DISTRIBUTION OF URANIUM IN URINE, HAIR AND NAILS IN RESIDENTS OF NISKA BANJA TOWN, A HIGH NATURAL BACKGROUND RADIATION AREA

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AIM OF STUDY

Quantification of uranium in human urine is a valuable technique for assessing occupant and public exposure to uranium in HBRA.

Human hair and nails can be considered as bio-indicators of the public exposure to certain natural radionuclides and toxic metals over a long period of months or even years.

Advantages of hair and nail

Hair and nail have many of the characteristics to be ideal tissue for assays:

- **Painlessly removed**
- **Easily collected and transported**
- **Highly stable at room temperature**
- **Normally discarded**
- **Relatively high with element concentration compared to body fluids and tissues**
- **Reflect the actual exposure over a period of months, or even year. (Blood and urine tend to show current or recent body status)**

Sampling Location

Niška Banja, a spa town of Serbia is located in the quaternary alluvium of River Nišava along the contact of the Koritnik limestone and travertine rock.

The high value of ^{226}Ra concentration in soil and indoor-outdoor radon concentrations found around Niška Banja make this region a high background radiation area.

Radionuclide in soil

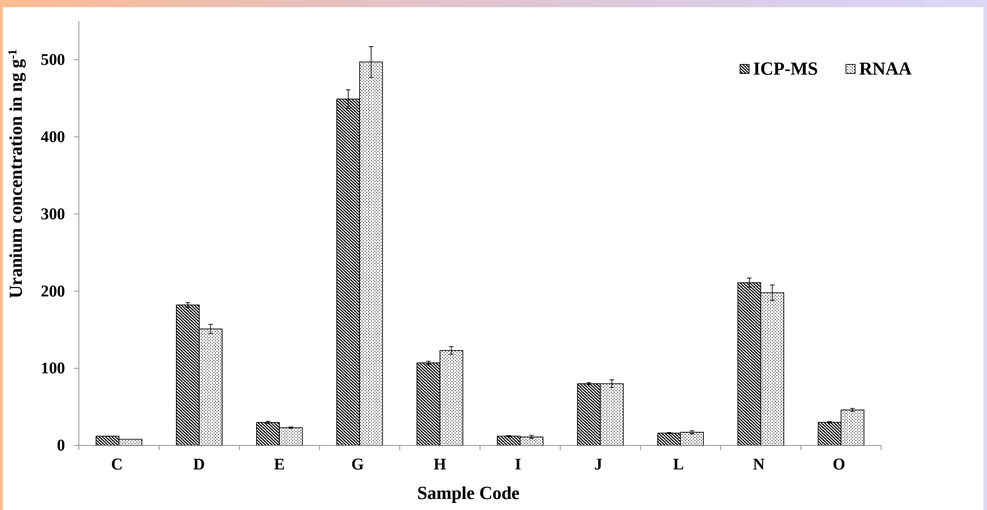
Radionuclide	Concentration (Bq/Kg)
^{226}Ra	10.2 – 750.2
^{232}Th	6.8 - 46.1
^{40}K	95.8 - 583.5

^{222}Rn Concentration	Bq/m^3
Indoor	6000
Outdoor	168

MATERIALS AND METHODS

- ❖ Urine, hair and nail samples were collected from same subjects.
- ❖ One day urine samples were collected for each subjects.
- ❖ Hair samples were cut with ceramic equipment to avoid any contamination.
- ❖ Alpha-spectrometry was used for uranium determination in urine.
- ❖ Hair and nail samples were micro-wave digested and uranium concentration was determined using ICP-MS.

Method validation results



Analytical validation between the ICP-MS and RNAA for uranium analysis in hair are within analytical error ±2% .

Advantages of ICP-MS

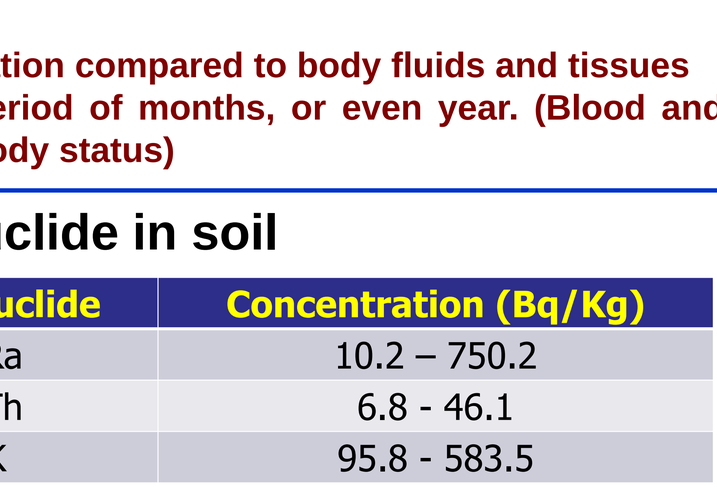
Inductively coupled plasma-mass spectroscopy (ICP-MS) is the analytical technique of choice because of its:

- Multi-element capability
- Low detection limit and high sensitivity
- Ability to measure a large range of concentration
- Simple experimental procedure

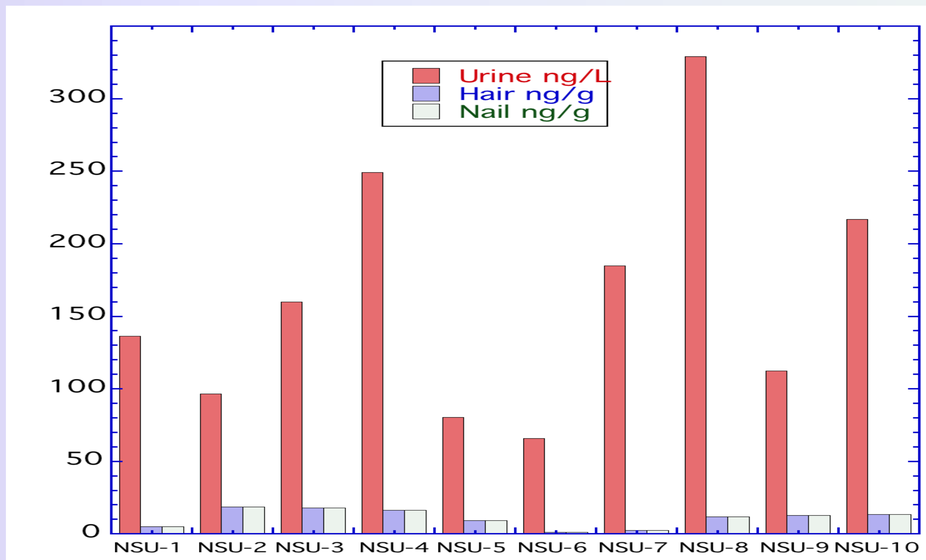
RESULTS

Concentration of ^{234}U and ^{238}U in Urine (mBq/g)

Subjects	Age (y)	U-238 mBq	U-234 mBq
NSU-1	64	1.1±0.4	0.62±0.2
NSU-2	40	1.7±0.3	0.96±0.23
NSU-3	47	1.1±0.2	0.68±0.16
NSU-4	66	1.8±0.2	1.1±0.3
NSU-5	72	1.5±0.3	0.99±0.24
NSU-6	53	0.37±0.16	0.57±0.2
NSU-7	87	0.49±0.18	0.69±0.21
NSU-8	67	2.1±1.0	2.0±1.0
NSU-9	55	0.75±0.21	0.57±0.18
NSU-10	62	1.4±0.5	1.3±0.5



Uranium Isotope ratio $^{235}U/^{238}U$ in selected Hair samples measured by TIMS



Hair and nail samples were collected from the volunteers same time.
Concentration in Hair > Nail

Comparison of Uranium Concentrations in Urine, Hair and Nail samples

Conclusion

- **A large variation in hair, nail and urine uranium concentrations.**
- **U levels are relatively high in hair, nail and urine supports individuals living in high natural background radiation area (HNBRA) whereas sample size is small to conclude.**
- **Elevated levels of uranium in human body could be related to environmental exposure. However, dietary intake is one of the most important factor.**

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Literature
S.K. Sahoo et al., Distribution of uranium, thorium and some stable trace and toxic elements in human hair and nails in Niska Banja Town, a high natural background radiation area of Serbia (Balkan region, South-East Europe) J. Environ. Radiaoact. (2015) 145, 66-77.