



*The Beverage Institute
For Health & Wellness*

Juice with Added Plant Sterols May Have Anti-Inflammatory Benefit

Clinical study finds plant sterols added to orange juice or a reduced-calorie orange juice beverage reduces both LDL cholesterol and CRP -- a marker of inflammation linked to heart disease -- in healthy adults.

Plant sterols – recognized for their cholesterol-lowering power when added to margarines, salad dressings and other fats – have also been found to be effective in reducing low-density lipoprotein, or "bad" LDL cholesterol" levels, when added to orange juice.* Now, a recent study by University of California Davis Medical Center researchers has found that twice-daily servings of either a reduced calorie orange juice beverage fortified with plant sterols or plant sterol-fortified orange juice also reduces levels of C-reactive protein (CRP), a marker of inflammation and an accepted risk marker for heart disease.

The results from the eight-week study, which was supported by grants from the National Institutes of Health and the Beverage Institute For Health & Wellness of The Coca-Cola Company, are published in the October 2006 issue of the American Journal of Clinical Nutrition.

About the Study

Seventy two healthy men and women, ages 19 to 74, with normal to borderline high total cholesterol were asked to drink two eight-ounce servings of reduced-calorie orange juice beverage (50-calories per 8-ounce serving) a day – one with breakfast, the other with dinner -- for eight weeks. Half the group received a reduced-calorie orange juice beverage fortified with 1 gram of plant sterols per 8-ounce serving, the others -- who served as the study controls -- received a reduced-calorie orange juice beverage without added sterols. Fasting blood samples were taken before and after the trial to measure total cholesterol and CRP levels.

* The U.S. Food and Drug Administration has concluded that foods and beverages containing at least 0.4 grams of plant sterols per serving consumed twice a day with meals, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease. The use of plant sterols, in addition to diet and lifestyle modification, has also been recognized by The American Heart Association as a as a therapeutic option for individuals with elevated cholesterol levels.

The Findings: At the end of the study, participants who drank the plant-sterol fortified reduced-calorie orange juice averaged a 9.4 percent reduction in their LDL cholesterol levels and a 12 percent reduction in their CRP levels compared to the beginning of the study -- while levels in the control group had not significantly changed.

Because this was the first time the effect of plant sterols on CRP levels had ever been measured, the researchers decided to also test blood samples preserved from an earlier study, which used regular orange juice fortified with the same level of plant sterols and followed a similar protocol,⁴ for CRP levels – and found similar results. Those who had consumed the sterol-fortified juice in the earlier study had a significant (23 percent) reduction in CRP levels, while levels in the control group were unchanged.⁵

About CRP and Heart Disease

Despite great strides in prevention and treatment, cardiovascular disease remains the leading cause of death throughout the Western world and the second most common cause of death world wide, and nearly half of all cardiovascular disease events occur in people without elevated blood cholesterol or lipid levels.⁶ As a result, the potential role of inflammation in the development of cardiovascular disease has come under intense study in recent years.

Initial reports suggested C-reactive protein levels merely reflected an underlying inflammatory process. However, accumulating evidence now suggests that C-reactive protein could also be a causative factor, and there is growing circumstantial evidence that reducing C-reactive protein levels might benefit some individuals. For example, C-reactive protein is present in atherosclerotic lesions, and some studies suggest it may actively contribute to the progression and/or instability of atherosclerotic plaques. The American Heart Association and Centers for Disease Control and Prevention now recommend that C-reactive protein levels be used to further evaluate cardiovascular disease risk.

Additional Information

Once considered simply the body's healing response to insults like infections, cuts and sprains, inflammation is now recognized as a pivotal player in all phases of cardiovascular disease.⁷ The American Heart Association and Centers for Disease Control and Prevention now recommend that CRP levels be used to further evaluate cardiovascular disease risk in individuals who have a 10 to 20 percent risk of heart disease or stroke within their next 10 years of life as determined by

their Framingham risk score. The Framingham risk score is a global risk assessment tool that weighs risk factors such as age, total and HDL cholesterol levels, smoking, blood pressure and presence of diabetes to assess an individual's 10-year cardiovascular disease risk.⁸

Whether CRP is simply a marker of inflammation or a proatherogenic culprit is still being debated. Initial reports suggested CRP levels merely reflected an underlying inflammatory process. However accumulating evidence now suggests that CRP could also be a causative factor and there is growing circumstantial evidence that reducing CRP levels might benefit some individuals.^{9,10,11,12} For example, CRP is present in atherosclerotic lesions and some studies suggest it may actively contribute to the progression and/or instability of atherosclerotic plaque.¹³

Dietary therapy is the cornerstone of strategies aimed at reducing the risk of cardiovascular disease. Incorporating foods fortified with plant sterols into a low fat diet, along with other lifestyle modifications such as exercise, have been recommended by the National Cholesterol Education Panel (NCEP).¹⁴ In light of the UC Davis findings and the increasing evidence supporting a possible role of CRP in the etiology of atherosclerosis, fortifying foods and beverages with cholesterol-lowering plant sterols could offer consumers concerned with CRP levels an easy-to-comply with strategy for lowering this marker of inflammation.**

About Heart Disease

- According to the Centers for Disease Control (CDC), heart disease is the leading cause of death for women and men in the United States, accounting for 28% of all U.S. deaths in 2003 (51% of them women).
- Heart disease death affects all populations groups, but some have higher rates than others. According to the CDC, rates per 100,000 population for the five largest U.S. racial/ethnic groups are as follows: blacks, 300; whites, 228; Hispanics, 173; American Indian/Alaskan Natives, 160 and Asian and Pacific Islanders, 128.
- In 2006, health care services, medications, and lost productivity due to heart disease are projected to cost \$142.5 billion.
- Studies among coronary heart disease patients have shown that 90% have prior exposure to at least 1 of these heart disease risk factors: high blood cholesterol or taking cholesterol-lowering drugs, high blood pressure or taking blood pressure-lowering drugs, current cigarette use, or clinical report of diabetes.

** Elevated CRP levels are usually found in conjunction with other risk factors for heart disease, including obesity, sedentary lifestyles, smoking, elevated cholesterol, hypertension, diabetes and metabolic syndrome. Factors that improve CRP levels - such as exercise, weight loss and diets rich in plant sterols - also tend to impact other risk factors.

Tips to Manage Heart Disease

Heart disease is a complex problem, but there are things all people can do to lower their risk:

- **Have your cholesterol checked regularly.** Even young adults need to have their cholesterol tested – The National Cholesterol Education Program III (NCEP III) recommends that both males and females 20 years of age and older have their cholesterol tested every five years.
- **Eat a heart-healthy diet.** Choose foods low in saturated fat, trans fat, and cholesterol, increase your intake of fiber-containing foods such as whole grains and fruit and vegetables, eat fish at least twice a week and limit your sodium intake. The NCEP III recognizes that adding plant sterols to the diet can be an option in a cholesterol reduction plan.
- **Watch your weight.** Being overweight increases your risk of heart disease. It is important to balance the number of calories you eat each day with the amount of calories you burn to maintain a normal body weight.
- **Move more.** Exercise has been shown to help prevent heart disease and improve cholesterol levels.
- **Don't smoke.** The risk of developing coronary heart disease is 2–4 times higher for smokers than for nonsmokers. Cigarette smoking is a powerful independent risk factor for sudden cardiac death in patients with coronary heart disease; smokers have about twice the risk of nonsmokers. People who smoke cigars or pipes and those who are exposed to other people's smoke also have a higher risk of coronary heart disease.

Resources

The American Heart Association

Inflammation, Heart Disease and Stroke: The Role of C-Reactive Protein

<http://www.americanheart.org/presenter.jhtml?identifier=4648>

National Heart, Lung and Blood Institute-National Cholesterol Education Program

Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack

<http://hp2010.nhlbihin.net/atp/iii/calculator.asp>

US Food and Drug Administration

The American Dietetic Association

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Abstract

Devaraj S, Autret BC, Jialal I. **Reduced-calorie orange juice beverage with plant sterols lowers C-reactive protein concentrations and improves the lipid profile in human volunteers.** Am J Clin Nutr. 2006 Oct;84(4):756-61.

BACKGROUND: Dietary plant sterols effectively reduce LDL cholesterol when incorporated into fat matrices. We showed previously that supplementation with orange juice containing plant sterols (2 g/d) significantly reduced LDL cholesterol. Inflammation is pivotal in atherosclerosis. High-sensitivity C-reactive protein (hs-CRP), the prototypic marker of inflammation, is a cardiovascular disease risk marker; however, there is a paucity of data on the effect of plant sterols on CRP concentrations.

OBJECTIVE: The aim of this study was to examine whether plant sterols affect CRP concentrations and the lipoprotein profile when incorporated into a reduced-calorie (50 calories/240 mL) orange juice beverage.

DESIGN: Seventy-two healthy subjects were randomly assigned to receive a reduced-calorie orange juice beverage either without (Placebo Bev) or with (1 g/240 mL; Sterol Bev) plant sterols twice a day with meals for 8 wk. Fasting blood was obtained at baseline and after 8 wk of Placebo Bev or Sterol Bev supplementation.

RESULTS: Sterol Bev supplementation significantly reduced total cholesterol (5%; $P < 0.01$) and LDL cholesterol (9.4%; $P < 0.001$) compared with both baseline and Placebo Bev ($P < 0.05$). HDL cholesterol increased significantly with Sterol Bev ($P < 0.02$). No significant changes in triacylglycerol, glucose, or liver function tests were observed with Sterol Bev. Sterol Bev supplementation resulted in no significant change in vitamin E and carotenoid concentrations. Sterol Bev supplementation resulted in a significant reduction of CRP concentrations compared with baseline and Placebo Bev (median reduction: 12%; $P < 0.005$).

CONCLUSION: Supplementation with a reduced-calorie orange juice beverage containing plant sterols is effective in reducing CRP and LDL cholesterol and could be incorporated into the dietary portion of therapeutic lifestyle changes.