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ESSENTIALITY OF FLUORINE

At the 138th meeting of the American Association for the Advancement of Science, Klaus Schwarz, M.D., reported on "Trace Elements Newly Identified as Essential to Animals (Fluorine as an Essential Element)." Dr. Schwarz is Chief, Laboratory of Experimental Metabolic Diseases, Medical Research Programs, Veterans' Administration Hospital, Long Beach, California, and Associate Professor, Department of Biological Chemistry, School of Medicine, University of California at Los Angeles. The discovery of the essentiality of fluorine was reported as the latest in a series of findings on indispensable trace elements in animals. Excerpts from Dr. Schwarz' paper follow:

The most recent result of systematic studies to identify new essential trace elements for mammals is the discovery that fluorine is an essential trace element. It is required for normal growth in the rat. Proof for an essential role of fluorine, normally supplied as fluoride, in growing animals was obtained in experiments carried out under rigidly controlled conditions in trace element sterile isolators. The rats were maintained on highly purified amino acid diets which contain all the known dietary agents in sufficient amounts. Under these conditions, supplements of 2.5 ppm (parts per million) of fluorine as potassium fluoride, stimulate growth by over 20%. The data are highly significant. Attempts to prove that fluorine is essential were made before, but under less carefully controlled conditions. The finding throws a new and different light on the use of fluoride. The element seems to be essential not only for the formation of teeth and bones -- in which it is normally contained in very high amounts (200-1,000 ppm) -- but appears of more general importance.

The project was carried out at the Laboratory of Experimental Metabolic Diseases, Medical Research Programs, VA Hospital, Long Beach, California under the auspices of UCLA, and with the financial support from the National Institutes of Health. Drs. J. C. Smith, Jr., E. Vinyard, and D. B. Milne contributed significantly to its success.

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NOTE. -- Underscore supplied.

The most sensitive indicator for deficiencies was growth. Three elements, namely tin, vanadium, and fluorine, have been firmly identified as essential for growth, while another one, silicon, is currently under investigation.

The discovery of an essential need for fluorine was made possible by further improvements in the purity of the diets after tin and vanadium had been recognized as being indispensable. Tin and vanadium were included in the basal diet, and the fluorine content of the diet was reduced to below 0.5 ppm. The growth promoting effect of fluoride was seen consistently in ten successive experiments, each carried out over a four week interval. Dose levels of 1, 2.5 and 7.5 ppm of fluorine were supplemented in the form of potassium fluoride. One ppm gave a significant but incomplete result. 2.5 ppm fluoride produced optimal results, not different from those obtained with 7.5 ppm in the diet. 20-30% increases in growth rates were obtained.

Normal fluorine levels in teeth and bone can easily reach 700-1000 ppm, while the concentration of fluorine in blood plasma is very effectively controlled at 0.1-0.2 ppm even if large amounts of fluoride are given. Any excess is rapidly deposited in the bone or excreted through the urine. The normal fluorine levels in tissues such as liver, heart, and kidney are approximately 2-5 ppm (on a dry basis). These levels are maintained steadily even if high amounts of fluoride are supplied over extended periods of time. The amounts in these tissues are quite similar to those in many nutrients. Cereal and other grains contain 1-3 ppm, cow's milk usually 1-2 ppm (on a dry basis), raw and peeled potatoes 1-2 ppm of dry matter, while ocean fish are reported to supply 5-10 ppm. The importance of various fluoride levels in drinking water is well known. A peculiar situation is presented by tea in which fluorine concentrations of 100 ppm are common. It is fair to assume that with the increasing refinement of our staple foods attention should be paid to the fluorine intake of growing animals and children to guarantee that the large amounts of fluorine needed during growth are adequately supplied.

Each of the elements newly identified as essential opens up new facets in biochemistry, nutrition, and also medicine. Thus the bio-inorganic and -organic chemistry of tin, vanadium, and fluorine are largely new, unexplored territory. The application and usefulness of these trace elements in animal and human nutrition can at this

point only be surmised. Also the medical implications of these findings will have to be worked out in detail. However, it is expected some of the newly identified essential elements may be clinically important, similar to those which have been known for a long time.

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