *in vitro* DNA synthesis, the DNA purified from cancer cells is slightly more productive than DNA purified from healthy cells. The cancer cell DNA is also much more susceptible to the addition of carcinogens to the reaction: known carcinogens trigger an increase in synthesis which is not seen in the reaction with the normal cell DNA template. The carcinogen induces further destabilization of the cancer DNA template, further separating the two strands, and thus enhancing DNA synthesis.

Beljanski used this susceptibility of cancer DNA to carcinogens to create an assay for the carcinogenic potential of any compound. Beljanski demonstrated the efficacy of the test by showing that well established carcinogens all increase DNA synthesis from cancer DNA templates while having negligible effect on synthesis from the healthy DNA template.

Testing the predicted anti-cancer activity of four green teas

The Oncotest can also be used to identify compounds or extracts that diminish instead of enhance *in vitro* DNA synthesis from the cancer DNA template. Beljanski used the test to screen for agents that specifically shut down DNA synthesis from the cancer DNA template and so exhibit potential anti-cancer activity.

The anti-cancer effect of plant extracts Pao pereira and Rauwolfia vomitoria were originally identified in the Oncotest because they shut down DNA synthesis from cancer DNA templates. Their anti-cancer activity has been verified in extensive research both *in vitro* and *in vivo*. Extracts of the bark of these two plants do indeed have broad spectrum anti-cancer activity. The extracts induce apoptosis in cancer cells, but do not affect healthy cells. The Oncotest correctly predicted anti-cancer activity of these plant extracts in cells and animals.

Beljanski's screens for other anti-cancer plants included extracts of teas. Recently, summaries of Oncotests with green teas were found in Beljanski's laboratory notebooks. Four specific green teas (Ceylon Green, Bi Lou Chun, Organic Gunpowder and Dragonwell) were identified as strongly anti-cancer and these four were combined to make the green tea blend that was analyzed at KUMC.

Experiments were conducted to compare the four green tea combination named OnkoTea against breast, liver and bladder cancer cells. For comparison three other teas were included in the tests: Bigelow Green Tea with Mint, Kusmi Chinese Green Tea, Lipton Black Tea. Two breast cancer cell lines were studied: MCF-7 (estrogen receptor positive) and MDB-MB-231 (estrogen receptor negative, highly metastatic). For the assays the extracts were dissolved in water, diluted, and cancer cell lines were treated for 24, 48 and 72 hours. Growth inhibition was found to be dose and time dependent.

"The bladder cancer cells 5637 were the most sensitive with IC50 values ranging from 85 - 200 μg/mL for 24 to 72 hours treatment, and the liver cancer cells HepG2 were the most resistant to the tea treatments. There seemed to be no difference in sensitivity between the two different breast cancer cell lines. Among the tea preparations, OnkoTea showed the best inhibitory effects, whereas the black tea Lipton was the least active." The Bigelow and Kusmi green teas gave intermediate results.

OnkoTea and Lipton were further tested against four melanoma cancer cell lines with consistent results. "Overall, the OnkoTea preparation reduced cell viability of all 4 tested melanoma cell lines with IC50s ranging from 150 to 370 μg/mL for 24 to 72 hours treatment. The inhibition increased as the treatment time increased. Lipton tea preparation had much less activity in inhibiting cell viability under the same conditions." The possibility that genetic makeup of the melanoma cells may influence their sensitivity to tea treatment was discussed [1-5].

Conclusion

A combination of four green tea extracts that showed anti-cancer potential in the Oncotest proved to inhibit breast, bladder, liver and skin cancer cell proliferation in the Kansas study. It will be interesting to determine whether the measured IC50s in the cell proliferation assays correlate with the level of polyphenols in the different teas and whether the standout results for OnkoTea can be attributed to its polyphenol content.

The results from the Oncotest indicate that the active polyphenols in the green tea extracts, catechins, bind directly to DNA and thereby could exert anti-tumor activity by preventing DNA synthesis in cancer cells. This may well be the mechanism of action for the anti-cancer effects of green teas.

There have been several reports of the binding of green tea catechins to DNA. In light of the Oncotest experiment, it will be interesting to determine the chemical affinity of the binding of the tea compounds to normal versus cancer cell DNA.

This approach represents a novel and promising avenue for understanding the health benefits of green tea.

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