Stability of Plant Sterols in Foods

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Plant sterols are present in natural levels of 0.01 – 1% in most plant foods, while the content may be increased up to 10% in plant sterol enriched foods. The major chemical concern on using plant sterol enriched foods is oxidation of sterols, and it should be taken in consideration when new food applications are developed. Plant sterols are prone to oxidation when exposed to e.g. heating, light or chemical catalysts. In order to recognize the potentially harmful conditions that a plant sterol enriched food might be subjected to, we have studied stabilities of plant sterols in different food models and under various food processing and storage conditions by measuring non-oxidized sterols and their major polar monomeric oxidation products.

In general, plant sterols in bulk and in oils were relatively stable at moderate temperatures, and considerable accumulation of oxides occurred only at high temperatures (>140 °C). There was a significant interaction between the temperature and the matrix. At high temperatures oxidation was enhanced in saturated oils while at lower temperatures it was greater in unsaturated oils. Moreover, plant steryl esters were more reactive than free sterols at 100 °C while the reactivity of free sterols was slightly greater at 180 °C. Most processed foods such as milk powder, processed milk, bread and plant sterol suspensions contained only similar levels of oxides as the plant sterol ingredients, and the products were stable during extended periods of storage; e.g. the amount of plant sterol oxides from original sterols increased from 0.03 to 0.07% in milk powder over a year. In some food applications, such as during pan frying, plant sterols were oxidized. The highest level of sitosterol oxides were formed in butter oil, 5.1% of sitosterol, while the level in rapeseed oil was only 35% of that. During the extrusion process of flours with added plant sterols, the sterols were resistant to oxidation. However, when oat-based products were stored under light for six months, significant oxidation of steryl esters occurred and the level of sitosteryl oxides reached 37% of sitosterol. We have found out that if sterols are highly oxidized, there is a "gap" between the decomposed sterols and the measured oxidation products, and this "gap" is currently being studied at our laboratory.