

## Analysis of hair and nails

### Research summary

ALS Scandinavia uses sector field inductively coupled plasma mass spectrometry (ICP-SFMS) for analysis of hair and nails. Here, some of the studies carried out by the ALS Scandinavia laboratory are summarized. The determination of 71 elements in hair and nails from approximately 100 individuals showed somewhat lower concentrations compared to previously published ranges. Some elements (Th, Al, Ti, REE) associated with soil were found in higher concentrations in hair and nails from small children, while Cd concentrations were higher for smokers.

Scalp hair (n=114) and fingernail (n=96) samples from a population living in north-east Sweden (42% males, 58% females, age range 1–76 y with mean=33 y and S.D.=17 y) were analyzed (1). Only samples from subjects without known occupational exposure to metals were used.

All samples were thoroughly pre-washed using different solvents in sequence. They were then digested with nitric acid and hydrogen peroxide in closed PFA containers in a microwave digestion system. After dilution with ultra-pure water, the digests were analysed by Inductively Coupled Plasma Sector Field Mass Spectrometry (ICP-SFMS).

The analysis comprised 71 elements. For both hair and nails, all except 9 elements were detected in all samples. For 39 elements, detection limits in the sub-ng/g range were achieved. Some examples of found concentrations are given in Table 1. Compared to previously published ranges, concentrations found in this study tended to be somewhat lower.

The accuracy of the method was assessed (2) by analysis of the certified reference material GBW07601 human hair, and by analysis of samples from an interlaboratory comparison program (from Le centre

de toxicologie du Québec, Canada). For selenium, comparison was also made with another analytical technique (Atomic Fluorescence Spectrometry). In total, accuracy could be assessed for more than 40 elements.

Significant correlation between hair and nail concentrations was found for 15 elements. This correlation, which was especially close for Hg, Cd, Pb, Sb, and Bi, is of importance for the usefulness of these sample media in biological monitoring.

Some findings in the population data may be mentioned. Concentrations of a group of elements (Th, Al, Ti, rare earths) showed a well-defined peak for hair and nails in the age interval 2–7 years. Since this group of elements is associated with soil, the pattern could be attributed to behavioural characteristics of this age group. Cadmium concentrations were five and ten times higher for smokers than for non-smokers in hair and nails, respectively. Some smokers also showed an anomalous pattern of rare earth elements (as shown by chondrite normalization) in hair and nails which could be attributed to flint in disposable lighters, containing La, Ce, Pr, and Nd.

**Table 1.** Element ranges (central 90% fraction) found in hair and nails. Concentrations in µg/g (1).

Element	Hair	Nails	Element	Hair	Nails
Zinc	68-198	80-191	Platinum	0.00002-0.00061	0.00002-0.0011
Copper	8.5-96	4.2-17	Mercury	0.053-0.927	0.028-0.311
Iodine	0.13-3.31	0.077-0.810	Cadmium	0.010-0.356	0.013-0.438
Arsenic	0.034-0.319	0.065-1.09	Antimony	0.007-0.122	0.014-0.128
Lead	0.22-7.26	0.27-4.75	Uranium	0.006-0.436	0.002-0.047



## References

1. Rodushkin I., Axelsson M.D., Application of double focusing sector field ICP-MS for multielemental characterization of human hair and nails. Part II. A study of the inhabitants of northern Sweden, *Sci. Tot. Environ.* 2000, 262/1-2, 21-36.
2. Rodushkin I., Axelsson M.D., Application of double focusing sector field ICP-MS for multielemental characterization of human hair and nails. Part I. Analytical methodology, *Sci. Tot. Environ.* 2000, 250/1-3, 83-100.

