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Heart Headlines

A professional resource on nutrition and heart health
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The Power of Plant Sterols

THE FOCUS

PLANT STEROLS FOR HEART HEALTH

This issue reviews the science behind the functional food component, plant sterols—addressing what they are, where they can be found, how they work and the important role they play in cholesterol management.

The cholesterol-lowering effects of plant sterols were revealed back when the Chevrolet Coupe Delux and the Everly Brothers were topping the charts. Unlike the aforementioned trends, the research and scientific evidence on the efficacy of plant sterols has continued to grow. As a result, plant sterols are recognized as a safe and effective dietary means to help manage cholesterol. Plant sterol-containing foods should be eaten twice a day with meals. Based on supporting evidence, the National Cholesterol Education Program's (NCEP) guidelines include plant sterols daily for effective cholesterol lowering in adults with elevated cholesterol levels.*[1] See Table 1 for the essential components of NCEP's Therapeutic Lifestyle Changes (TLC) from the ATP III final report and Table 2 for calorie equivalents of saturated fat recommendations from recent research from the Dietary Guidelines for Americans 2005 report.

Table 1

Essential Components of Therapeutic Lifestyle Changes (TLC) from the National Cholesterol Education Program Adult Treatment Panel III Report

Component	Recommendation
LDL-raising nutrients*	
Saturated fat	Less than 7% of total calories
Dietary cholesterol	Less than 200 mg/day
Therapeutic option for LDL-lowering	
Plant sterols/stanols	2 g/day
Increase viscous (soluble) fiber†	10-25 g/day
Total calories (energy)	Adjust total calorie intake to achieve and maintain desirable body weight/prevent weight gain.
Physical Activity	Include enough moderate exercise to expend at least 200 kcal per day.

*Trans fatty acids are another LDL-raising fat that should be kept at a low intake.
†Includes both soluble and insoluble fiber according to the Institutes of Medicine for prevention of CHD.

National Cholesterol Education Program Adult Treatment Panel III Final Report, Table V.2-1, page V-4, http://www.nhlbi.nih.gov/guidelines/cholesterol/atp3full.pdf.

Plant Sterols Defined

Plant sterols, sometimes called phytosterols, are naturally occurring in a variety of foods. Small quantities can be found in vegetable oils, nuts, grain products, fruits and vegetables. From these food sources, the average intake in Western countries is approximately 150-350 mg/day of plant sterols.[2] Similar in molecular structure to cholesterol but unique in their side chain, the most common include beta-sitosterol, campesterol, and stigmasterol. In plants, sterols are involved in cell membrane permeability,

Table 2

Grams of Saturated fat based on Calorie Intake

Total calorie intake	7% limit on saturated fat intake
1,600	12 g or less
2,000‡	16 g or less
2,200	17 g or less
2,500‡	19 g or less
2,800	22 g or less

‡Percent Daily Values on the Nutrition Facts Panel of food labels are based on a 2,000-calorie diet. Values for 2,000 and 2,500 calories are rounded to the nearest 5 grams to be consistent with the Nutrition Facts Panel.

Adapted from the 2005 Dietary Guidelines Advisory Committee Report http://www.health.gov/dietaryguidelines/dga2005/report/.

**Data is based on studies conducted mainly in spreads consumed at least twice a day with meals. Individual experience tends to vary widely.*

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Heart Headlines™ is published regularly and sent to health care professionals by the **Promise Institute for Heart Health Nutrition**. Promise established the Promise Institute for Heart Health Nutrition to provide heart health educators and the public with the latest scientific information and useful educational tools about nutrition and heart disease.

Promise Institute for HEART HEALTH NUTRITION

KEY POINTS

1. The NCEP guidelines for adults with elevated cholesterol include plant sterols daily for effective lowering of LDL-cholesterol.*
2. Plant sterols should be eaten with a meal.

**Data is based on studies conducted mainly in spreads consumed at least twice a day with meals. Individual experience tends to vary widely.*

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structure and function, similar to that of cholesterol in humans. The absorption of plant sterols in the body is very low compared to cholesterol and unlike cholesterol, sterols are not metabolized to bile acids.[3,4] Like cholesterol, however, recent data suggests that sterols are transported at the enterocyte by the same intestinal protein.[5]

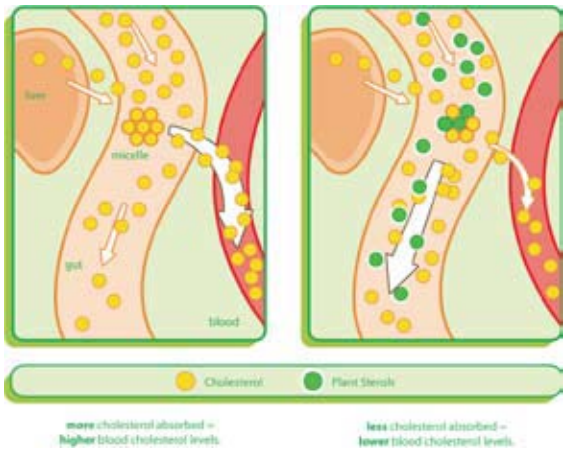
How do they do that?

Plant sterols help lower blood LDL-cholesterol levels by modifying cholesterol absorption. During absorption, cholesterol mixes with bile salts, lecithin and triglycerides in the gut to form tiny water-soluble packets called dietary mixed micelles.[6] Micelles deliver cholesterol into the body when they make contact with the intestinal cell wall. A transport protein (Niemann-Pick C1-Like protein 1 or NPC1L1) in the brush border of the intestine has recently been shown to aid in the uptake of micelles into the intestinal mucosal cell.[7]

Although the details are not fully understood, plant sterols' beneficial effect on cholesterol levels appears to be at the point of absorption.[8] After ingestion, the plant sterols reach the enterocytes of the intestinal wall and potential actions include:

- Due to the fact that plant sterols have a similar structure to cholesterol, they displace cholesterol from the micelles. In this way, less cholesterol is presented to the lining of the intestinal wall in a form that can be absorbed.[9]
- Plant sterols may interfere with chylomicron formation in the enterocyte, thereby decreasing the amount of cholesterol in the blood.
- Plant sterols may block cholesterol absorption into the enterocyte and compete with cholesterol for access to cholesterol transporters at the gut wall.[5]

As a result of consuming plant sterols the absorption of cholesterol is reduced by 30-40%.[3-4] The cholesterol that is not incorporated into the micelles in the gut is excreted (along with the plant sterols). In this way, cholesterol is removed from the body. Initially, cholesterol synthesis may be slightly increased as the body tries to compensate for the dramatic reduction in cholesterol absorption. However, after 2-3 weeks of 2-3 grams of plant sterols per day, when formulated into higher fat foods the net result can be a significant reduction in LDL-cholesterol levels.* HDL-cholesterol and triglyceride levels remain unaffected.



P.S. Plant Sterols help Lower LDL-Cholesterol!

More than 140 studies have shown that plant sterols and stanols significantly lower LDL-cholesterol. See Table 3 for the approximate and cumulative LDL cholesterol reduction achievable by dietary modifications.

Table 3

The National Cholesterol Education Program Adult Treatment Panel III for People with Elevated LDL Cholesterol

Approximate and Cumulative LDL Cholesterol Reduction Achievable by Dietary Modifications

Dietary Component	Dietary Change	Approximate LDL Reduction
Major		
Saturated fat	<7% of calories	8-10%
Dietary Cholesterol	<200 mg/day	3-5%
Weight Reduction	Lose 10 lbs	5-8%

What are the National Cholesterol Education Program and the Dietary Guidelines for Americans?

Launched by the National Institutes for Health in 1985, NCEP strives to reduce illness and death from coronary heart disease by lowering the percentage of Americans with high blood cholesterol. NCEP provides health professional and consumer cholesterol education to raise the awareness and understanding of the risk of high cholesterol and benefits of lowering blood cholesterol levels (http://www.nhlbi.nih.gov/about/ncep).

The Dietary Guidelines for Americans is based on current research and compiled by the Departments of Health and Human Services and the Department of Agriculture to help guide consumers in best food choices. The National Nutrition Monitoring and Related Research Act of 1990 require the Secretaries of HHS and USDA to publish the *Dietary Guidelines for Americans* at least every five years (http://www.health.gov/dietaryguidelines/dga2005/report/default.htm).

The Proof of the Pudding is in the Eating: Plant Sterols in the Diet

The benefits from plant sterols can only be gained by eating them! The intake of plant sterols determines the effect on LDL-cholesterol levels.*[10] Intakes higher than 3 grams are not recommended as this does not provide further benefit for managing LDL-cholesterol levels.[10] Research has shown that in as few as three weeks of regular consumption, LDL-cholesterol levels can decrease.[11-13] Table 4 provides a list of plant sterol-containing foods.

In achieving the NCEP recommendations for plant sterol intake, a question arises as to whether it should be consumed in one sitting or throughout the day, and with or without a meal. Evidence for the cholesterol lowering effect of plant sterol-containing foods is largely founded on studies investigating daily servings across multiple intake occasions. For maximal cholesterol lowering it is recommended that plant sterols should be consumed with a meal.

Recognized by NCEP ATP III as an important way to maximize the dietary management of cholesterol, plant sterols can be an easy, convenient and beneficial part of a healthy diet!

Table 4

Dietary Source of plant sterols

Dietary Source	Serving Size	Calories	Fat	Plant Sterols‡
Almonds	1 oz	164	14 g	0.03 g
Avocados	1 small	227	20 g	0.13 g
Corn Oil	1 Tbsp	120	13 g	0.13 g
Olive Oil	1 Tbsp	119	13.5 g	0.03 g
Orange Juice with plant sterols	8 oz	110	0 g	1.0 g†
Oat Bars with plant sterols	1 bar	160	4 g	0.4 g
Soybeans	1 cup	254	11.5 g	0.09 g
Sunflower Seeds	¼ cup	186	16 g	0.19 g
Promise activ® Buttery Spread* *(formerly known as Take Control®)*	1 Tbsp	70	8 g	1.0 g‡
Promise activ® Light Spread* *(formerly known as Take Control®)*	1 Tbsp	45	5 g	1.0 g‡
Promise activ® SuperShots®*	3 oz bottle	70	3.5 g	2.0 g‡

USDA Nutrient Database unless otherwise specified.
*www.promisehealthyheart.com
‡ In some foods plant sterols are combined with a fatty acid from a vegetable oil to form a plant sterol ester (this improves the solubility of the plant sterols in foods low in saturated fat). About 65% of the plant sterol ester is plant sterol.
† www.minutemaid.com

**Data is based on studies conducted mainly in spreads consumed at least twice a day with meals. Individual experience tends to vary widely.*

Tomato, Tomato; Sterol, Stanol

With plant sterols and stanols, it is not merely a case of syllabic emphasis; rather it reflects a true difference and an important similarity. Stanols are the saturated form of plant sterols and lack the 5 double bond in their B-rings.[2] Although they differ in solubility and absorption (stanols being less absorbed than sterols), research has shown that both sterols and stanols help to reduce LDL-cholesterol.[2,18] Plant sterols and stanols are often combined with an unsaturated fat from a vegetable oil to increase their solubility in foods, they are then called plant sterol/stanol esters.[2]

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Glossary of Terms

Chylomicron: triglyceride-rich lipoproteins formed in the intestine in response to dietary fat. Their function is to transport fat from its port of entry in the intestine to the liver and to adipose tissue.

Enterocyte: an intestinal epithelial cell.

Ezetimibe: medication used to reduce the amount of total cholesterol, LDL-cholesterol, and apolipoprotein B in the blood. Ezetimibe is used with a low cholesterol diet and, in some cases, other cholesterol lowering medications.

Fibrates: a group of compounds structurally related to clofibrate that can reduce triglyceride and cholesterol levels; used to treat hypertriglyceridemia and hypercholesterolemia.

Looking for Heart Healthy, Tasty Recipes?

The Promise Institute for Heart Health Nutrition offers easy to prepare, heart healthy recipes for you and your patients.

Each recipe has:

- No more than 35% calories from fat per recipe serving. Of that, no more than 10% of calories are from saturated fat, and no trans fats.
- No more than 100 mg of cholesterol, per recipe serving.
- No more than 500 mg of sodium per recipe serving.

To access these dining delights, visit www.promiseinstitute.org, login and enjoy!

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