CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION
2017, VOL. 57, NO. 9, 1906–1921
http://dx.doi.org/10.1080/10408398.2015.1033611

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Influence of phytosterol and phytostanol food supplementation on plasma liposoluble vitamins and provitamin A carotenoid levels in humans: An updated review of the evidence

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ABSTRACT

Phytosterols and phytostanols (PAP) compete with cholesterol absorption in the intestine, resulting in a 5–15%-reduction in plasma total and LDL cholesterol. An important issue is the PAP potential to reduce the plasma concentrations of fat-soluble vitamins and provitamin A carotenoids. Here, an update of the scientific evidence is reviewed to evaluate plant PAP-enriched foods impact on plasma fat-soluble vitamins and carotenoid levels, and to discuss potential implications in terms of cardiovascular risk. Based on 49 human interventional and 3 bioavailability studies, results showed that regular consumption, particularly over the long term, of foods fortified with PAP as recommended in labeling does not significantly impact plasma vitamins A, D, and K concentration. A 10% significant median reduction was observed for α-tocopherol. Concerning carotenoids, while 13 studies did not demonstrate statistically significant plasma β-carotene reduction, 20 studies showed significant reductions, with median effect size of −24%. This decline can be mitigated or offset by increased fruits and vegetables consumption. Furthermore, higher cardiovascular risk was observed for differences in plasma β-carotene concentration of the same magnitude as the estimated average decrease by PAP consumption. These results are supported by the only study of β-carotene bioavailability showing decrease in absorption by phytosterols daily intake.

Abbreviations: PAP: Phytosterols and phytostanols

KEYWORDS

Phytosterol and phytostanol-enriched foods; liposoluble vitamins; provitamin A carotenoids; intervention studies; cardiovascular disease risk

Introduction

Phytosterols and phytostanols (PAP) are natural compounds found in plant products, notably in grains, plant oils (e.g., pine tree oil for industry), and some fruits and vegetables. They have a similar structure to cholesterol but differ in their side chain at C24 and/or the position and configuration of the double bonds. Phytostanols are produced by hydrogenating phytosterols. These compounds compete with cholesterol absorption in the intestine, resulting in LDL cholesterol reduction that ranges from 5 to 15% (EFSA Panel on Dietetic Products, 2012; Ras et al., 2013), a high level of LDL cholesterol being a well-known cardiovascular risk factor (Kritchevsky and Chen, 2005). Phytosterols and phytostanols have been incorporated into various food vectors, mainly in margarines, accompanied by health claims.

The most recent review of the literature agrees on the average dose–response effect of PAP on LDL cholesterol (Musa-Veloso et al., 2011). The meta-analysis by Ras et al. reported that intake of 0.3–3.2 g of plant sterols reduces LDL-cholesterol by 8.5% (Ras et al., 2013). The ANSES (French Agency for Food, Environmental and Occupational Health & Safety) concluded that intakes of 1.5–2.4 g/day PAP reduce total and LDL-cholesterol by approximately 10% over both short and medium durations (one to two years) (ANSES, 2014). At similar daily levels of intake, PAP exhibit similar effects (ANSES, 2014).

An important issue regarding the effectiveness and nutritional value of PAP is their potential to reduce plasma concentrations of fat-soluble vitamins, including tocopherols (vitamin E) and carotenoids, some being precursors of vitamin A (e.g., β-carotene as provitamin A) (Rocha et al., 2011).

Therefore, the effect of PAP on fat-soluble vitamin absorption has been thoroughly studied. In 2003, a meta-analysis of 18 studies concluded that PAP significantly decreased the serum concentration of α-carotene and β-carotene by 8.7% and 19.9%, respectively. After adjusting those reductions to the reduction in plasma cholesterol, the decrease was significant for β-carotene only (estimated at −12.1%) (Katan et al., 2003). However, the meta-analysis procedure was not reported in this paper, and several studies (Weststrate et al., 1998; Hallikainen et al., 1999; Plat et al., 2000; Tammi et al., 2000; Nestel et al., 2001; Relas et al., 2001; Volpe et al., 2001; Amundsen et al., 2002; Judd et al., 2002) were not included in the analysis, without clear rationale.

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