

## Flavonoids in orange juice suppress oxidative stress from high-fat, high-carb meal

March 30 2010

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Eating foods containing flavonoids -- orange juice, in this case -- along with a high-fat, high-carbohydrate fast-food meal neutralizes the oxidative and inflammatory stress generated by the unhealthy food and helps prevent blood vessel damage, a new study by University at Buffalo endocrinologists shows.

Free radicals, or [reactive oxygen species](#), are known to induce inflammation in blood vessel linings and contribute to the risk of heart attack and stroke. Study researchers say the potent preventative effect of [orange juice](#) likely is linked to its heavy load of the flavonoids naringenin and hesperidin, which are major antioxidants.

"Our data show, for the first time to our knowledge, that drinking orange juice with a meal high in fat and carbohydrates prevented the marked increases in reactive oxygen species and other inflammatory agents," says UB's Husam Ghanim, PhD, first author on the study.

"This did not happen when participants drank water or a sugary drink with the meal," he says. "These issues of inflammation following a meal are important because the resultant [high glucose](#) and high triglycerides are known to be related to the development of cardiovascular events."

Ghanim is a research assistant professor in UB's Division of Endocrinology, Diabetes and Metabolism. The study appears in the March issue of the [American Journal of Clinical Nutrition](#) and appeared online ahead of print.

The study involved three groups of 10 normal-weight healthy men and women between the ages of 20 and 40. After an overnight fast, participants ate a 900-calorie breakfast composed of an egg "muffin" sandwich, a sausage "muffin" sandwich and a serving of hash browns. The meal contained 81 grams of carbohydrates, 51 grams of fat and 32 grams protein.

Along with the breakfast, one group drank 300 calories of "not-from-concentrate" orange juice, a second group drank a 300-calorie glucose drink and the third group drank an equal amount of water. All participants were given 15 minutes to finish their food and drink. Blood samples were collected before the meal and at 1, 3 and 5 hours afterwards. There was no significant difference in inflammatory mediators among the groups before the meal.

Analysis of the samples after the meal showed that oxygen [free radicals](#) increased an average of 62 percent with water, 63 percent with the glucose and 47 percent with orange juice. There also was an increase in blood components known as toll-like receptors, which play an important role in the development of inflammation, atherosclerosis, obesity, insulin resistance, and injury to cardiac cells than can occur after a blocked vessel is reopened.

Orange juice also prevented a significant increase in SOCS-3, an important mediator of insulin resistance, which contributes to development of type 2 diabetes.

"These data emphasize that a high-fat, high-carbohydrate meal is profoundly and rapidly proinflammatory, and that this process occurs at the cellular and molecular level," says Paresh Dandona, MD, UB distinguished professor of medicine, director of the Diabetes-Endocrinology Center of Western New York at Kaleida Health and senior author on the study.

"In addition, specific proinflammatory genes are activated after the intake of glucose and a high-fat, high-carbohydrate meal, and these changes are observed in mononuclear cells that participate in vascular inflammation and insulin resistance," he says.

"These observations extend our previous work showing oxidative and inflammatory stress following such meals by demonstrating a remarkable increase in the mediators of [insulin resistance](#) after a single meal, and the equally remarkable prevention of these changes following the intake of orange juice."

Dandona emphasizes that vascular inflammation is an essential component of atherosclerosis, and that this inflammation may become permanent if a person consumes similar meals regularly.

"The choice of safe foods that are not proinflammatory may provide protection from the unending cycle of postprandial and cumulative inflammation," he says. "This choice may lower the risk of atherosclerosis and resistance to insulin."

Provided by University at Buffalo

Citation: Flavonoids in orange juice suppress oxidative stress from high-fat, high-carb meal (2010, March 30) retrieved 25 April 2024 from <https://medicalxpress.com/news/2010-03-flavonoids-orange-juice-suppress-oxidative.html>

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