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Light and Electron Microscopical Visualization of Selenium in Adrenal Glands from Rats Exposed to Sodium Selenite

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A histochemical study was performed to determine the cellular localization of selenium in the adrenals from rats exposed to sodium selenite, as these organs were known to obtain the highest concentration in the rats. Male rats were treated either with 1–15 mg of sodium selenite for 14 days to 6 months in the drinking water, or with 1–20 mg as intraperitoneal injections. Selenium was shown to accumulate in both norepinephrenic and epinephrenic cells in a dose-dependent fashion. After oral exposure most deposits were found in the epinephrenic cells, whereas the norepinephrenic cells contained most in the injected animals. Fourteen days after a single injection (4 mg/kg), deposits could still be observed in the granules of the chromaffin cells. At the ultrastructural level, accumulations were primarily found in the chromaffin granules and to a lesser extent in the lysosomes. Selenium may possibly form bonds to endogenous zinc in the adrenals as has been suggested for the brain.

INTRODUCTION

In 1957, selenium was recognized as an essential trace element (Schwarz and Foltz, 1957), and it has since been known as this. In 1973, Rotruck *et al.* found it to be a part of the mammalian enzyme glutathione peroxidase.

Selenium and selenoproteins have some unique chemical properties. On the one hand, selenoproteins containing two selenol anions in close proximity are extremely powerful metal-binding agents. On the other hand, metal ions can strip selenium from other organo-selenium compounds. This stripping is very effective with heavier metals of the transitional metal series and with group B elements such as zinc, copper, and mercury (Williams, 1978). In the CNS, selenium has been suggested to form bonds with zinc (Danscher *et al.*, 1985).

Selenium is also known to be a toxic substance if given in excess. Among the symptoms of intoxication, endocrine dysfunction including growth reduction (Jensen, 1975; Glover *et al.*, 1979) and intrauterine absorption of fetuses and ovarian dysfunction (Rosenfeld and Beath, 1954) have been described. Moreover, selenium has been known to accumulate in different parts of the endocrine system such as the anterior pituitary (Schoental, 1968; Thorlacius-Ussing and Danscher, 1985) and the pancreas (Schoental, 1968). In the adrenal gland, selenium has been found to accumulate after exposure to sodium selenite as well as organo-selenium compounds such as seleno-methionine and -cystein (Thomson and Steward, 1973; Thomson *et al.*, 1975). The investigations showed that together with the kidneys, the adrenal glands contained the highest concentration of selenium in the rat during the first week after intravenous injection, but no distinction has ever been made between the adrenal medulla and the cortex. Neither has the cellular localization of selenium ever been investigated. We have therefore decided to investigate the cellular localization of selenium in the adrenal gland of the rat after exposure to sodium selenite. This has been done using a histochemical technique based upon silver amplification of selenium–metal bonds at light and electron microscopical levels (Danscher, 1982).

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