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Cardiovascular Benefits of Tea Consumption

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Abstract

Tea, a popular beverage worldwide, is classified into green, oolong and black tea based on the degree of fermentation. Increasing evidence from animal experiments and epidemiologic studies support the properties of tea and its constituent's for protecting against atherosclerosis, coronary heart disease, stroke, and hypertension. This study demonstrates that potential cardiovascular benefits of consuming tea or tea polyphenols regularly (dose-dependent effect for drinking ≥1 cup of tea daily or weekly).

Keywords: Tea; Polyphenol; Cardiovascular Disease

Introduction

Tea is commonly classified into three forms based on the degree of fermentation involving unfermented green tea, partially fermented oolong tea and fully fermented black tea. Tea leaves contain polyphenols in high quantity (~30% of dried tea leaves), mainly flavonoids. For green tea, polyphenols are maintained in monomeric forms and catechins are present in higher quantities than in oolong or black tea. Black tea contains polymeric compounds thearubigins and theaflavins due to extended fermentation. Black tea has 2-3 times more caffeine as compared to green tea. Oolong tea is a mixture of monomeric polyphenols and theaflavins. Of the tea produced worldwide, 78% is black tea mainly consumed in Western countries; 20% is green tea commonly consumed in Asian countries; whilst 2% is oolong tea usually consumed in southern China. Compelling evidence shows the cardiovascular benefits of consuming tea or the major ingredient polyphenols during pathological conditions like diabetes, obesity, hypertension and atherosclerosis [1-3]. Tea or tea polyphenols have been shown to possess anti-inflammatory, antioxidative, antithrombogenic, hypocholesterolemic and hypotensive effects [4]. This short communication highlights the protective effects of consuming tea or tea polyphenols for the prevention of cardiovascular complications.

Regular Tea Consumption Promotes Cardiovascular Health

Epidemiologic studies support the potential role of tea consumption to reduce the risk of cardiovascular diseases. Increased tea intake (>375 ml/day, or <14 cups/week) contributes to the protection against myocardial infarction and reduces infarct-related ventricular arrhythmia and mortality [5-7]. Similarly, the inverse association of tea consumption (≥1 cup/day, or 1-6 cups/week)with mortality due to all causes and due to cardiovascular disease was reported in Japanese adults [8,9]. A dose-response meta-analysis indicated that regular green tea consumption (1 cup/day) reduced the

risk of cardiovascular disease mortality and all-cause mortality [10]. A recent meta-analysis also provides evidence that green tea consumption (≥1 cup/day) reduced the risk of myocardial infarction and stroke [11]. Of note, black tea promotes cardiovascular health as potently as green tea with the predominant theaflavins and thearubigins counterbalancing the lack of catechins [12].

Atherosclerosis

Studies using animal models like apo E deficient mice demonstrate that flavonoids present in tea can attenuate atherosclerotic lesion development [1,13]. Green tea consumption (≥2 cups/day) was found to be negatively associated with the occurrence of coronary atherosclerosis in men [14]. Similarly, lower prevalence of carotid plaques was shown in women with increasing daily tea consumption (≥1 cup/day) [15]. Consumption of green tea (8 g/day) for two weeks improves flow-mediated vasodilatation in chronic smokers [16]. Furthermore, long-term ingestion of black tea (5 cups/day) for 4 weeks improves vasodilation of the brachial artery in mildly dyslipidemic subjects [17]. Chronic inclusion of black tea extract (15 mg/kg/day for 4 weeks) favorably modifies lipid profile and attenuates endothelial dysfunction in rat model of estrogen deficiency [18].

Coronary heart disease

Tea drinking (≥2 cups/day) appears to be inversely correlated with coronary heart disease [19]. Regular consumption of black tea (5 cups/day) is demonstrated to link with diminished total and LDL cholesterol in mildly hypercholesterolemic adults; and thereby reduce the risk of coronary heart disease [20]. Black tea intake enhances flow-mediated dilation in patients with coronary artery disease (900 ml/day) [21] as well as in healthy individuals (1-8 cups/day) [22]. On the other hand, a meta-analysis supports the protective role of green tea (1 cup/day) against coronary artery disease but not for black tea [23].

Stroke

Green tea intake (≥2 cups/day) reduces the stroke incidence in Japanese population [24]. Another study in China also suggests a lowered risk of ischemic stroke among frequent tea drinkers (1-2 cups/day) [25]. A meta-analysis reveals that daily consumption of black tea can prevent the onset of ischemic stroke [26]. Lower risk of total stroke was observed among Swedish individuals with daily consumption of black tea(≥4 cups/day) [27].

Hypertension

Consumption of green or black tea was shown to lower both systolic and diastolic pressure in hypertensive rats [28,29]. Cardiovascular benefits of black tea consumption are attributed to scavenge of reactive oxygen species (ROS) level [30] and the increase of nitric oxide (NO) bioavailability through PI3/Akt pathway [31] in endothelial cells. In addition, oral administration of black tea extraction (15 mg/kg/day for 2 weeks) can improve endothelium-dependent relaxations and normalize blood pressure through alleviation of endoplasmic reticulum stress in hypertensive rats [32]. In agreement with animal studies, black tea consumption decreased both systolic and diastolic blood pressure in hypertensive patients [33]. Habitual drinks of green or oolong tea (≥120 ml/day for at least 1 year) have decreased risk of hypertension in Chinese population [34]. The protective association between green tea consumption (100 ml/day) and blood pressure was observed in another study [35].

Detrimental effects on human health

Tea is “generally recognized as safe” by US Food and Drug Administration (FDA). There are no reports of clinical toxicity from daily tea consumption as a beverage. However, adverse effects following the consumption of large amounts of tea have been reported. Overconsumption of tea may be considered harmful primarily due to its caffeine content, presence of aluminum and the effect of tea polyphenols on iron bioavailability. The reported deleterious effects of caffeine include nervousness, restlessness, tremor, palpitation, tachycardia, insomnia, nausea, vomiting, diarrhea, diuresis, headache, and abdominal pain [36]. FDA advises pregnant women or those may become pregnant to avoid caffeine. Not specific to tea, caffeine content needs attention. Some people are more sensitive to it and pregnant women should use it with constrains. Caffeine should be limited to less than 400 mg a day (or less than 200 mg for pregnant or nursing women). Hepatotoxicity is considered from excessive levels of epigallocatechin gallate or its metabolites [37]. Multi-dose pharmacokinetic studies suggest a daily dosage of 800 mg/day of epigallocatechin gallate capsules for up to 4 weeks to be safe and well tolerated. It is a natural ability of the tea plant to absorb fluoride from surrounding soil which mostly accumulated in leaves. Excess tea drinking (consuming a pitcher of tea made from 100 to 150 tea

bags daily for 17 years which approximately equivalents to 20 mg fluoride intake per day) may lead to skeletal fluorosis [38]. Tea consumption may limit the absorption of non-heme iron from diet and thereby individuals at risk of iron deficiency are advised to wait at least one hour after meal before drinking tea [39].

Conclusion

The positive evidence for the cardioprotective effects of tea or tea polyphenols in human and murine models provides insights into taking tea as dietary supplements to prevent or retard the development of cardiovascular diseases. Many studies indicate the dose-dependent effect: the more cups of tea you drink, the more obvious the health effects; nevertheless, an overdose can lead to unpleasant side effects. To gain its health benefits, drinking a few cups of green tea each day (approximately 3 cups) is recommended by Harvard Health Publications and the University of Maryland Medical Center. Notably, the bioavailability of polyphenols varies in different types of tea and different studies supporting the cardioprotective potentials have used a mixture of several polyphenols, so further detailed investigation is required to correlate the amount of tea polyphenols to vascular benefits. To conclude, tea consumption can reduce the risk of cardiovascular diseases like other well-established ways such as healthy eating and physical activity. It is not necessary to have strict regulation on the amount of tea to be consumed as drinking 1 cup of tea daily has already been shown to be beneficial; whilst drinking more cups of tea daily or weekly can obtain greater cardioprotective effects.

References

1. Suzuki J, Ogawa M, Izawa A, Sagesaka YM, Isobe M (2005) Dietary consumption of green tea catechins attenuate hyperlipidaemia-induced atherosclerosis and systemic organ damage in mice. Acta Cardiol 60(3): 271-276.

2. Kim JA (2008) Mechanisms underlying beneficial health effects of tea catechins to improve insulin resistance and endothelial dysfunction. Endocr Metab Immune Disord Drug Targets 8(2): 82-88.

3. Greyling A, Ras RT, Zock PL, Lorenz M, Hopman MT, et al. (2014) The effect of black tea on blood pressure: a systematic review with meta-analysis of randomized controlled trials. PLoS One 9(7): 103247.

4. Hodgson JM, Croft KD (2010) Tea flavonoids and cardiovascular health. Mol Aspects Med 31(6): 495-502.

5. Geleijnse JM, Launer LJ, Van der Kuip DA, Hofman A, Witteman JC (2002) Inverse association of tea and flavonoid intakes with incident myocardial infarction: the Rotterdam Study. Am J Clin Nutr 75(5): 880-886.

6. Mukamal KJ, Maclure M, Muller JE, Sherwood JB, Mittleman MA (2002) Tea consumption and mortality after acute myocardial infarction. Circulation 105(21): 2476-2481.

7. Mukamal KJ, Alert M, Maclure M, Muller JE, Mittleman MA (2006) Tea consumption and infarct-related ventricular arrhythmias: the determinants of myocardial infarction onset study. J Am Coll Nutr 25(6): 472-479.

8. Kuriyama S, Shimazu T, Ohmori K, Kikuchi N, Nakaya N, et al. (2006) Green tea consumption and mortality due to cardiovascular disease, cancer, and all causes in Japan: the Ohsaki study. JAMA 296(10): 1255-1265.

9. Mineharu Y, Koizumi A, Wada Y, Iso H, Watanabe Y, et al. (2011) Coffee, green tea, black tea and oolong tea consumption and risk of mortality from cardiovascular disease in Japanese men and women. J Epidemiol Community Health 65(3): 230-240.

10. Tang J, Zheng JS, Fang L, Jin Y, Cai W, et al. (2015) Tea consumption and mortality of all cancers, CVD and all causes: a meta-analysis of eighteen prospective cohort studies. Br J Nutr 114(5): 673-683.

11. Pang J, Zhang Z, Zheng TZ, Bassig BA, Mao C (2016) Green tea consumption and risk of cardiovascular and ischemic related diseases: A meta-analysis. Int J Cardiol 202: 967-974.

12. Lorenz M, Urban J, Engelhardt U, Baumann G, Stangl K, et al. (2009) Green and black tea are equally potent stimuli of NO production and vasodilation: new insights into tea ingredients involved. Basic Res Cardiol 104(1): 100-110.

13. Loke WM, Proudfoot JM, Hodgson JM, McKinley AJ, Hime N, et al. (2010) Specific dietary polyphenols attenuate atherosclerosis in apolipoprotein E-knockout mice by alleviating inflammation and endothelial dysfunction. Arterioscler Thromb Vasc Biol 30(4): 749-757.

14. Sasazuki S, Kodama H, Yoshimasu K, Liu Y, Washio M, et al. (2000) Relation between green tea consumption and the severity of coronary atherosclerosis among Japanese men and women. Ann Epidemiol 10(6): 401-408.

15. Debette S, Courbon D, Leone N, Gariepy J, Tzourio C, et al. (2008) Tea consumption is inversely associated with carotid plaques in women. Arterioscler Thromb Vasc Biol 28(2): 353-359.

16. Kim W, Jeong MH, Cho SH, Yun JH, Chae HJ, et al. (2006) Effect of green tea consumption on endothelial function and circulating endothelial progenitor cells in chronic smokers. Circ J 70(8): 1052-1057.

17. Hodgson JM, Puddey IB, Burke V, Watts GF, Beilin LJ (2002) Regular ingestion of black tea improves brachial artery vasodilator function. Clin Sci (Lond) 102(2): 195-201.

18. Leung FP, Yung LM, Ngai CY, Cheang WS, Tian XY, et al. (2016) Chronic black tea extract consumption improves endothelial function in ovariectomized rats. Eur J Nutr 55(5): 1963-1972.

19. de Koning Gans JM, Uiterwaal CS, van der Schouw YT, Boer JM, Grobbee DE, et al. (2010) Tea and coffee consumption and cardiovascular morbidity and mortality. Arterioscler Thromb Vasc Biol 30(8): 1665-1671.

20. Davies MJ, Judd JT, Baer DJ, Clevidence BA, Paul DR, et al. (2003) Black tea consumption reduces total and LDL cholesterol in mildly hypercholesterolemic adults. J Nutr 133(10): 3298-3302.

21. Duffy SJ, Keaney JF, Holbrook M, Gokce N, Swerdloff PL, et al. (2001) Short- and long-term black tea consumption reverses endothelial dysfunction in patients with coronary artery disease. Circulation 104(2): 151-156.

22. Grassi D, Mulder TP, Draijer R, Desideri G, Molhuizen HO, et al. (2009) Black tea consumption dose-dependently improves flow-mediated dilation in healthy males. J Hypertens 27(4): 774-781.

23. Wang ZM, Zhou B, Wang YS, Gong QY, Wang QM, et al. (2011) Black and green tea consumption and the risk of coronary artery disease: a meta-analysis. Am J Clin Nutr 93(3): 506-515.

24. Kokubo Y, Iso H, Saito I, Yamagishi K, Yatsuya H, et al. (2013) The impact of green tea and coffee consumption on the reduced risk of stroke incidence in Japanese population: the Japan public health center-based study cohort. Stroke 44(5): 1369-1374.

25. Liang W, Lee AH, Binns CW, Huang R, Hu D, et al. (2009) Tea consumption and ischemic stroke risk: a case-control study in southern China. Stroke 40(7): 2480-2485.

26. Arab L, Liebeskind DS (2010) Tea, flavonoids and stroke in man and mouse. Arch Biochem Biophys 501(1): 31-36.

27. Larsson SC, Virtamo J, Wolk A (2013) Black tea consumption and risk of stroke in women and men. Ann Epidemiol 23(3): 157-160.

28. Negishi H, Xu JW, Ikeda K, Njelekela M, Nara Y, et al. (2004) Black and green tea polyphenols attenuate blood pressure increases in stroke-prone spontaneously hypertensive rats. J Nutr 134(1): 38-42.

29. Potenza MA, Marasciulo FL, Tarquinio M, Tiravanti E, Colantuono G, et al. (2007) EGCG, a green tea polyphenol, improves endothelial function and insulin sensitivity, reduces blood pressure, and protects against myocardial I/R injury in SHR. Am J Physiol Endocrinol Metab 292(5): 1378-1387.

30. Ying CJ, Xu JW, Ikeda K, Takahashi K, Nara Y, et al. (2003) Tea polyphenols regulate nicotinamide adenine dinucleotide phosphate oxidase subunit expression and ameliorate angiotensin II-induced hyperpermeability in endothelial cells. Hypertens Res 26(10): 823-828.

31. Anter E, Thomas SR, Schulz E, Shapira OM, Vita JA, et al. (2004) Activation of endothelial nitric-oxide synthase by the p38 MAPK in response to black tea polyphenols. J Biol Chem 279(45): 46637-46643.

32. Cheang WS, Ngai CY, Tam YY, Tian XY, Wong WT, et al. (2015) Black tea protects against hypertension-associated endothelial dysfunction through alleviation of endoplasmic reticulum stress. Sci Rep 5: 10340.

33. Grassi D, Draijer R, Desideri G, Mulder T, Ferri C (2015) Black tea lowers blood pressure and wave reflections in fasted and postprandial conditions in

hypertensive patients: a randomised study. Nutrients 7(2): 1037-1051.

34. Yang YC, Lu FH, Wu JS, Wu CH, Chang CJ, et al. (2004) The protective effect of habitual tea consumption on hypertension. Arch Intern Med 164(14): 1534-1540.

35. Alkerwi A, Sauvageot N, Crichton GE, Elias MF (2015) Tea, but not coffee consumption, is associated with components of arterial pressure. The Observation of Cardiovascular Risk Factors study in Luxembourg. Nutr Res 35(7): 557-565.

36. Higdon JV, Frei B (2006) Coffee and health: a review of recent human research. Crit Rev Food Sci Nutr 46(2): 101-123.

37. Mazzanti G, Menniti-Ippolito F, Moro PA, Cassetti F, Raschetti R, et al. (2009) Hepatotoxicity from green tea: a review of the literature and two unpublished cases. Eur J Clin Pharmacol 65(4): 331-341.

38. Kakumanu N, Rao SD (2013) Images in clinical medicine. Skeletal fluorosis due to excessive tea drinking. N Engl J Med 368(12): 1140.

39. Nelson M, Poulter J (2004) Impact of tea drinking on iron status in the UK: a review. J Hum Nutr Diet 17(1): 43-54.