

HEALTH CONSIDERATIONS

Copper is an essential trace element for humans. It is estimated that adult requirements are about 2-3 mg per person per day. High doses of copper (above 50 mg/kg bodyweight) can be lethal.

The absorption of copper by the gastrointestinal tract is in the range of 25–60%, depending on a number of factors, including copper speciation and copper dietary status (Olivares *et al* 1998). Copper is stored in the liver, brain and muscle tissue. High concentrations can also be found in the kidneys, heart and hair. Copper is eliminated from the body mainly in the bile.

Many cases of copper poisoning have been reported, including cases involving the poisoning of children who had their food prepared in copper or brass pots (Tanner 1998). Copper poisoning has resulted in cirrhosis of the liver and, in extreme cases, death. Other less severe symptoms associated with the consumption of water containing 3-5 mg/L copper (but not 1 mg/L) are gastrointestinal symptoms such as nausea, abdominal pain and vomiting (Pizarro *et al* 1999). Infants are thought to be most susceptible, though in one study of 3-month-old infants given water containing 2 mg/L copper over 9 months there were no acute or chronic adverse consequences (Olivares *et al* 1998). In the genetic disorders Wilson's disease and idiopathic copper toxicosis, sufferers are particularly susceptible to copper (Lönnerdal and Uauy 1998).

Apart from humans, sheep are the most susceptible animals to the toxic effects of copper, with a daily intake of 1-2 mg/kg body weight resulting in serious illness and death.

Copper was not found to be carcinogenic in tests with mice and dogs. The results of mutagenicity tests with different strains of bacteria were generally negative. Tests for mutagenicity using mammalian cells, both *in vitro* and *in vivo*, gave predominantly positive results.

DERIVATION OF GUIDELINE

The health-based guideline value of 2 mg/L (rounded up) for copper in drinking water was derived as follows:

$$2 \text{ mg/L} = \frac{0.5 \text{ mg/kg bodyweight per day} \times 70 \text{ kg} \times 0.1}{2 \text{ L/day}}$$

where:

- 0.5 mg/kg body weight per day is the provisional maximum tolerable daily intake for humans (WHO 1982)
- 70 kg is the average weight of an adult
- 0.1 is the proportion of total daily intake attributable to the consumption of water
- 2 L/day is the average amount of water consumed by an adult.

It should be emphasised that in this derivation, which others have also used and which is still endorsed by the WHO (1998), there is considerable uncertainty (Fitzgerald 1998). Nevertheless, on the basis of recent copper investigation studies, the derived guideline value appears to be a safe level for infants and is just below a level where minor symptoms were observed in adults.

In premises with a history of copper corrosion, water that has been in stagnant contact (6 hours or more) with copper pipes and fittings should not be used in the preparation of food or drink. Copper levels can be effectively reduced by flushing the taps for 1 minute.

NOTE: Important general information is contained in PART II, Chapter 6