Plants lose their

Continuing our look at the impact of modern farming on diet, Tim Lobstein examines the loss of nutrients in plant foods.

This series of articles looks at changes in the way our food is supplied and asks how this may be affecting the nutritional content. We have shown that chicken meat has become fattier and contains less polyunsaturated fat and more saturated fat (see issue 66). Farmed fish are likely to have a poorer ratio of omega 3 fatty acids to omega 6 fatty acids compared with wild fish, especially if the fish feed is based on soya (issue 67).

In this issue we look at fruit and vegetable crops and ask what impact modern farming techniques could be having on their nutrient content.

There are few studies which compare the nutritional values of uncultivated, wild plant foods with their agricultural cousins grown as commercial crops. However, a study of edible vegetables eaten in Crete found that wild, green-leafed plants used in traditional cuisine were rich in phytonutrients, such as antioxidant flavonols and flavones (1). The authors noted that over 150 varieties of edible wild greens are believed to be consumed in Greece, often in the form of traditional 'green pies' made with virgin olive oil. Analyses of these pies showed that levels of antioxidants were considerably higher than in well-recognised rich sources of such biochemicals, such as red wine.

In most cases, the size and quality of a plant crop is determined largely by the species, variety and cultivar of the plant, and the conditions in which it is grown such as the nutrient and moisture levels in the soil, along with post-harvest treatments. Soil fertility has long been recognised as an important influence on crop production. But the practice of leaving fields fallow for one season in every three or four to allow some natural regeneration in their fertility has been abandoned by many farmers seeking to maximise the use of their land to grow crops. And the payments made to farmers under the Common Agricultural Policy to set land aside as a means of cutting total production levels – which might have been used to encourage fallow periods – has instead led to the neglect of poorer quality land and even greater exploitation of the land remaining in production.

Arable land may be routinely used for two crops per year. The rotation of crops to encourage maximum fertility, for example, alternating nitrogen-fixing crops with nitrogen-depleting crops, has given way to the replacement of soil nitrogen by applying nitrogen-rich fertiliser. The drive to increase animal and dairy production has also led to the increasing use of fertilisers to promote the growth of selected fast-growing grasses on pastureland, in place of traditional multi-species meadows.

The potential danger from this intensive use of land with minimum replenishment of micronutrients is that the crops produced are themselves lacking in nutrients. There appear to be no systematic studies of the effects on the nutritional content of plant crops when trace elements in the soil are not replenished.

It may be argued that, at least in some areas, there are sufficient quantities of trace elements in the soil to ensure high levels in plants and hence in our nutrition. But this cannot be taken for granted, and indeed there are occasions when a lack of trace elements makes itself known. For example, a suspected lack of iodine in the diets of people in a region of China was rectified by adding iodine to the irrigation water during one planting season: this led to a five-fold increase in the iodine levels in locally-grown cereal crops, vegetables and meat for the following three years, and resulted in fewer infant deaths and stillbirths (2).

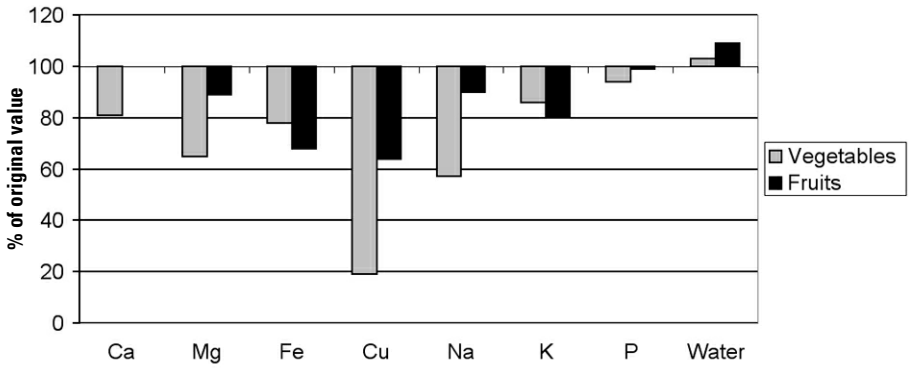
There is evidence that the quantity of essential minerals in commonly grown crops in the UK has declined significantly in the last 50 years. In a comparison of the mineral composition of twenty types of fruits and vegetables analysed in the 1930s with those grown in the 1980s, the levels of calcium, magnesium, sodium and copper in vegetables, and potassium, iron, magnesium and copper in fruit were found to have declined significantly (see graph). Phosphorous showed no change and water content increased. Other minerals could not be compared across the surveys.

Care must be taken interpreting these changes in plant mineral content: they can be influenced by changes in analytical techniques as well as in the sources of fruit and vegetables and their particular varieties.

The issue of species and varieties is itself of concern. Different apple varieties have significantly different vitamin C levels. Some types have three or even five times more of this vitamin than others, although the heaviest cropping varieties (Golden Delicious especially) have amongst the lowest levels (see table).

There is increasing evidence that various plant chemicals, such as phenols and flavonoids, have a role to play as protective agents against degenerative diseases. Few studies of the effects of agricultural systems on these plant chemicals have been undertaken. Researchers at the University of Copenhagen have suggested that plants will produce some of these compounds as a defence mechanism against attack from pests, and that these defence mechanisms are weakened by high levels of fertiliser use,

Figure: Changing amounts of minerals and water in vegetables and fruits analysed in the 1980s compared with the 1930s (1930s = 100)



Source: A-M Mayer (3)

value

necessitating in turn greater use of pesticide compounds to protect the crops (5).

Flavonoid levels in plants can be affected by sunlight and UV light. Reducing sunlight can dramatically reduce the amounts of quercetin, naringenin and caffeic acid in tomatoes. For example, Maianii and co-workers report a 50% decrease in phenol levels in cherry tomatoes when sunlight is reduced by 60%, and a similar decrease when UV-B light is reduced (6).

These findings have implications for the growing of crops under glass or plastic sheeting. Covered production of fruit and vegetables has increased dramatically in recent years. The findings also have implications for moves in agriculture to grow early-maturing crops. Flavonoids and anthocyanins are reported to be several hundred per cent higher in red onions harvested in July compared with those harvested in April. (6)

Further losses occur with processing techniques and long storage times. Improvements in storage techniques have allowed perishable crops to be preserved for increasingly long periods without noticeable deterioration in their appearance. But there may be deterioration and loss of some of the more volatile compounds, such as the antioxidant phenols coumaric acid, quercetin and lutein. These levels can drop almost as quickly in a low-oxygen, high nitrogen atmosphere (as used in salad bags) as they can in normal air. A test of onions stored in air and in a low-oxygen atmosphere showed the levels of these antioxidants to decline by 60% in both atmospheres over a week. In lettuce stored for one week, the quercetin levels fell by 18% in air, but by nearly 40% in the modified atmosphere (6).

Profound changes in our agricultural systems, markets and processing technologies have occurred in recent years. It would not be surprising if these changes did not alter the intrinsic nature of the foods produced, and the evidence suggests that this is the case.

The exhortation to eat at least five portions of fruit and vegetables per day are based on studies of countries where such consumption levels are commonplace – mainly around the Mediterranean – and their link to a long life expectancy. But that region's traditional diets were based on the consumption of fruits and vegetables grown, stored and processed in ways that have been changing, and the modern food supply – even in that region – may no longer contain the rich assortment of nutrients it once did.

If we are to rely on modern production methods, then five-a-day may need to be raised to a higher target.

Some apple varieties score poorly on vitamin C

Variety	Vitamin C (per 100g)
Sturmer	20mg
Discovery	16mg
Cox's Orange	9mg
Russet	8mg
Worcester	5mg
Golden Delicious	4mg
Granny Smith	4mg
Red dessert	3mg

Source: J Blythman (4)

1. A Trichopoulou *et al*, Nutritional composition and flavonoid content of edible wild greens and green pies: a potential rich source of antioxidant nutrients in the Mediterranean diet. *Food Chemistry*, 703:319-323, 2000.

2. DeLong *et al*, Effect on infant mortality of iodination of irrigation water in a severely iodine-deficient area of China. *Lancet*, 350:771-773, 1997.

3. A-M Mayer, Historical changes in the mineral content of fruits and vegetables. *British Food Journal*, 99:207-211, 1997.

4. Blythman J, *The food we eat*. London: Michael Joseph, 1996.

5. Andersen JO, Farming, plant nutrition and food quality. University of Copenhagen, 1999.

6. Maiani G *et al*, Factors of change, technological progress and the uncertain future of the Mediterranean diet. *Public Health Nutrition*, 4(2a):415, 2000.

European Commission urged to curb corporate lobby

Over 270 European consumer, health and environmental organisations have written to the President of the European Commission demanding that he takes action to '*curb the excessive influence of corporate lobby groups over EU policy-making*'.

The letter states that '*over 15,000 full-time lobbyists now operate in Brussels, a large majority representing business interests*', working to postpone, weaken or block EU social, environmental and consumer-protection legislation. The letter was coordinated by Corporate Europe Observatory, a not-for-profit campaign group that tracks and exposes the economic and political influence of corporations and their lobby groups.

According to a report issued by the European Parliament (2003), 70% of lobbyists in Brussels work for corporate interests, while only 20% represent non-government organisations (NGOs), including trade unions, health organisations and environmental groups. The remaining 10% work on behalf of regions, cities and international institutions.

Corporate Europe reports that typical lobbying strategies of the PR firms based in Brussels include threats of business relocation if policy proposals are not dropped, and good-cop/bad-cop routines – where one lobby group takes a hard-line position, allowing another to present what seems like a moderate compromise.

Because much of our food, agricultural, environmental and health policy is no longer decided at national level, companies dealing in food, chemicals and pharmaceuticals have shifted their policy specialists and PR activities to Brussels, far away from the eye of consumers and democratic control.

■ **Corporate Europe has published a map showing how major industry groups have clustered in offices in the EU Quarter – the four square kilometres around the European Parliament, conveniently close for lobbying. The map is at: www.corporateeurope.org/docs/lobbycracy/lobbyplanet.pdf**