

Phytochemical malabsorption: clinical significance

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CLINICAL SIGNIFICANCE OF PHYTOCHEMICALS

Until recent years, nutritionists have focused primarily on macronutrients and micronutrients in foods. Appreciation is now increasing that many food components, of plant origin ('phytochemicals') in particular, have the potential to affect human biology. Phytochemicals by definition are important components of food that may not be essential in the classical sense, and may not even be required to sustain life as vitamins or minerals do, but are likely to contribute to optimal health.

A problem in considering the place of phytochemicals in human health is that they are numerous, alongside a few known essential nutrients. Therefore, their net interactive effect ultimately requires a study of food itself and food patterns, so that food component intake may need to be subject to sophisticated mathematical modelling. However, the advent of advanced informatics may help resolve this dilemma.

Examples of phytochemicals, along with some of their food sources are listed according to their chemical structure in Table 1. The possible roles of these phytochemicals in the treatment of health conditions are rapidly unfolding^[1], and the use of an index of preferred phytochemical intake has been suggested^[2]. Yet limited information is available on the bioavailability of most of these compounds. With complex factors influencing the absorption and transport of phytochemicals, it is not easy to predict their bioavailability, let alone consider the implications of gastrointestinal malabsorption.

BIOLOGICAL OCCURRENCE AND RELEVANCE OF PHYTOCHEMICALS

The presence and the physiological concentration of phytochemicals in biological tissues or fluids, especially blood and urine, create the opportunity for biomarkers of the consumption of

phytochemical-containing foods^[4-6] (Table 2). Equally, measurements of phytochemicals reflect bioavailability, including absorption.

Table 1 Selected phytochemicals and their possible roles in health^[3]

Phytochemicals	Some important food sources	Possible roles in health
Carotenoids	Orange pigmented and green leafy vegetables, e.g. carrots, tomatoes, spinach	Antioxidants Antimutagen Anticarcinogen Immuno-enhancement
Flavonoids, isoflavonoids and saponins	Green and yellow leafy vegetables, e.g. parsley, celery, soy bean and soy products	Antioxidants Anticarcinogen Oestrogenic Immuno-modulating
Polyphenols	Cranberry, raspberries, blackberries Rosemary, oregano, thyme	Antioxidants Antibacterial Reduce urinary tract infection
Catechins	Green tea	Antimutagen Anticarcinogen Anticarcinogen
Allyl thiosulfates	Garlic, onions, leeks	Anticarcinogen Antibacterial Cholesterol lowering
Isolathiocyanates and indoles	Cruciferous vegetables, e.g. broccoli, cabbage	Antimutagen
Phytosterols, e.g. β -sitosterol	Pumpkin seeds	Reduce symptoms of prostate enlargement

This list is not exhaustive for phytochemicals.

Table 2 Occurrence of phytochemicals in human blood and tissues

Phytochemicals	Where can we find them in the body
Carotenoids	Serum (five major carotenoids)
Lutein/zeaxanthin	Skin
β -cryptoxanthin	Adipose tissues
Lycopene	Lens and macula (lutein/zeaxanthin)
α -carotene	Various tissues like prostate (lycopene)
β -carotene	
Flavonoids	Serum
Quercetin, kaempferol	Urine
Isoflavones	Serum
Genistein, daidzein	Urine
Catechins epigallocatechin gallate	Serum
Allyl thiosulfates	Blood, serum, red blood cells
organosulfides	Adipose tissue
vinyl dithiols	Liver Kidney Breath
Tocotrienols	Skin

For the moment, the presence of phytochemicals in tissues, is presumptive evidence of functional

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significance, especially where there is a plausible mechanism of action (e.g. carotenoids as antioxidants for serum lipoproteins). Observations like this generate a number of exciting hypotheses for further research.

CLINICAL SIGNIFICANCE OF PHYTOCHEMICAL MALABSORPTION

Given the putative health benefits of phytochemicals, gastrointestinal malabsorption may well contribute to a loss of their protective effects. This could result in a number of clinical disorders which could be referred to as 'phytochemical deficiency disorders'^[1]. Candidate disorders are:

a. The menopause as a 'phytoestrogen deficiency disorder'^[7]

b. Cardiovascular disease because of the role of certain phytochemicals as antioxidants, others as regulators of endothelial function and others as modulators of myocardial function

c. Colorectal cancer in relation to a range of phytochemical intakes from various fruits and vegetables, and whole grain cereals^[8]

d. Prostatic disease in relation to lycopene and isoflavones^[9,10]

e. Maculopathy on account of the contribution to macular function of lutein and zeaxanthin^[11]

Two cases of short bowel syndrome where carotenoids were undetectable in serum illustrate the potential for these disorders (Case reports 1 and 2). In each case, it was possible to increase serum carotenoid concentrations by vegetable juice supplements.

Case report 1 Mrs BW (b. 1956)

Vaginal cancer (1990) treated with radiotherapy

Rectovaginal fistula - colostomy (1992)

Short bowel syndrome (1995)

Vegetable juice/soup		No	Yes
Serum concentration (nmol/L)	Reference range	Jan 96	May 97
Lutein/zeaxanthin	80-850	102	202
β-cryptoxanthin	175-1350	Not detectable	12
Lycopene	69-650	Not detectable	33
α-carotene	15-300	Not detectable	Not detectable
β-carotene	45-900	Not detectable	93

Case report 2. Mrs CM (b. 1956)

Severe road traffic accident (1976)→ruptured bowel, bowel resections

Short bowel syndrome

V-8ceTM (glass/day)	0	1×2	1×1	
Serum concentration (nmol/L)	Reference range	Nov 95	May 96	Nov 96
Lutein/zeaxanthin	80-850	Not detectable	243	17
β-cryptoxanthin	175-1350	Not detectable	18	Not detectable
Lycopene	69-650	Not detectable	32	11
α-carotene	15-300	Not detectable	Not detectable	Not detectable
β-carotene	45-900	Not detectable	10	8

CONCLUSIONS

With anergent evidence for physiological roles of phytochemicals and for their potential for disease protection, the use of foods, which are good phytochemical sources, to prevent and manage disease will be encouraged. The malabsorption of phytochemicals is likely to be one of many pathways to so-called "phytochemical deficiency disorders".

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