

## **Iodine**

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### *Function*

Iodine is essential in human nutrition because it is a constituent of the thyroid hormones thyroxine (T4) and triiodothyronine (T3) (Hetzel and Clugston 1999; Stanbury 1996). Both iodine deficiency and excess have adverse consequences for the thyroid gland. Iodine deficiency not only results in a syndrome known as Iodine Deficiency Disorder (IDD) but can also, in extreme cases, ultimately result in goiter, the overt manifestation of thyroid gland enlargement stimulated by deficiency of the thyroid hormones. This hormone deficiency leads to many adverse effects in addition to gland enlargement, including congenital and developmental defects, poor growth, and mental retardation.

### **Safety Evidence**

Except for rare instances of hypersensitivity, humans are remarkably tolerant to high intakes of iodine (Stanbury 1996). Although toxic effects are not observed in humans until daily intakes have exceeded 10,000 µg, intakes of 2,000 µg should be regarded as excessive and potentially harmful (Hetzel and Clugston 1999). Residents of coastal regions in some areas of Japan have chronic daily intakes of iodine as high as 50,000 to 80,000 µg. Persons who have not been conditioned by iodine deficiency can maintain normal thyroid size and function when they are consuming several milligrams of dietary iodine per day, but previous deficiency can cause hypersensitivity (Hetzel and Clugston 1999). In such situations, hyperthyroidism and iodine-induced thyroiditis may occur when intakes exceed approximately 200 to 300 µg per day. Healthy adults are much less sensitive to excess iodine. Excess iodine—as well as iodine deficiency—can lead to thyroid dysfunction and elevated thyroid stimulating hormone (TSH) levels (Laurenberg et al. 1998).

### **Published Official Reviews of Iodine Safety**

The FNB concluded that elevated TSH levels with high levels of iodine intake constituted the critical indicator for adverse effects of excess iodine in a healthy adult population (Food and Nutrition Board 2001). For normal persons who have not been conditioned to iodine deficiency, FNB identified a LOAEL of 1,700 µg per day. A UL of 1,100 µg of iodine from all sources was derived by applying a UF of 1.5 to the LOAEL. The FNB concluded that the adult iodine intake in the U.S. is usually 240 to 300 µg per day from foods plus another 140 µg from supplements.

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The EC SCF also identified a LOAEL of 1,700 µg, but selected a default UF of 3 to derive a UL of 600 µg per day (Scientific Committee on Food 2002). The report concluded that dietary intakes are unlikely to exceed 500 µg per day, since the 97.5 percentile intake in European men is 434 µg per day.

The UK EVM, deciding that neither human nor animal data were sufficient to set a UL value, instead set a GL (Expert Group on Vitamins and Minerals 2003). From several clinical studies of supplemental iodine (Paul et al. 1988; Chow et al. 1991; Gardner et al. 1988), it was concluded that 500 µg of supplemental iodine “would not be expected to have any significant adverse effects in adults.” The UK EVM identified 430 µg as the 97th percentile intake by adults. This led to establishment of a GL of 500 µg for supplemental iodine and 930 µg for total intake from all sources. Notably, UK EVM did not cite the article by Laurenberg and coworkers (Laurenberg et al. 1998) that was relied upon by FNB and EC SCF in their calculations.

## **CRN ULS for Iodine**

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CRN identifies its NOAEL for iodine as 500 µg per day for supplements and 1,000 µg for total intake. These values are based on the absence of adverse effects in healthy adults given 500 µg of supplement. Although the experimental subjects consumed diets of unknown composition (Paul et al. 1988; Chow et al. 1991; Gardner et al. 1988), their dietary intake of iodine almost certainly did not exceed 500 µg. The NOAEL for supplemental iodine is justified as the ULS because adverse effects occur only at 1,700 µg or higher total intake (the LOAEL identified by FNB and EC SCF), and because dietary intakes almost certainly will not exceed 500 µg.

### **Comparison of Safety Values for Iodine**

<b>CRN ULS</b>	500 µg
<b>US FNB UL</b>	1,100 µg
<b>EC SCF UL</b>	600 µg
<b>EC supplement maximum</b>	Not established (as of May 2004)
<b>UK EVM GL</b>	500 µg supplement; 930 µg total

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