

Selenium and Health

Selenium is an essential trace element, which is present in most foods, with brazil nuts, fish and offal containing the highest amounts. The selenium concentration of plants is determined by the content and availability of the element in the soil in which they are grown. The selenium content of plant foods, therefore, varies from country to country, being generally low in UK and Europe. There are also regional variations. The amount of selenium in animal foods reflects the feeding patterns of livestock.

The UK reference nutrient intake (RNI) for selenium is 75 and 60 ug/day for adult males and females respectively. Selenium intake in the UK has fallen over the last 25 years, largely due to the reduction in the import of high selenium wheat from North America. The most recent Total Diet Study, carried out by the Ministry of Agriculture, Fisheries and Food in 1997, estimated current intake to be 39 ug/day (MAFF 1999). Whilst the estimated intake from this study cannot be compared directly with reference nutrient intakes, concern has been expressed about this level being at the lower end of the recommended reference range for adults. There is also some evidence to support a corresponding fall in blood selenium levels.

At high doses, selenium has been shown to be toxic and a maximum safe intake of 450 ug/day has been proposed. The use of selenium supplements has become increasingly popular in the UK and could confer a risk of selenium toxicity at high doses.

Selenium is present in foods mainly as the amino acids selenomethionine and selenocysteine. Around 80% of dietary selenium is usually absorbed but the amount is affected by chemical form in the diet and a range of other factors including intake of protein and the presence of any appreciable levels of toxic elements in the diet, such as mercury and arsenic. The major route of excretion is via the urine and under normal physiological conditions this constitutes the prime method of body selenium regulation.

Selenium, in the form of selenocysteine, is incorporated into a range of enzymes (selenoproteins) in the body, which are crucial to human health. The best known of these is glutathione peroxidase, which plays an important role in protecting cell membranes from damage by free radicals. There is now considerable evidence that selenium plays a key role in the functioning of the immune system and in thyroid hormone metabolism, and that the trace element is needed for successful reproduction.

Selenium can be measured in a variety of media including plasma or serum, whole blood, red cells, platelets, hair and nails. Of the blood components, red cells probably provide the more accurate assessment of long-term intake. Toenail clippings are easy to collect and have been used in large epidemiological studies. Status can also be assessed by estimating the activity of the selenium-containing enzymes, such as glutathione peroxidase.

Selenium deficiency occurs in cattle and sheep grazing on low selenium soils in the UK unless supplementation is provided. Deficiency signs for selenium in animals include vascular changes, poor growth and reproductive failure. There are two major human selenium deficiency-related conditions – Keshan disease (an endemic cardiomyopathy) and Kashin Beck disease (a deforming arthritis). These diseases have occurred in areas of selenium-deficient soils in central and western China and neighbouring regions.

Links between less overt deficiency and many other disorders have been suggested. Epidemiological evidence to examine the role of selenium in cancer risk is accumulating. A recent trial in the US showed a substantial reduction in cancer mortality in those taking selenium supplements and large trials are now underway to assess the validity of these findings. Some studies have also shown an association between low blood selenium levels and heart disease risk, although this has not been confirmed by others. The finding that blood levels of selenium influence the outcome in HIV infection has also raised interest in the role of selenium in the progression of this disease. Selenium supplementation has been advocated for

many other conditions in humans, including Down's syndrome, cystic fibrosis, muscular dystrophy, sudden infant death syndrome, multiple sclerosis and defective immunoresponses. However, any link with these conditions is likely to be an outcome of the disease process.

The recognition of the importance of selenium in health has led to considerable concern about the falling intake in the UK. Some countries that have experienced a similar decline in selenium intake have instituted special measures. For example in Finland an agricultural fertilisation programme has been implemented in order to raise cereal selenium concentrations and boost dietary intakes. Since this programme was implemented in 1985, the selenium intake in Finland has more than tripled and the prevalence of coronary heart disease and some forms of cancer has fallen. The contribution of increased selenium intake to this decline, however, is unclear since several other aspects of the diet have improved simultaneously.

The adoption of fertilisation or fortification programmes has been advocated in the UK. A review by the Committee on Medical Aspects of Food and Nutrition Policy (COMA) in 1998 concluded that there was insufficient evidence of adverse health consequences from current selenium intakes to warrant action at that time, but recognised the need to continue to monitor intake and status.

In order to establish whether or not current average intakes are acceptable and to define intakes that are consistent with good health, selenium is one of the nutrients that has been studied within MAFF's Optimal Nutrition Status programme of research (responsibility for this programme was transferred to the Food Standards Agency on 1st April 2000). Other identified objectives of this programme included the development of accurate measures of bioavailability from foods and the identification of functional markers of selenium status. This Briefing Paper summarises current nutritional knowledge on selenium and places in context the work on selenium conducted within MAFF's research programme.

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