Biochemistry of Selenium

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Preface

In recent years many exciting research results have indicated that selenium, depending on its concentration, can influence mammalian metabolism. It has been estimated that in selenium-deficient areas, selenium or selenium–vitamin E combinations added to animal feed can prevent annual losses to beef and dairy cattle and sheep valued at 545 million dollars and poultry and swine losses valued at 82 million dollars.

Some animal diseases that can be prevented by a selenium-supplemented diet include liver necrosis, nutritional muscular dystrophy, exudative diathesis, pancreatic degeneration, mulberry heart disease, infertility, growth impairment, periodontal disease, and encephalomalacia. Selenium intake levels are dependent on the plant or animal feed concentrations, which, in turn, are dependent on the pH of the soil and the types of rocks from which the soils are derived.

At normal metabolic levels selenium possesses an antioxidant affect manifested through glutathione peroxidase, and selenium also has an effect on cytochrome P-450 and heme metabolism. Comparisons are made between metabolism of selenium and sulfur in plants, animals, and humans. At greater selenium intake levels acute poisoning occurs when high-selenium-content (10,000 ppm Se) plants are consumed in large quantities. The toxic reactions were first manifested in cavalry horses near Fort Randall, Nebraska, in the 1860s.

Selenium has been found to be a potent anticarcinogen for a variety of chemically-induced cancers, and some inverse relationships between selenium occurrence and human cancer mortality have been demonstrated. The anticarcinogenicity of selenium holds much promise in regard to finding the body's anticancer mechanism. If this mechanism is elucidated, perhaps cancer control can be achieved. The potential of selenium may even surpass that of interferon. In addition, selenium has been shown to prevent Keshan disease, a severe myocardiopathy which occurs in young Chinese children. Inverse epidemiological relationships have also been observed between coronary heart disease and environmental selenium.

Much evidence indicates that selenium or selenium–vitamin E combinations counteract the toxic effects of mercury, methylmercury, cadmium, lead, silver, thallium, and arsenic in animals. Selenium–vitamin E combinations may offer a workable antidote to metal toxicity in humans exposed to these environmental hazards.

The forms of naturally occurring selenium are classified according to whether they are of low or high molecular weight. The synthetic forms of selenium along with their chemotherapeutic effects are also outlined. Because the levels of selenium are important in tissues, numerous nondestructive as well as destructive methods of selenium analyses are outlined.

In order to reduce the cost of the textbook, lists of several references were reduced to the most recent reference. The author wishes to thank Kathryn Risko, Phyllis Pittman, and Helen Brewster for their excellent typing, and Barbara DeWitt, Cindy Kopf, Ann McHugh, and Andrea Yartin for their careful help in proofreading.

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