

PLANT STEROLS LOWER CHOLESTEROL, BUT INCREASE RISK FOR CORONARY HEART DISEASE

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It is widely accepted that cholesterol lowering is healthful *per se*. We challenge this view, with particular reference to plant sterols. Cholesterol lowering should not be an end in itself. The objective must be to reduce health outcomes, such as incidence of Coronary Heart Disease (CHD). We hypothesised that plant sterols may lower cholesterol, but not CHD. We found the outcome on CHD in fact to be detrimental.

Cholesterol lowering has become a national obsession for the developed world, from America to New Zealand. Statins are the preferred and most lucrative mechanism (Johnson and odds, 2011) for reducing serum cholesterol levels. Plant sterols offer another option. They were first added to margarine and launched in Europe in 1997 (Patch *et al.*, 2006). The European market for substances with added plant sterols remains the most mature, with revenues of \$400 million having been reached (Frost and Sullivan, 2006). Plant sterols is the collective term for free and esterified phytosterols and phytostanols, regardless of biological source. Phytosterols are cholesterol-like molecules found in all plant foods, with the highest concentrations occurring in vegetable oils. They are absorbed only in trace amounts, but inhibit the absorption of intestinal cholesterol (Ostlund, Jr., 2002). The most commonly occurring phytosterols in the human diet are β -sitosterol, campesterol and stigmasterol, which account for approximately 65%, 30% and 3% of diet contents respectively (Weihrauch and Gardner, 1978). The ability of phytosterols to inhibit the absorption of cholesterol was first established in 1953 (Pollak, 1953).

Phytosterols effectively compete with the cholesterol made by the human body and replace it to an extent, thus

lowering serum cholesterol levels. It is pertinent to question whether the replacement of human cholesterol with plant cholesterol is a positive health intervention.

The European Food Safety Authority responded to a request from Unilever PLC to be able to make cholesterol lowering claims on their plant sterol enriched products (Bresson, 2008). The review body concluded that "Plant sterols have been shown to lower/reduce blood cholesterol". They also stated "However, there are no human intervention studies demonstrating that plant sterols reduce the risk of coronary heart disease."

Rajaratnam *et al.* (2000) studied the association of phytosterols and Coronary Artery Disease (CAD) in postmenopausal women. They concluded that "women with elevated ratios of serum squalene, campesterol and sitosterol to cholesterol and low respective lathosterol values have enhanced risk for CAD. Thus, enhanced absorption and reduced synthesis of cholesterol may be related to coronary atherosclerosis."

Plant sterols were reviewed as a potential risk factor for CHD by Sudhop *et al.* (2002). They concluded: "These findings support the hypothesis that plant sterols might be an additional risk factor for CHD."

Assmann *et al.* (2006) article reported that: "Elevations in sitosterol concentrations and the sitosterol/cholesterol ratio appear to be associated with an increased occurrence of major coronary events in men at high global risk of coronary heart disease."

Most recently, Silbernagel *et al.* (2010) studied 1,257 individuals in the Ludwigshafen Risk and Cardiovascular health (LURIC) study. They found that high absorption of phytosterols and concomitant low synthesis of cholesterol predicted increased all-cause and cardiovascular mortality in LURIC participants.

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The best evidence to support plant sterols for heart disease is that they are: possibly protective; neutral; or don't appear to be adversely related. In a Dutch cohort of subjects older than 65 years, Fassbender *et al.* (2008) found that "plant sterols could have neutral or even protective effects on development of coronary heart disease, which have to be confirmed in interventional trials." The EPIC Norfolk cohort found that "higher levels of plant sterols, do not appear to be adversely related to CAD [coronary artery disease]" among 373 cases and 758 controls (Pinedo *et al.*, 2007).

The majority of evidence for CHD is not favourable. The evidence for cancer is also of concern. There is one review of epidemiological evidence for phytochemicals and cancer risk. Phytosterols are one of the five main categories of phytochemicals included in the review; carotenoids, isothiocyanates, chlorophyll and phytoestrogens being the other four (Miller and Snyder, 2012). This review reported that there is only one study focused on phytosterols and cancer risk (Normen *et al.*, 2001). This Netherlands cohort study involved 120,852 people over an average 6.3 year follow up. It concluded that there was no association between phytosterol intake and colon cancer risk in men. There were positive associations between risk of rectal cancer and campesterol and stigmasterol intakes in men. For women, there was no clear association between intake of any of the plant sterols and colorectal cancer risk.

Despite the evidence cited, it was a Dutch study of 30 people (Kelly *et al.*, 2011) that elicited an amendment in the EU regulation for plant sterols (CR, 2013). Kelly *et al.* (2011) found a significant correlation between the campesterol concentration in the blood plasma and the thickness of veins in the retina after 85 weeks in people taking statin medication, while ingesting plant sterols. The German Federal Institute for Risk Assessment noted that an increase in the diameter of the retinal vessels is being discussed as an early risk marker for cardiovascular disease (BfR, 2011). Accordingly the EU mandated that, from February 2014, products with added plant sterols must state that the product is not intended for people who do not need to control their blood cholesterol level (CR, 2013).

We argue that this caution should be extended to all people and all products containing plant sterols. The majority of studies raising concerns involved participants who were deemed 'at risk' and thus targets for cholesterol lowering measures (Sudhop *et al.*, 2002; Assmann *et al.*, 2006; Silbernagel *et al.*, 2010).

Plant sterols do lower cholesterol levels; replacing human cholesterol levels may be a better description of methodology. However there is no evidence that plant sterols reduce the risk of CHD and much evidence that they are detrimental.

It is time for us to remember that we are in the business of improving health outcomes and not surrogate endpoints. In losing sight of real targets, we can do more harm than good.

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