Selenium in human nails: a preliminary study using INAA

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Abstract

Selenium (Se) is an essential trace element for healthy body functions in humans. Deficiency of Se may cause diseases such as cancer and cardiovascular disease. However, Se toxicity or selenosis can also occur in humans as a result of high doses of dietary intake or industrial exposure. This study aims to use human nails for biomonitoring of Se in a healthy Malaysian adult. The results are used to assess long-term Se status and comparisons are made with literature values. Instrumental neutron activation analyses (INAA) were used to determine Se in nail samples collected in a 5-month period. There were 10 fingernail samples and 3 toenail samples. Results showed that fingernails contain an average of 1.06 ± 0.05 μg/g Se (range: 0.98 – 1.13 μg/g Se) and toenails contain an average of 0.94 ± 0.07 μg/g Se (range: 0.89 – 1.02 μg/g Se). Temporal variations of fingernail and toenail Se contents were rather small with RSD of less than 10%. Fingernails show slightly higher Se contents than those of toenails. Both fingernails and toenails show reproducibility of Se concentrations taken during the sampling period. These results are in agreement with literature values for healthy individuals, which show no deficiency or chronic exposures to Se in the past months. Thus, there is no potential health risk in the subject studied.

Keywords: Biomonitoring, Selenium, human nails, INAA.

Introduction

Selenium (Se) is an essential trace element for producing Se-containing proteins or selenoproteins important for biological functions. Reilly [1] reported that diseases and conditions of humans associated with Se deficiency include diabetes, cystic fibrosis, Keshan disease, cancer and muscular dystrophy. Selenium deficiency can be prevented through dietary intake of food with high Se content such as meat, fish and eggs. Besides, Se supplement in the form of sodium selenite, sodium selenate, L-selenomethionine and selenium-enriched yeast can be used to compensate a low dietary intake [2]. The U.S. Recommended Dietary Intakes (RDIs) for Se is 55 μg/d and the tolerable Upper Intake Level (UL) is 400 μg/d [3]. In Malaysia, the Recommended Nutrient Intakes (RNIs) for men and women are 33 μg Se/d and 25 μg Se/d, respectively [4]. Through sufficient dietary intake, Se compounds can help to prevent and to treat cancer [5]. However, excess of Se intake may cause genotoxic effects but the mechanisms are not fully understood [5].

Because of potential harmful effects of Se deficiency and toxicity, it is of great importance to monitor the level of Se in humans through the use of biomonitors. To date, Se contents in various biological samples such as blood, skeletal muscle, urine, internal organs, breast milk, hair and nails have been reported (e.g. [6]). For recent Se intake, blood and urine are commonly used whereas human nails are analyzed for long-term (6 to 12 month period) Se intake. The chemical composition of nail is stable after its formation and will not be affected by blood chemistry or chemical exposure [7]. The growth rate of fingernails is about 0.1 mm/day and toenails grow 0.03-0.05 mm/day [8]. Collection and storage of nails is simple and small amounts (about 50 – 100 mg) are adequate for chemical analysis. The INAA method utilized in this study is sensitive for determination of Se contents in nail samples. The biomonitoring of trace elements such as Se using nail samples is still lacking in Malaysia. Therefore, this