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# HerbClip™



**FILE: ▪Plant Sterols**
**▪Plant Stanols**
**▪Cholesterol**

**HC 050664-316**

**Date: November 15, 2006**

**RE: Recent Advances in Cholesterol-lowering Effects of Plant Sterols**

Abumweis SS, Nicolle C, Jones PJH. Cholesterol-lowering action of plant sterol-enriched products. *Food Science Tech Bull: Functional Foods.* Jan. 16, 2006; 2(9):101-110.

Plant sterols, a.k.a. phytosterols, are naturally-occurring steroid alcohols found in nuts, seeds, vegetable oils, fruits, and vegetables. Plant stanols are derivatives of plant sterols. Plant sterols and stanols are known to block the absorption of cholesterol in the gut. Clinical trials have shown that plant sterols and stanols can reduce total cholesterol by an average of 10% and low-density lipoprotein cholesterol (LDL) by 13%.[1] This article reviews "recent advances in the knowledge of the cholesterol-lowering action of plant sterols," and discusses the efficacy of plant sterols and stanols in different population groups, new plant sterol and stanol food products, and dosing regimens.

Plant sterols have cholesterol-like chemical structures and can be converted into plant stanols through a simple reaction. When esterified, plant sterols can be incorporated into food products, including butter-like spreads. Across different populations, the average daily dietary intake of plant sterols ranges from 167-437 mg. Plant sterols are effective in lowering cholesterol as part of a low-cholesterol diet (200-300 mg cholesterol/day). However, it is still unclear whether plant sterols lower cholesterol when incorporated into medium-high cholesterol diets. Most clinical studies have shown that taking plant sterols in two divided daily doses at meals is an effective dosing regimen. However, it has been shown that a single dose of plant sterols or stanols at lunch is also effective. It has been hypothesized that plant stanols may stay in the gut lumen longer than plant sterols, making them more effective at a single dose. It remains to be determined whether a single dose of plant sterols/stanols at dinner or breakfast is effective in reducing cholesterol levels. Plant sterols and stanols block cholesterol absorption in the gut by 25-56%. The exact mechanism of action by which plant sterols and stanols block cholesterol absorption is not clear. One mechanism of action proposes that plant sterols may prevent the incorporation of free cholesterol into micelles (formed when a variety of molecules including soaps and detergents are added to water). Another proposes that plant sterols prevent the esterifaction of free cholesterol into

cholesterol esters. Another proposed mechanism of action theorizes that plant sterols affect "the genetic mRNA expression of transporters involved in sterol homeostasis."

The United Sates Food and Drug Administration (FDA) and the Scientific Committee on Foods of the European Union classify plant sterols and stanols as safe for human consumption. The data indicates that plant sterols and stanols are safe, but there is still concern over possible adverse effects. It is possible that plant sterols and stanols have a negative effect on the absorption of fat-soluble vitamins, including carotenoids and tocopherols. However, evidence suggests that this effect can be compensated for by increasing dietary intake of fruits and vegetables. Plant sterol intake also increases the levels of sterols in the bloodstream, leading to concerns about the possibility of increased red blood cell fragility and increased cell membrane composition of fatty acids. These possible adverse effects have not been well-studied. Plant sterol and stanol butter-like spreads seem to reduce LDL cholesterol in older adults to a greater extent than in young adults. However, older adults generally have higher LDL cholesterol levels. The overall percentage of LDL cholesterol reduction is constant across different age ranges, indicating an equivalent effect. Other clinical trials indicate that plant sterol and stanol spreads reduce blood cholesterol levels in diverse populations, regardless of the patient's genetic make-up or starting cholesterol levels. However, the authors caution against the use of plant sterol and stanol spreads in children with high cholesterol, due to lack of safety data. Evidence suggests that incorporating plant sterols and stanols into a low-fat low-cholesterol diet is more effective than diet alone in reducing cholesterol levels. In fact, incorporating plant sterols and stanols may double the reduction in LDL cholesterol levels. The addition of plant sterol and stanol spreads to the diet is a cost-effective alternative to doubling the dose of cholesterol-lowering statin drugs. Incorporating plant sterol and stanol spreads into the diet "should be part of a healthy diet and not a substitute for it."

Commercially available plant sterol and stanol spreads include Logicol® (Meadow Lea, Australia), Smart Balance® spread (Peerless, Australia and GFA Brands, United States), Take Control and Proactive (Unilever, United States), and Benecol® (McNeill Nutritionals, United States). Daily consumption of 20-25 g of plant sterol spreads is generally needed to achieve the suggested daily dose of 1.6-2.0 g of free plant sterols and stanols. Patients may experience weight gain if the plant sterol/stanol spreads are not consumed in place of their regular spreads, due to their caloric content. In addition, the stability of plant sterols and stanols in high temperatures is not known, so plant sterol and stanol spreads should not be used for frying. Plant sterols and stanols are now being incorporated into low-fat foods, including low-fat spreads, yogurt, milk, and orange juice. Clinical trials show that these low-fat preparations may reduce LDL cholesterol as much as the regular full-fat plant sterol and stanol spreads. However, reduced-fat and non-fat foods do not always reduce LDL cholesterol as much as regular plant sterol and stanol spreads. In addition, plant sterols and stanols are not as effective when administered in capsules. Evidence suggests that the efficacy of plant sterols and stanols incorporated into reduced-fat and non-fat products is dependent on proper solubilization. The efficacy of plant sterol and stanols incorporated into yogurt drinks varies, and seems to be affected by dose (>2 g/day is needed), time of day, frequency of administration, and whether the product is taken with or without a meal. It is possible that plant sterols and stanols incorporated into liquids may be eliminated faster,

giving them less time to mix with gastrointestinal contents. The efficacy of plant stanol esters may be dependent on the food they are incorporated into. For example, plant stanols incorporated into low-fat milk are much more effective than plant stanols in bread and cereal products. Future study is needed to determine if plant sterols and stanols incorporated into other food matrices, such as low-fat and non-fat spreads, breads, cereals, yogurts, and milk are as effective as the regular-fat plant sterol and stanol spreads.

The cholesterol-lowering effect of plant sterol and stanol regular fat spreads is well established. These spreads are an effective addition to low-fat low-cholesterol diets, physical exercise, and statin drugs aimed at lowering cholesterol levels. Future studies are needed to determine the effect of incorporating plant sterols and stanols into medium to high cholesterol diets. In addition, future studies on the effect of a single dose of plant sterols at breakfast or dinner, the exact mechanism of action, possible adverse effects, and effects of different food matrices on solubilization and efficacy of plant sterols and stanols are warranted.

*—Marissa Oppel, MS*

**References**

1.Webb D. Plant Sterols and Stanols Reduce Cholesterol. *Herbclip*. May 15, 2000. (No. 011101-176). Austin, TX: American Botanical Council. Review of Effects of dietary phytosterols on cholesterol metabolism and atherosclerosis: Clinical and experimental evidence by Moghadasian MH., Frohlich JJ. *Am J Med.* 2000; 107:588-594.

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