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File: ■ Green Tea (*Camellia sinensis*)
■ Diabetes Mellitus
■ Metabolic Syndrome

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RE: Green Tea Helps Improve Features of Metabolic Syndrome in Prediabetics

Toolsee NA, Aruoma OI, Gunness TK, et al. Effectiveness of green tea in a randomized human cohort: relevance to diabetes and its complications. *Biomed Res Int*. 2013;2013:412379. doi: 10.1155/2013/412379.

Diabetes mellitus, a chronic metabolic disorder, is characterized by insulin deficiency leading to hyperglycemia. Reactive oxygen species are formed through a number of pathways during hyperglycemia. In addition to the conventional methods used to manage type 2 diabetes (diet modifications, exercise programs, and drugs), green tea (*Camellia sinensis*) polyphenols have been shown to improve features of metabolic syndrome and the subsequent risks for diabetes and its complications. Green tea is among various polyphenol-rich beverages receiving attention for their physiological effects and the role as healthful dietary sources of antioxidants. In this randomized, controlled trial, the phytophenolic profiles of a green tea infusate were determined and its antioxidant potential was evaluated by using multiple assays. The potential modulatory effects of green tea consumption on selected parameters (waist-hip ratio, glucose level, arterial pressure, antioxidant status, alanine aminotransferase [ALT], and lipid profiles) were assessed in individuals prone to develop type 2 diabetes.

The trial was conducted from November 2010 to March 2011 at the Cardiac Centre of the Sir Seewoosagur Ramgoolam National Hospital in Pamplemousses in the Republic of Mauritius. Selected for the trial were 300 prediabetic Mauritians who had participated in a 2009 nationwide survey organized by the Non-Communicable Diseases Unit of the Ministry of Health and Quality of Life in the Republic of Mauritius. Inclusion criteria were a risk for developing diabetes (fasting plasma glucose, 110-126 mg/dL) and an age range from 35 to 65 years. Green tea bags (Bois Chéri, Republic of Mauritius) were used; each tea bag contained approximately 2 g green tea.

The 65 subjects in the green tea group consumed 1 cup of green tea infusion (1 green tea bag infused for 6 minutes in 200 mL hot water) 3 times daily before meals for 14 weeks, followed by a 2-week washout period. The control group subjects (n=58) consumed an equivalent volume of warm water for 16 weeks. Subjects were phoned twice weekly as a reminder to keep a dietary record. No subject withdrew from the trial because of adverse effects associated with the intervention.

Results are presented for male and female subjects in both the green tea and control groups. Anthropometric and blood pressure data were recorded for each subject. Fasting blood draws determined total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides, urea, albumin, creatinine, ferritin, total antioxidant status, aspartate aminotransferase, and ALT.

Prominent phytophenolics in the green tea infusion included, in decreasing order, procyanidin B2, epigallocatechin gallate, epigallocatechin, epicatechin gallate, epicatechin, catechin, and gallic acid. Regarding the green tea's antioxidant profile, the ranking order indicated that 50% antioxidant activity (AA_{50}) for the extract in each of 7 antioxidant assays was established as follows: $ABTS^{\cdot+}$ scavenging activity; ferric reducing activity; nitric oxide scavenging activity; Fe^{2+} chelating activity; HOCl scavenging activity; superoxide scavenging activity; DPPH radical scavenging activity.

During the trial, the waist-hip ratio increased significantly ($P<0.01$) in the female control group; the female green tea group did not experience any change in that variable. ALT values, used to measure liver health, decreased significantly by 13% ($P<0.1$) in the female green tea group at week 14; no significant change in ALT was seen in the female control group throughout the trial.

Mean arterial pressure decreased insignificantly at week 14 in the green tea group; whereas, mean arterial pressure in the male and female control groups decreased by 3.0% ($P<0.1$) and 2.6% ($P<0.1$), respectively. This indicates that green tea consumption "may promote a good blood flow all around the body and as a consequence prevents ischemic reperfusion injury of end organs," write the authors.

Male subjects in the green tea group showed an insignificant reduction of 3.0% in ferritin concentration after week 14; the male control group saw a considerable rise (39.2%; $P<0.1$). The male green tea group experienced a significant 7.1% decrease in estimated glomerular filtration rate (eGFR) after week 14 ($P<0.1$), which is used to diagnose and monitor kidney function. That value increased by 4.8% increase ($P<0.1$) after the 2-week washout period. The earlier decrease in eGFR was at a value greater than the cutoff point associated with kidney damage, the authors point out.

Green tea did not affect fasting plasma glucose or glycated hemoglobin (Hb1Ac) levels. Regarding impaired fasting glucose, green tea did prevent a significant increase compared with the control group. "These findings show the potential role of green tea as a glycemic regulator," write the authors. The time taken for the human sera to delay hemolysis by 50%, which represents the antioxidant potential of sera at the cellular level, increased significantly after 14 weeks in the green tea groups: by 2.7% ($P<0.1$) in males and 5.1% ($P<0.1$) in females. The male and female control groups experienced a decrease. This suggests that the oxidative stress condition that can be encountered in diabetes could benefit from green tea consumption, say the authors.

The authors conclude that a "green tea regimen could form part of a healthy lifestyle that might ameliorate features of metabolic syndrome and subsequent risks for diabetes and its complications." The mechanisms responsible for those beneficial effects should be further explored at the molecular level.

—Shari Henson

Referenced article can be found at www.hindawi.com/journals/bmri/2013/412379.