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"TEA", AN ANTI CARCINOGENIC COMPOUND – A REVIEW

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ABSTRACT

A healthy diet supports energy needs and provides for human nutrition without exposure to toxicity. Tea has received a great deal of attention because tea polyphenols are strong antioxidants, and tea preparations have shown inhibitory activity against tumorigenesis. It is consumed in different forms namely green, black and oolong tea. Tea is used in the management of different types of cancers including Oral Cancer. Micronuclei (MN) act as a cancer biomarker. The present review focuses on the antioxidants of various tea and their mechanism of protective effects on oral cancer.

KEYWORDS: Tea, Polyphenols, Micronuclei, Oral Cancer.

INTRODUCTION:

The word "diet" often implies the use of specific intake of nutrition for health . The requirements for a healthy diet can be met from a variety of plant-based and animal-based foods. A healthy diet supports energy needs and provides for human nutrition without exposure to toxicity. More and more research is finding that diet plays a crucial role in the prevention of cancer. A joint WHO/ FAO Expert Consultation report has estimated that dietary factors account for approximately 30% of cancers in industrialized countries[1]. There is convincing evidence that being overweight and obese increase the risk of cancer, The World Cancer Research Fund has made the following dietary recommendations[2]:-

- Increase fruit and vegetable intake - at least 5 portions per day.
- Consume a high proportion of high fiber foods such as whole meal bread and other cereals
- Choose a variety of plant based foods such as cereals, legumes (such as lentils, beans and peas), starchy foods (such as pasta, rice and bread) as well fruit and vegetables
- Select foods low in fat and salt
- Drink alcohol in moderation if at all.

These dietary changes as well as maintaining a healthy weight and being physically active can help reduce the risk of developing cancer. There is increasing evidence that specific substances found in certain foods can enhance general healthy eating recommendations e.g. phenolic compounds found in plants. Tea is rich in specific phenolic compounds including flavonoids. Tea is one of the most widely consumed beverages in the whole world, second only to water, and its medicinal properties have been widely explored. It is believed that tea originated from China around 2737 B.C., although earliest documented evidence as mentioned in a Chinese dictionary can be traced back to 350 B.C.[3]. Tea was brought to Europe in 1559 A.D. The tea plant, Camellia sinensis, is a member of the Theaceae family. The three major forms of tea black, green and oolong are produced from the leaves of the tea plant. Tea leaves are dark green in colour, alternately arranged , oval in shape and have serrated edges. Green tea beverage contains 30 - 42 % catechins by dry weight[4]. These catechins are present in higher quantities in green tea than in black or oolong tea, because of differences in the processing of tea leaves after harvest. For the green variety, fresh tea leaves from the plant Camellia sinensis are steamed and dried to inactivate the polyphenol oxidase enzyme, a process that essentially maintains the polyphenols in their monomeric forms. Black tea, on the other hand is produced by extended fermentation of tea leaves leading to the formation of polymeric compounds, thearubigins and theaflavins. Oolong tea is a partially fermented product and contains a mixture of the monomeric polyphenols and higher molecular weight theaflavins[4]. All these varieties of tea contain significant amounts of caffeine (3–6%) which is unaffected by the different processing methods [5].There are several polyphenolic catechins in green tea, viz. (−) epicatechin (EC), (−) epicatechin-3-gallate (ECG), (−) epigallocatechin (EGC), (−) epigallocatechin-3-gallate (EGCG), (+) catechin and (+) gallocatechin (GC). EGCG, the most abundant catechin in green tea, accounts for 65% of the total catechin content. A cup of green tea may contain 100–200 mg of EGCG, trace amounts of catechin and gallocatechin[6]. Black tea contains 2-6% theaflavins, >20% thearubigins, and 3-10% catechins in the water-extractable portion. Tea leaves also contain flavonols, such as quercetin and myricetin, as well as nitrogenous compounds, such as caffeine and theobromine. Caffeine accounts for 2-5% of the water-extractable material in green, oolong, and black tea. Many health benefits including prevention of cancer, hepato cellular carcinoma, etc have been ascribed to the consumption of this beverage.

BLACK TEA: An Overview

Black tea is made from leaves that have been withered before being rolled and dried [10]Quantitatively, black tea is the major type of tea produced worldwide[3]. In black tea, catechins, theaflavin (TF) and thearubigins (TR) accounts for 3 - 10, 2 - 6 and > 20% respectively. Theaflavins consist of two catechin molecules joined together and account for about 10% of the converted catechins, whereas the thearubigins are more complex flavonoid molecules, whose structural chemistry are still unknown, and may account for up to 70% of flavonoids in black tea[11]. Researchers from New Jersey, USA have shown that theaflavin-2 (TF-2), a compound unique to black tea and oolong tea kills cancer cells. Theaflavin-2 suppresses the activity of a gene that induces the inflammatory enzyme cyclooxygenase (COX 2), while also reducing the activity of other inflammatory molecules such as TNF-α and nuclear factor-kappa B (NF-KB). Theaflavin-2 was also shown to produce a pattern of gene regulation similar to that found in the cancer cells.

GREEN TEA: An Overview

Green tea and its constituent catechins are best known for their antioxidant properties, which has led to their evaluation in a number of diseases such as cancer associated with reactive oxygen species (ROS). The chemical composition of green tea is complex. It contains proteins (15-20% dry weight), the amino acids constituents of protein such as theanine or 5-N-ethylglutamine, glutamic acid, tryptophan, glycine, serine, aspartic acid, tyrosine, valine, leucine, threonine, arginine, and lysine and contributed towards (1-4% dry weight); carbohydrates (5-7% dry weight) such as cellulose, pectins, glucose, fructose, and sucrose; minerals and trace elements (5% dry weight) such as calcium, magnesium, chromium, manganese, iron, copper, zinc, molybdenum, selenium, sodium, phosphorus, cobalt, strontium, nickel, potassium, fluorine, and aluminum; and trace amounts of lipids (linoleic and a-linolenic acids), sterols (stigmasterol), vitamins (B, C ande E), xanthic bases (caffeine, theophylline etc), pigments (chlorophyll, carotenoids etc) and volatile organic compounds (aldehydes, alcohols, esters, lactones, hydrocarbons etc)[7]. The yellowish green color of the unoxidized extract is attributed to the chlorophyll content. A cup of green tea contains about 300 to 400 mg of polyphenols, which are essentially colorless. Of the polyphenols, epigallocatechin gallate (EGCG) and epigallocatechin (EGC) are the most important and it is estimated that a typical cup of green tea contains 10 to 30 mg of EGCG. Several epidemiological studies as well as studies in animal models have shown that green tea can offer protection against various cancers such as oral, skin, breast, prostate and lung[8,9].

OOLONG TEA : An Overview

Oolong tea also known as blue green tea or wu long tea is produced by partial oxidisation. It is rolled by hand or machine and pan fried and then allowed to oxidize. This process is repeated several times until the desired level of oxidation is achieved . It contains catechins , theasinensins and other polymerized catechin derivatives but the amount of cathechin content is less than that of green tea. Tea leaves also contain flavonols, such as quercetin and myricetin, as well as nitrogenous compounds, such as caffeine and theobromine. Caffeine accounts for 2-5% of the water-extractable material in green, oolong, and black tea. Oolong tea extract (OTE) contains substances, notably polyphenols that have antibacterial properties against oral pathogens, such as Streptococcus mutans, the bacteria

closely associated with dental caries[12,13].

ORAL CANCER and TEA:

Oral cancer is the sixth most common human cancer[14], representing 3% of all types of cancer. They are located in the oral cavity in 48% of cases, and 90% of these are oral squamous cell carcinoma[15]. They are sometimes preceded by pre-cancerous lesions, such as leukoplakia and erythroplakia. More than 300,000 new cases of oral squamous cell carcinoma are diagnosed annually[16].The most common site for intraoral carcinoma is the tongue, which accounts for around 40% of all cases in the oral cavity proper. Tongue cancers most frequently occur on the posterior-lateral border and ventral surfaces of the tongue.

MICRONUCLEI (MN) and TEA:

Micronuclei are extra nuclear cytoplasmic bodies. It has been reported as marker for high cancer risk as they arise in response to carcinogens. The formation of micronuclei can be induced by substances that cause chromosome breakage (clastogens) as well as by agents (aneugens) that affects the spindle apparatus[17]. The frequency of micronucleated exfoliated cell elevates in human tissues, which appear to be the main targets of carcinogens and from which the carcinomas arise[18]. Micronuclei are induced in oral exfoliated cell by a variety of carcinogenic substances which is found in tobacco ,betel nut and alcohol[19].Tobacco specific nitrosamines{N- nitrosoanabasine (NAB), 4-(N- methyl-N-nitrosamino)-1-(3-pyridyl)-1-butanone(NNK)}[20] have been reported to a potent clastogenic and mutagenic effect which are responsible for the induction of chromatid / chromosomal aberrations resulting in the production of micronuclei[19]. Chang et al., (2003) have shown that there is minimal genotoxic concern with a decaffeinated green tea catechin mixture.The antigenotoxic and anticlastogenic activities of the tea are mostly due to its antioxidant activity that inactivates the direct carcinogens[21]. The antioxidant property has been highly attributed to the polyphenolic compounds in the tea. Catechins and flavonoids from the polyphenols are primarily responsible for the beneficial healthful properties of the tea [22,23].

CONCLUSION:

The process of formation of oral cancer results from multiple sites of premalignant changes in the oral cavity. Micronuclei act as a biomarker of squamous cell carcinoma. Percentage of MN formation has been observed in pre cancerous lesions of the oral cavity of betel quid chewers. The polyphenols present in tea decrease the risk factor of specific type of cancers by inducing phase I and phase II metabolic enzymes that increase the formation of carcinogens.

We have screened 311 subjects from different areas of Eastern, North Eastern India and also from RKMSP Hospital, Kolkata. 61.09% had betel quid chewing habit. Percentage of micronuclei is higher than the normal in cases who had betel quid chewing habit .Black tea without milk is very much effective for oral cancer. After supplementation of black tea micronuclei percentage are lower than before. Overall tea is an affordable beverage of natural origin, shown some protective effect and also reducing the risk of cancer.

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Conflicts of Interest: The author declares no conflicts of interest.

REFERENCES:

1. Diet, Nutrition and the Prevention of Chronic Diseases, Report Of A Joint WHO/FAO Expert Consultation, Who Technical Report Series 916. 2002.
2. Diet and Health Guidelines for Cancer Prevention. World Cancer Research Fund 1998.
3. Wickremansinghe, R.L. (1978).Tea. Adv Food Res., 24, p 229.
4. Graham, H.N. (1992) .Green tea composition, consumption, and polyphenol chemistry. Preventive Medicine. 21 (3), p 334–350.
5. Chu, D.C. (1997).Green tea—its cultivation, processing of the tea leaves for drinking materials, and kinds of green tea. In: Juneja, L.R., Chu, D.-C., Kim, M. (Eds.), Chemistry and Applications of Green Tea. CRC Press, Boca Raton , p 1–11.
6. Chu, D.C., Juneja, L.R. (1997).General chemical composition of green tea and its infusion. In: Juneja, L.R., Chu, D.-C., Kim, M. (Eds.), Chemistry and Applications of Green Tea. CRC Press, Boca Raton, p 13– 22.
7. Belitz, D.H., Grosch, W. (1997). Qui'mica de los Alimentos Zaragoza: Acribia.
8. Mukhtar, H., Ahmad, N.(2000).Tea polyphenols: prevention of cancer and optimizing health. American Journal of Clinical Nutrition, 71 (6 Suppl):1698S–1702S (discussion 1703S-1694S).
9. Yang, C.S., Maliakal, P., Meng, X. (2002). Inhibition of carcinogenesis by tea. Annual Reviews in Pharmacology and Toxicology, 42, p 25–54.
10. Bokuchava, M.A., Skobeleva, N.I. (1980). The biochemistry and technology of tea manufacture. CRC Crit. Rev. Food Sci. Nutr, 12, p303.
11. ICMR Bulletin (2003). April – May.vol. 33, No. 4-5, p 39 – 51.
12. Kempler, D.,Anaise, J., Westreich , V., Gedalia, I. (1977).Caries rate in hamsters given non acidulated and acidulated tea , J. Dent. Res, 56, p 89.
13. Hamilton-Miller, J .M. (2001). Anti-cariogenic properties of tea (Camellia sinensis), J. Med. Microbiol., 50, p 299-302.
14. Williams, H. K. (2000). Molecular pathogenesis of oral squamous carcinoma, Molecular Pathology, 53(4), p 165–172.
15. Jemal, A. R.,Siegel, E.,Ward, et al.(2009). Cancer statistics, CA Cancer Journal for Clinicians, 59(4), p 225 – 249.
16. Parkin, D. M., Laara, E., Muir, C. S. (1988).Estimates of the worldwide frequency of sixteen major cancers in 1980, International Journal of Cancer, 41(2), p184 – 197.
17. Ribero, D.A., de Oliveira, G., de Castro, G.M. et al(2008). Cytogenic biomonitering in patients exposed to dental X- rays: Comparison between adults and children . Dento maxillofac Radiol , 37, p 404 – 407.
18. Buajeeb,W., Kraivaphan, P., Amornch, at C. et al. (2007). Frequency of micronucleated exfoliated cells in oral lichen planus. Mutation Research, 627, p 191- 196.
19. Kumar, V., Rao, N.N., Nair, N.S. (2000). Micronuclei in oral squamous cell carcinoma: A marker of genotoxic damage. Indian J Dent Res, 11, p 101 -106.
20. Bhide, S.V., Nair, U.J., Nair, J. et al. (1986). N- Nitrosamines in the saliva of tobacco chewers or maseri users. Food Chemical Toxicol, 24, p 293 -297.
21. Chang, P.Y., Mirsalis, J., Riccio, E. S. et al. (2003). Genotoxicity and toxicity of the potential cancer-preventive agent polyphenon E. Environ Mol Mutagen, 41, p 43–54.
22. Venditti, E., Bacchetti ,T., Tiano, L. et al. (2010). Hot vs. cold water steeping of different teas: Do they affect antioxidant activity? Food Chem , 119, p1597–1604.
23. Nie,S .P.; Xie, M.Y. (2011). A review on the isolation and structure of tea polysaccharides and their bioactivities. Food Hydrocolloid, 25, p144–149.

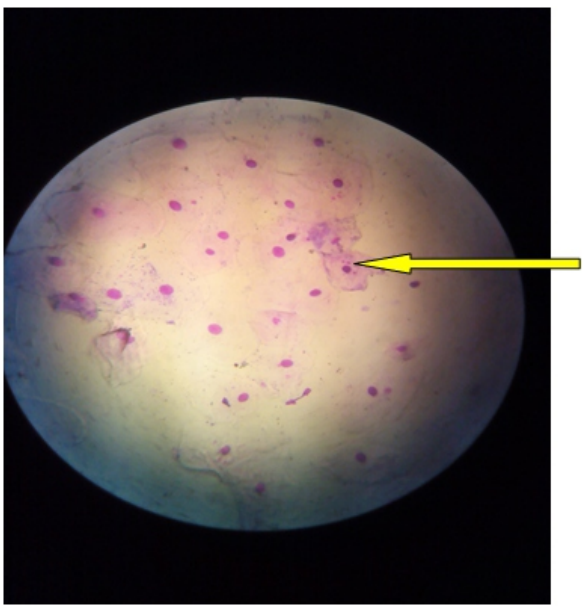

FIG 1: "⟵" SHOWING MICRONULEI (ORAL CANCER BIOMARKER)