CHAPTER II

TOXICITY OF COPPER AND ZINC
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Toxicity of Copper:

Copper appears to be highly suitable for the production of food manufacturing plant and kitchenware because of its properties of malleability, heat conductivity, and relative resistance to corrosion. Unfortunately, it has acquired a bad reputation of toxicity. The subject of toxicity of copper salts is in a confused state, probably because of the failure to distinguish between heavy and minute doses. According to Evans, "Actually the presence of a certain amount of copper is necessary for the health of many animals, and copper salts are intentionally given to pigs and cattle where their normal food is deficient in copper apart from the use of copper to counteract hurtful elements (such as molybdenum, which is present in certain pastures)."

Watson states that 1 to 2 gm. of copper sulphate can be fed to cattle, apparently without effect on the health; it would be surprising if an element which could be tolerated by cattle in such relatively large quantities was dangerous if taken in small traces by human beings. According to Flinn and Inouye, small quantities of copper are definitely beneficial to
life. This receives a remarkable support from Charaka and Susruta (loc. cit. p. 12). Potable water may be considered wholesome when the average copper content does not exceed 1.4 mg. per litre. The human body contains on an average about 5 p.p.m. of copper. Copper is also present in food sold in the market like, fruits, wholemeal flour, dried foods, table salts, tea, coffee, chocolate, curry powder and gelatin. Probably most of the copper is derived from contamination with copper vessels in food processing industries.

When present in comparatively larger amounts, copper salts are definitely harmful. "Copper salts are strongly astringent and irritating to the stomach. When administered as sulphate the astringent dose for man is 16 to 32 mg. of copper and the emetic dose 80 to 160 mg. of copper. If copper is absorbed into blood in considerable amounts, it acts as haemolytic agent. According to Mallory, copper poisoning may cause the disease known as haemochromatosis, characterised by pigmentation of the liver, due to haemolysis of the red blood corpuscles, associated with necrosis of liver cells, cirrhosis and diabetes. The pigment may affect other parts of the body, including the skin whence the disease is sometimes known as 'bronze -
- diabetes'. Subsequently, however, Mellory has remarked, "it cannot be too strongly emphasised that a sufficient dose of copper must be administered to produce our results. It is not likely that repeated ingestion of small quantities may produce similar poisoning results. According to Heyroth and Cholak, "In man the ingestion of a large quantity of copper sulphate has caused vomiting, gastric pain, dizziness, exhaustion, anaemia, cramps, convulsions, shock, coma and death. Symptoms attributed to damage to the nervous system and kidney have been recorded. Jaundice has been observed and in some cases, the liver has been enlarged. Deaths have been reported to have occurred following the ingestion of so little as 27 gm. of the salt, while other victims have recovered after having taken much larger amounts, up to 120 gm."

It has also been considered that traces of copper in milk, fruit and vegetable juices tend to oxidise and destroy vitamin C, probably by the oxidation of ascorbic acid. Hence it is objectionable to use copper salts for greening canned and bottled vegetables. Copper also affects adversely the keeping quality of butter.
Concluding one can say, although very small doses of copper are beneficial to the human system, adverse effects are likely to occur with large doses. Hence, copper vessels are tinned when in use for food processing industries. In India, however, one is constrained to remark that hotels utilise untinned or detinned (vessels in which tinning has been destroyed by usage) vessels for storing and cooking substances containing considerable amounts of sour substances. Unfortunately, no statistics appear to be available regarding poisonous effects of large doses of copper which may be passing in the human system by the use of such vessels.

In June 1957, a number of students in a local hostel suffered from nausea, vomiting etc., by taking butter milk stored in detinned brass vessels. They recovered after medical assistance.

Toxicity of Zinc:

Experiments on rats have shown that traces of zinc in food are indispensable. Human requirements of zinc in food are given by Scoular$^{11}$ as 7 mg. daily for a child of about 50 lbs. weight. Zinc is present in the food sold in the market like oranges, lemons,
vegetables, most sea-fish, tomatoes, white flour, rice (whole), cocoa, oysters, gelatin etc.\textsuperscript{12}, Te

The permissible limit for zinc in drinking water is usually taken as 5 p.p.m. Water containing this amount, if bicarbonates are also present, may turn opalescent and show an iridescent film on boiling and deposit a greyish-white paint like coating on the surface of the vessel\textsuperscript{13}. Distilled water dissolves more zinc than hard water, and saturation with carbonic acid greatly increases corrosion\textsuperscript{14}. Water containing oxygen will dissolve zinc from brass pipes if the water is soft and acid\textsuperscript{15}. Barton and Weigle\textsuperscript{16} state that certain United States water supplies contain as much as 50 p.p.m. of zinc and no ill effects have been observed in persons drinking such water. Soda water containing 57 p.p.m. of zinc has been reported in Australia to have caused vomiting, but the victim may have been unusually susceptible. The lowest emetic dose of zinc sulphate in the British Pharmacopoeia is about 147 mg. of zinc. Cases have been reported of vomiting by excessive quantities of zinc passing in the system. Apart from vomiting caused by large doses of zinc in food, there are no records of chronic poisoning in man. It is clear,
however, that the irritant action of zinc salts on the stomach is largely dependent on the kind of zinc salt passing in the system and the nature of the food. The zinc naturally present in food is, about four times as much as copper and the amounts found to be toxic to animals are also about four to five times those of copper and hence it is likely that the limits appropriate to copper in food, increased fourfold, may be taken as a guide for zinc.
REFERENCES

3A. Thresh, Lancet, 1925, 208, 1676.
5. Monier-Williams, G.W., Trace elements in food. Johnwiley & Sons Inc. 1950, p.11.
12. Ibid. Ref. 5, p. 113.
15. Ibid., Ref. 5, p.114.
17. Ibid., Ref. 5, p.117.