

Molecular evidences of health benefits of drinking black tea

Zafar Rasheed

Department of Medical Biochemistry, College of Medicine, Qassim University, Buraidah, Saudi Arabia

Address for correspondence:

Zafar Rasheed, MS, Ph.D., PGDCA.,
Department of Medical Biochemistry, College of Medicine,
Qassim University, P.O. Box 6655, Buraidah 51452, KSA.
E-mail: zafarrasheed@qumed.edu.sa

WEBSITE: ijhs.org.sa

ISSN: 1658-3639

PUBLISHER: Qassim University

Drinking black tea is an excellent option if you are looking for an alternative of coffee or energy drinks. Black tea is not only a non-sweetened or less-calorie drink but also provides several health benefits as it contains powerful groups of polyphenols including epigallocatechin gallate, theaflavins, thearubigins, an amino acid L-theanine, and several other catechins or flavonoids which provide protection against the onset of several chronic disorders. Recently, Autumn Enloe has reviewed the health benefits of black tea. In her excellent review, she mentioned that drinking black tea has a range of health benefits as it contains lots of powerful antioxidants and other compounds which have potential to decrease inflammation and to reduce the risk for the onset of chronic conditions.^[1] In the past two decades, research on natural health products at molecular levels has extensively performed^[2-9] and their health benefits are now globally well accepted as their usage is free from side effects.^[10,11] Besides water, black tea is one of our most consumed drinks obtained from a plant *Camellia sinensis* and now available in the markets of all over the world in both unblended form such as Assam tea, and Darjeeling tea or blended with various other plants products to obtain different flavors such as Earl Grey, Bigelow, and Chai.

As we know elevated cholesterol, high triglyceride level, and obesity are directly associated with a number of cardiovascular disorders including heart attack, which are now considered as number one cause of death in all over the world.^[12] Studies have shown that drinking black tea on a regular basis helps to reduce the chances of onset of cardiovascular disorders.^[13,14] Gardner *et al.* performed databases searched from 1990 to 2004 on both aspects (helpful or harmful) of black tea, and they concluded that drinking black tea on a regular basis significantly reduced the risk of onset of heart disorders.^[13] By discussing the results from some studies, they pointed out that the drinking black tea three cups per day significantly improved the antioxidant status of the body and most importantly, no credible evidence has found by them that showed black tea is harmful.^[13] Moreover, similar benefits of drinking black

tea on the onset of risk factors of cardiovascular disorders were reported by Bahorun *et al.* through their randomized controlled clinical trial.^[14] Furthermore, Davies *et al.* also reported health benefits of black tea against cardiovascular disorders, as the inclusion of black tea in the diet reduced low-density lipoprotein cholesterol in hypercholesterolemic humans.^[15] Another study also showed that drinking black tea improves the cholesterol levels not only in adults with risk of heart disorders but also in obese.^[16] Besides these benefits, drinking black tea also plays a key role in reducing body weight.^[17] Pan *et al.* reported that the polyphenols present in black tea inhibit obesity by suppressing the digestion and absorption of lipid and complex sugar. They also noticed that the black tea polyphenols also increase lipolysis and decrease lipid accumulation by reducing the proliferation of fat cells.^[17] Interestingly, Pan *et al.* also reported that black tea polyphenols are more effective than polyphenols present in green tea.^[17]

Hypertension or high blood pressure is very common and is either directly or indirectly linked with several deadly complications such as heart failure, heart attack, stroke, kidney damage, and a risk of atherosclerosis.^[18] Studies also show that long-term drinking black tea results in the improvement of blood pressure either from lower or higher sides.^[19] Greyling *et al.* have reviewed and pointed out the same benefit of drinking black tea on blood pressure among normal adults.^[20] In views of these findings, it is suggested that drinking black tea helps us to reduce the risk of these deadly complications associated with hypertension.^[19,20] Besides these, regular drinking of black tea also reduces the risk for stroke.^[21,22] Larsson *et al.* performed an extensively study on 74,961 stroke patients during the course of 10.2 years and concluded that drinking four or more cups of black tea on a daily basis inhibited the risk associated with stroke.^[21] Not only this, Arab *et al.* performed a meta-analysis on black tea intake and risk of stroke. By pooling the data from nine studies on 194,965 adults including 4378 stroke patients, concluded that drinking three cups of black tea on a daily basis reduced the

risk of stroke.^[22] Interestingly, drinking black tea also prevents the risk of cancer onset. As Way *et al.* reported that black tea polyphenol theaflavins perform chemoprotective action against hormone-dependent breast tumors.^[23] In addition, Liang *et al.* demonstrated anti-proliferative activity of black tea polyphenol, theaflavin-3,3-digallate on tumor cells.^[24] In another study, Beltz *et al.* have reviewed the action of black tea polyphenols against the cancer onset and found that black tea polyphenols inhibited the survival of cancerous cells by regulating their growth and metastasis at both nucleic acid and protein levels.^[25] Furthermore, Hudlikar *et al.* have recently reported that black tea polyphenols markedly reduced the proliferation of cancerous cells and increased their apoptosis in a dose-dependent manner in experimental animals.^[26] Moreover, Singh *et al.* recently have given an update on molecular constituents of black tea leaves and their clinical applications. They noticed that black tea leaves contain a range of bioactive constituents including polyphenols, amino acids, volatile compounds, and alkaloids that exhibit several promising anti-disease activities at various points.^[27] They mentioned that drinking black tea on a regular basis inhibited the risk of cancer onset as the phytochemicals present in black tea are known to inhibit the key events of cancer stimulation including tumor necrosis factor- α , p53, cyclooxygenase-2, nuclear factor- κ B, activator protein-1, STAT, epidermal growth factor receptor, AKT, Bcl2, PARP, Bcl-xL, caspases, FOXO1, 5-LOX, and mitogen-activated protein kinases.^[27] It is also important to point out that although studies at *in vitro* and pre-clinical levels fully supported the role of black tea against cancer development but its role at human trails level remains to be completely investigated.

Beside anticancer property, consumption of black tea is also good for diabetic patients, as it is a non-sweetened drink that not only decreases the blood glucose but also reported to improve the status of insulin.^[28-31] Tanga *et al.* reported that black tea extract reduced the blood glucose level and improved the body ability to metabolize the sugar.^[29] In another study, investigators reported that black tea catechin improved the status of insulin hormone.^[30] Moreover, Butacnum *et al.* reported that the intake of black tea improved postprandial blood sugar levels in normal and pre-diabetic adults.^[31] Drinking black tea also performed the antimicrobial activity as the polyphenols present in black tea are reported to kill the growth of harmful bacteria.^[32] The antimicrobial potential of black tea constituents is also proved by another study, showed significant reduction in the growth of a range of harmful bacteria.^[33]

Excess generation of free radicals has the ability either directly or indirectly to damage our biomolecules including the damage of nucleic acids or proteins, which has now considered being one of the key sources responsible for the induction of a number of chronic disorders.^[34-40] It is now well documented that black tea polyphenols have potential to perform an antioxidant function to neutralize the harmful

effects of elevated levels of free radicals, and thus drinking black tea reduced the chances of onset of numerous chronic disorders.^[1,41,42] Specifically, Rietveld and Wiseman pointed out that drinking black tea 1–6 times/day significantly increased the plasma antioxidant potential in humans and decreased the oxidative biomolecular damage including the damage of nucleic acids and lipids.^[41] Another mechanism was reported by Luczaj and Skrydlewska in their excellent review that black tea polyphenols inhibited the activity of pro-oxidative enzymes such as nitric oxide synthase and xanthine oxidase.^[42] In short, it is now well established that drinking black tea on a regular basis improves the antioxidant potential of the body which helps us to reduce the risk of chronic disorders and to improve the overall health. However, the quality of the studies at molecular levels is still lacking to further validate the health benefits of drinking black tea. Therefore, further evidences at molecular level are required.

References

1. Enloe A. 10 Evidence-Based Health Benefits of Black Tea. Healthline Nutrition New Letter; 2018. Available from: <https://www.healthline.com/nutrition/black-tea-benefits>. [Last accessed on 2019 Apr 07].
2. Rasheed Z, Altorbag AA, Al-Bossier AS, Alnasser NA, Alkharraz OS, Altwayjiri KM, *et al.* Protective potential of thymoquinone against peroxynitrite induced modifications in histone H2A: *In vitro* studies. *Int J Biol Macromol* 2018;112:169-74.
3. Rasheed Z, Rasheed N, Al-Shaya O. Epigallocatechin-3-O-gallate modulates global microRNA expression in interleukin-1 β -stimulated human osteoarthritis chondrocytes: Potential role of EGCG on negative co-regulation of microRNA-140-3p and ADAMTS5. *Eur J Nutr* 2018;57:917-28.
4. Rasheed Z. Green tea bioactive polyphenol epigallocatechin-3-O-gallate in osteoarthritis: Current status and future perspectives. *Int J Health Sci (Qassim)* 2016;10:5-8.
5. Rasheed Z, Rasheed N, Al-Shobaili HA. Epigallocatechin-3-O-gallate up-regulates microRNA-199a-3p expression by down-regulating the expression of cyclooxygenase-2 in stimulated human osteoarthritis chondrocytes. *J Cell Mol Med* 2016;20:2241-8.
6. Rasheed Z. Intake of pomegranate prevents the onset of osteoarthritis: Molecular evidences. *Int J Health Sci (Qassim)* 2016;10:5-8.
7. Rasheed N, Alghasham A, Rasheed Z. Lactoferrin from *Camelus dromedarius* inhibits nuclear transcription factor-kappa B activation, cyclooxygenase-2 expression and prostaglandin E2 production in stimulated human chondrocytes. *Pharmacognosy Res* 2016;8:135-41.
8. Rasheed Z, Akhtar N, Haqqi TM. Pomegranate extract inhibits the interleukin-1 β -induced activation of MKK-3, p38 α -MAPK and transcription factor RUNX-2 in human osteoarthritis chondrocytes. *Arthritis Res Ther* 2010;12:R195.
9. Rasheed Z, Akhtar N, Anbazhagan AN, Ramamurthy S, Shukla M, Haqqi TM, *et al.* Polyphenol-rich pomegranate fruit extract (POMx) suppresses PMACI-induced expression of pro-inflammatory cytokines by inhibiting the activation of MAP kinases and NF-kappaB in human KU812 cells. *J Inflamm (Lond)* 2009;6:1.
10. Rasheed Z. Medicinal values of bioactive constituents of camel milk: A concise report. *Int J Health Sci (Qassim)* 2017;11:1-2.
11. Shukla M, Gupta K, Rasheed Z, Khan KA, Haqqi TM. Consumption of hydrolyzable tannins-rich pomegranate extract suppresses inflammation and joint damage in rheumatoid arthritis. *Nutrition* 2008;24:733-43.

12. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, *et al.* Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. *J Am Coll Cardiol* 2017;70:1-25.
13. Gardner EJ, Ruxton CH, Leeds AR. Black tea helpful or harmful? A review of the evidence. *Eur J Clin Nutr* 2007;61:3-18.
14. Bahorun T, Luximon-Ramma A, Neergheen-Bhujun VS, Gunness TK, Googoolye K, Auger C, *et al.* The effect of black tea on risk factors of cardiovascular disease in a normal population. *Prev Med* 2012;54 Suppl: S98-102.
15. Davies MJ, Judd JT, Baer DJ, Clevidence BA, Paul DR, Edwards AJ, *et al.* Black tea consumption reduces total and LDL cholesterol in mildly hypercholesterolemic adults. *J Nutr* 2003;133:3298S-3302S.
16. Fujita H, Yamagami T. Antihypercholesterolemic effect of Chinese black tea extract in human subjects with borderline hypercholesterolemia. *Nutr Res* 2008;28:450-6.
17. Pan H, Gao Y, Tu Y. Mechanisms of body weight reduction by black tea polyphenols. *Molecules* 2016;21: E1659.
18. Ahluwalia M, Bangalore S. Management of hypertension in 2017: Targets and therapies. *Curr Opin Cardiol* 2017;32:413-21.
19. Hodgson JM, Puddey IB, Woodman RJ, Mulder TP, Fuchs D, Scott K, *et al.* Effects of black tea on blood pressure: A randomized controlled trial. *Arch Intern Med* 2012;172:186-8.
20. Greyling A, Ras RT, Zock PL, Lorenz M, Hopman MT, Thijssen DH, *et al.* The effect of black tea on blood pressure: A systematic review with meta-analysis of randomized controlled trials. *PLoS One* 2014;9:e103247.
21. Larsson SC, Virtamo J, Wolk A. Black tea consumption and risk of stroke in women and men. *Ann Epidemiol* 2013;23:157-60.
22. Arab L, Liu W, Elshoff D. Green and black tea consumption and risk of stroke: A meta-analysis. *Stroke* 2009;40:1786-92.
23. Way TD, Lee HH, Kao MC, Lin JK. Black tea polyphenol theaflavins inhibit aromatase activity and attenuate tamoxifen resistance in HER2/neu-transfected human breast cancer cells through tyrosine kinase suppression. *Eur J Cancer* 2004;40:2165-74.
24. Liang YC, Chen YC, Lin YL, Lin-Shiau SY, Ho CT, Lin JK, *et al.* Suppression of extracellular signals and cell proliferation by the black tea polyphenol, theaflavin-3,3'-digallate. *Carcinogenesis* 1999;20:733-6.
25. Beltz LA, Bayer DK, Moss AL, Simet IM. Mechanisms of cancer prevention by green and black tea polyphenols. *Anticancer Agents Med Chem* 2006;6:389-406.
26. Hudlikar RR, Pai V, Kumar R, Thorat RA, Kannan S, Ingle AD, *et al.* Dose-related modulatory effects of polymeric black tea polyphenols (PBP) on initiation and promotion events in B(a)P and NNK-induced lung carcinogenesis. *Nutr Cancer* 2019:1-16.
27. Singh BN, Rawat AK, Bhagat RM, Singh BR. Black tea: Phytochemicals, cancer chemoprevention, and clinical studies. *Crit Rev Food Sci Nutr* 2017;57:1394-410.
28. Jing Y, Han G, Hu Y, Bi Y, Li L, Zhu D, *et al.* Tea consumption and risk of Type 2 diabetes: A meta-analysis of cohort studies. *J Gen Intern Med* 2009;24:557-62.
29. Tanga W, Lia S, Liub Y, Huangb M, Hoac C. Anti-diabetic activity of chemically profiled green tea and black tea extracts in a Type 2 diabetes mice model via different mechanisms. *J Functional Foods* 2013;5:1784-93.
30. Anderson RA, Polansky MM. Tea enhances insulin activity. *J Agric Food Chem* 2002;50:7182-6.
31. Butacnum A, Chongsuwat R, Bumrungpert A. Black tea consumption improves postprandial glycemic control in normal and pre-diabetic subjects: A randomized, double-blind, placebo-controlled crossover study. *Asia Pac J Clin Nutr* 2017;26:59-64.
32. Hervert-Hernández D, Goñi I. Dietary polyphenols and human gut microbiota: A review. *Food Rev Int* 2011;27:2154-69.
33. Chan EW, Soh EY, Tie PP, Law YP. Antioxidant and antibacterial properties of green, black, and herbal teas of *Camellia sinensis*. *Pharmacognosy Res* 2011;3:266-72.
34. Al-Shobaili HA, Rasheed Z. Oxidized tyrosinase: A possible antigenic stimulus for non-segmental vitiligo autoantibodies. *J Dermatol Sci* 2015;79:203-13.
35. Al-Shobaili HA, Rasheed Z. Mitochondrial DNA acquires immunogenicity on exposure to nitrosative stress in patients with vitiligo. *Hum Immunol* 2014;75:1053-61.
36. Rasheed Z, Al-Shobaili HA, Alzolibani AA, Khan MI, Ayub MT, Khan MI, *et al.* Immunological functions of oxidized human immunoglobulin G in Type 1 diabetes mellitus: Its potential role in diabetic smokers as a biomarker of elevated oxidative stress. *Dis Markers* 2011;31:47-54.
37. Rasheed Z, Ahmad R, Rasheed N, Ali R. Reactive oxygen species damaged human serum albumin in patients with hepatocellular carcinoma. *J Exp Clin Cancer Res* 2007;26:395-404.
38. Rasheed Z, Ahmad R, Rasheed N, Ali R. Enhanced recognition of reactive oxygen species damaged human serum albumin by circulating systemic lupus erythematosus autoantibodies. *Autoimmunity* 2007;40:512-20.
39. Rasheed Z, Alzolibani AA, Al-Shobaili HA, Saif GB, Al Robaee AA. Biochemical and immunological studies on erythrocytes superoxide dismutase modified by nitric oxide in patients with alopecia areata: Implications in alopecia patchy persistent and alopecia universalis. *Immunol Lett* 2014;160:50-7.
40. Alzolibani AA, Rasheed Z, Al Robaee AA. Acquired immunogenicity of DNA after modification with malondialdehyde in patients with alopecia areata. *Scand J Clin Lab Invest* 2014;74:312-21.
41. Rietveld A, Wiseman S. Antioxidant effects of tea: Evidence from human clinical trials. *J Nutr* 2003;133:3285S-3292S.
42. Łuczaj W, Skrzydlewska E. Antioxidative properties of black tea. *Prev Med* 2005;40:910-8.