Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation Design Proposal)

Team Number: SDBC272

Project Title: Anti-onco tea

Project Type: Investigation Design Proposal

To our best knowledge and after thorough literature research, as at 26/4/2022 , there are no similar works.

I. Background

Breast cancer occurs due to the mutation of BRCA1 and BRCA2 or ageing. In 2020, there were 2.3 million women diagnosed with breast cancer and 685 000 deaths globally, making it the world's most prevalent cancer. [1]We hope to find feasible method to bring-down the occurrence of breast cancer and alleviate it. Tea is a traditional, well-known beverage in many regions. Its main component, epigallocatechin-3-gallate, was proven capable of preventing and alleviating breast cancer.[2] As tea is popular among different regions, it is believed to be a feasible option to prevent and alleviate breast cancer by easily assimilating into the society of different cultures.

II. Objective(s)

This investigation aims to compare the effectiveness of various types of green tea from different regions on breast cancer, ranging from Longjing from China, Matcha from Japan, Celyon green tea from Sri Lanka, Zealong teas from New Zealand, to Moroccan mint tea from Morocco, in terms of both prevention and alleviation respectively. We attempt to discover a less-invasive choice to prevent breast cancer, and a possible diet treatment to alleviate breast cancer.

III. Hypothesis

It is proven that green tea contains large amounts of EGCG, which is capable of reducing the risk and suppressing breast cancer by six major cellular mechanisms.[3] Therefore, we deduce that with constant intake of green tea, it has positive results in preventing and alleviating breast cancer. The experiment is divided into investigating the effectiveness of different types of tea in the prevention and alleviation of breast cancer, with an in-vitro test to measure the concentration of EGCG and in-vivo test on animal models. Hence, our assumption is made that the type of green tea with the highest concentration of EGCG is the most effective alternative to prevent and alleviate breast cancer.

IV. Methodology

In-vitro test

For prevention and alleviation, we designed an in-vitro test on the concentration level of EGCG in various types of tea. EGCG concentration is tested by the high-performance liquid chromatography[4]. 5 experimental setups are designed to test the concentration of EGCG in 5 different types of tea. Distilled water is used as control to ensure that the different types of tea is the only factor affecting the concentration of EGCG.

In-vivo animal test

Prevention

Transgenic mouse models with BRCA1 and BRCA2 deficiency are used. [5] 5 mice are fed with each type of tea 3 times a day, while 1 mice are fed with water as a control setup, also feeding 3 times a day. This continued for a year, as mice develop breast cancer within six months on average. [6] The mice then are diagnosed with or without breast cancer, by the VEGFR2-targeted ultrasound molecular imaging.[7] The experiment is repeated twice with another cohort of mice, to increase the reliability of the experiment. The number of occurrences of breast cancer is noted down.

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[1] https://www.who.int/news-room/fact-sheets/detail/breast-cancer#:~:text=Scope%20of%20the%20problem,the%20world's%20most%20prevalent%20cancer.

[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4127621/

[3] https://pubmed.ncbi.nlm.nih.gov/33319659/

[4] https://www.researchgate.net/publication/238445342_A_method_for_fast_determination_of_epigallocatechin_gallate_EGCG_epicatechin_EC_catechin_C_and_caffeine_CAF_in_green_tea_using_HPLC

[5] https://www.nature.com/articles/1209871

[6] Muller WJ, Sinn E, Pattengale PK, Wallace R, Leder P (1988) Single-step induction of mammary adenocarcinoma in transgenic mice bearing the activated c-neu oncogene. *Cell* 54: 105-115

[7] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3602408/#:~:text=These%20results%20suggest%20that%20VEGFR2,breast%20cancer%20detection%20in%20women.

Alleviation

5 mice are fed with each type of tea 3 times a day, measured between two feeding with tea, while 1 mice are fed with water as a control setup. This will continue for a year. The alleviation of breast cancer is determined by measuring the reduction in size of tumours. The initial size of the tumour is noted down. Continuous measurement will be done, once per week, as mice develop breast cancer within six months on average, smaller intervals can measure continuous changes more accurately. The experiment is repeated twice with another cohort of mice, to increase the reliability of the experiment.

Variables	Prevention	Alleviation
Independent variable	5 different types of tea	
Dependent variable	The result in VEGFR2-targeted ultrasound molecular imaging: Prevention - either having breast cancer or without. Alleviation - either having the alleviation in breast cancer or without.	
Control variable	All mice are transgenic mice with BRCA-1 and BRCA-2 deficiency, same gender, diet, similar physical activity and health status.	All mice are transgenic mice with BRCA-1 and BRCA-2 deficiency, all mice have breast cancer (different stages are separated in different experimental groups), same gender, diet, similar physical activity and health status.

The quantitative measurement of the alleviation of breast cancer - reduction of size of tumour

$V = (4/3) \times \pi \times (L/2) \times (L/2) \times (D/2)$ [8]

V. Expected Results and Impact of research

For both prevention and alleviation, it is expected that one of, a few of or all five types of tea is/are effective in reducing the occurrence and alleviating breast cancer. Or else, all five types of tea are not effective to reduce or alleviate breast cancer.

By carrying out the in-vitro test on the concentration level of EGCG in various types of tea in the first stage, one (or more) type(s) of tea has the highest concentration of EGCG. That type of tea is expected to have the most active results in the in-vivo animal test. A type of tea with the highest concentration of EGCG is revealed ultimately as the final outcome. Compared to the previous literature, this research contains comparisons of tea from different origins.

The existing medical intervention includes intake of tamoxifen and raloxifene (for prevention), surgery, chemo, hormonal and Radiation therapy (for alleviation). These methods may have serious side effects on people's mental and physical health as they increase the risk of menopause, deep venous thrombosis, pulmonary embolism or even cancers of the uterus.[9] The cost of these treatments is extremely high and [10] The use of chemotherapy also causes harmful effects to the environment including pollution of water supply.[11]

Compared to the above-mentioned, since different researches have shown that no harmful side effects are caused with a moderate tea intake, we conclude that tea is a safe substitute for adults.[12] It is also generally more affordable for many families due to its economical cost and is an environmentally-friendly alternative.

Based on the above health, economic and environmental aspects, we deduce that the type of green tea which demonstrates the best capabilities in preventing and alleviating breast cancer at the end of this experiment is an effective but less-invasive natural alternative for the prevention and alleviation of breast cancer sustainably.

VI. Conclusion

Following this investigation, the effect of different types of tea in various regions is compared and evaluated. The comparison among several continents and tea from different origins broaden our research scope and increase the possibilities of this study.

[8] https://pubmed.ncbi.nlm.nih.gov/23689461/
[9] https://www.cancer.org/cancer/breast-cancer/risk-and-prevention/tamoxifen-and-raloxifene-for-breast-cancer-prevention.html
[10] https://www.reuters.com/article/us-health-mentalhealth-breast-cancer-idUSKBN1O627N
[11] https://ecori.org/2012-11-19-chemo-drugs-pose-serious-public-health-risks-html/#:~:text=A%20handful%20of%20life%2Dsaving,eventually%20into%20drinking%20water%20supplies
[12] https://www.rxlist.com/green_tea/supplements.htm#SideEffects