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File: ▪ Tea (*Camellia sinensis*)
▪ Impaired Glucose Regulation
▪ Type 2 Diabetes Mellitus

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RE: Green Tea and Rock Tea Consumption Protects against Development of Type 2 Diabetes Mellitus

Huang H, Guo Q, Qiu C, et al. Associations of green tea and rock tea consumption with risk of impaired fasting glucose and impaired glucose tolerance in Chinese men and women. *PLoS One.* 2013;8(11):e79214. doi:10.1371/journal.pone.0079214.

Tea (*Camellia sinensis*) can be classified into the following 3 types by level of oxidation: green tea, which is not oxidized; oolong tea, which is partially oxidized; and black tea, which is fully oxidized.[1] Rock tea, a type of oolong tea, is produced in the Mount Wuyi region of Fujian, China. Although numerous studies have examined tea for its potential to influence insulin activity, plasma glucose concentration, and the incidence of diabetes mellitus, its effect on the development of diabetes remains unexplored. These authors investigated the association of tea consumption (green and rock tea) with risk of impaired glucose regulation, using data from a cross-sectional study of Chinese Han people in Fujian Province, China.

The cross-sectional study was conducted during 2011-2012, using a multistage, stratified, cluster random-sampling method to select a representative sample. A total of 4,808 subjects were enrolled. The subjects completed a questionnaire about age, gender, family history of diabetes, and medical histories of illnesses such as cardiovascular disease, hypertension, diabetes, cancer, and pancreatic, liver, kidney, and gastrointestinal diseases that could affect diet and tea absorption. Dietary and lifestyle factors, including smoking, alcohol consumption, and physical activity, were also recorded. In particular, subjects were asked about tea consumption, including the type of tea and how much they drank. The 4 categories of tea consumption were <1 cup weekly, 1-15 cups weekly, 16-30 cups weekly, and >30 cups weekly. The subjects' weight, height, and waist and hip circumferences were measured, and body mass index (BMI) and waist-to-hip ratio were calculated.

After fasting blood draws were performed, all subjects were administered a 75 g oral glucose tolerance test (OGTT). After 30 and 120 minutes, blood was drawn again to measure levels of blood glucose, total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C). Fasting

plasma glucose (FPG), 2-hour post-load plasma glucose (2hPG), and impaired glucose tolerance (IGT) were defined using diagnostic criteria of the American Diabetes Association.

The authors report that of the 4,808 subjects, 1,242 (25.83%) had impaired fasting glucose (IFG) and 648 (13.48%) had IGT at baseline. The subjects who drank green tea were older than those who did not, while subjects who drank rock tea were younger than those who did not. Subjects who drank both teas were more likely to be men, with the percentage of men increasing with higher tea consumption. Subjects who drank rock tea more likely had a family history of diabetes, were more likely to drink milk and soy (*Glycine max*) milk, and less often participated in physical activity.

The authors used univariate analyses of general linear models to compare differences in FPG and 2hPG according to the consumption of each tea in subjects with normal glucose tolerance. Those analyses showed that subjects who consumed green tea weekly had lower FPG levels, while subjects who consumed rock tea weekly had lower 2hPG levels. For those who consumed 16-30 cups of green or rock tea weekly, the reductions in FPG and 2hPG were more pronounced compared with the other subjects.

Further analyses revealed that the subjects who drank green tea had a reduced risk for IFG compared with subjects who never drank tea, and the subjects who consumed rock tea had a reduced risk for IGT. The authors report that the subjects drinking 16-30 cups of green or rock tea weekly had the lowest odds ratios for IFG or IGT.

Green tea lowered the risk for IFG, probably as a result of its high catechin content, especially epigallocatechin gallate (EGCG), which has an "insulin mimetic effect," say the authors. Rock tea is semifermented; during fermentation, the majority of catechins are transformed to theaflavins and thearubigins. Theaflavins have been reported to have an antihyperglycemic effect.[2]

"Our study adds to increasing evidence that tea consumption may provide protection against the development of type 2 diabetes," the authors conclude.

—*Shari Henson*

References
[1]Cheng TO. All teas are not created equal: the Chinese green tea and cardiovascular health. *Int J Cardiol*. 2006;108(3):301-308.

[2]Matsui T, Tanaka T, Tamura S, et al. α-Glucosidase inhibitory profile of catechins and theaflavins. *J Agric Food Chem*. 2007;55(1):99-105.

Referenced article can be found at
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0079214.